Annexure-2

	Curriculum Structure of 2nd Year of PG for Two years PG Programme (3+2) OR							
	One Year PG Programme After Completion of Four-Year UG Programme (4+1)							
	Structure-1 (Level-6.5): PG Curriculum Structure with only Course Work							
Level-6.5	Year-2				Year-2			
			Paper	Credits			Paper	Credits
	Semester-3	DSC-7	Instrumental Techniques in Forensic Analysis - I	4	Semester-4	DSC-9	Instrumental Techniques in Forensic Analysis - II	4
		DSC-8	Introduction to Digital and Cyber Forensics	4		DSC-10	Questioned Documents and Multimedia Forensics	4
				8				8
		Students can OPT for either 3 New DSEs, OR 2 New DSEs & 1 GE from the list below				Students can OPT for either 3 New DSEs, OR 2 New DSEs & 1 GE from the list below		
		DSE-5	Human Genetics and Molecular Forensics	4		DSE-11	Forensic Toxicology and Pharmacology	4
		DSE-6	Forensic Genomics, Proteomics and Bioinformatics			DSE-12	Forensic Accounting	
		DSE-7	Advanced Forensic Anthropology	4		DSE-13	Forensic Analytical Chemistry	4
		DSE-8	Forensic Engineering			DSE-14	Cryptography & Steganography	
		DSE-9	Advanced Techniques in Crime Scene Investigation			DSE-15	Research Methodology	
		DSE-10	Disaster Victim Identification			DSE-16	Forensic Narcotics Analysis	
						DSE-17	Biometric Systems of Identification	
		GE-3	Fundamentals of Immunological techniques in Forensic science	4		GE-5	Fundamentals of Nanotechnology	4
		GE-4	Fundamentals of AI and Machine Learning in Forensic science			GE-6	Forensic Medicine	
				12				12
		One Skill Based/Workshop/Specialized Laboratory/Hands on Learning				One Skill Based/Workshop/Specialized Laboratory/Hands on Learning		
		SEC--1	Optical Techniques with Laboratory training	2		SEC--4	Digital Evidence Analysis with Laboratory training	2
		SEC--2	Separation Techniques with Laboratory training			SEC--5	Evidence Handling with Laboratory training	
		SEC--3	Formulation of Research Design			SEC--6	Big data Analysis in Forensic Science	
				22				22

Structure 1 (Course Work Only)

SEM-III

DSC - 7 INSTRUMENTAL TECHNIQUES IN FORENSIC ANALYSIS - I

Paper	Total Credit	Lecture	Practical/ Practice	Pre-requisite of the course
Instrumental Techniques in Forensic Analysis - I	**04**	**03**	**01**	Basic knowledge of Forensic Science

Course Outcomes:

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

1. Understand the principles and working mechanisms of major instrumental techniques used in forensic science.
2. Explain the applications of microscopy, spectroscopy, electrophoresis, and chromatography in forensic evidence analysis.
3. Develop practical skills in the operation of basic analytical instruments and interpretation of analytical data.
4. Evaluate the suitability, accuracy, and limitations of instrumental techniques for forensic investigations

Learning Objectives:

After completing the course, students will be able to:

1. Explain the principles and instrumentation of commonly used forensic analytical techniques.
2. Select appropriate instrumental methods for the examination of different types of forensic evidence.
3. Interpret analytical results obtained from spectroscopic, chromatographic, microscopic, and electrophoretic techniques.
4. Demonstrate laboratory competency in sample preparation, instrument handling, and forensic data interpretation.

Unit 1 Light Microscopy (12 Hours)

Introduction to microscopy, theory and principles of microscopy, Construction, working, and applications of Simple, Compound, Comparison, Fluorescence, Polarized, Stereo and infrared microscopes, Digital microscopy and image analysis in forensic examinations.

Unit 2 Molecular Spectroscopy (11 Hours)

Introduction to molecular microscopy, theory, principles and application of UV, VIS spectroscopy, IR spectroscopy, Fourier Transform Infrared spectroscopy (FTIR) and Raman

spectroscopy, Applications of molecular spectroscopy in forensic examination of drugs, fibers, paints, inks, and explosives.

Unit 3 Electrophoresis (11 Hours)

Introduction, theory, principle and application of Cross-over electrophoresis, Agarose gel electrophoresis, Polyacrylamide gel electrophoresis, Sodium dodecyl sulphate (SDS) polyacrylamide gel electrophoresis, Pulse field gel electrophoresis, Capillary electrophoresis, Immuno- electrophoresis, Iso-electric focusing.

Unit 4 Chromatography (11 Hours)

Introduction, theory, principle, instrumentation, and forensic applications of Thin Layer Chromatography (TLC), HPTLC, Paper and Column chromatography, High performance liquid chromatography, LC-MS, Ion chromatography. Gas chromatography: Pyrolysis GC, GC-MS, Introduction to Headspace Gas Chromatography (HS-GC) for alcohol and volatile poison analysis.

Practical's (30 Hours)

1. Identification of natural and synthetic fibers using a microscope.
2. To find out the unknown concentration of the given sample using a UV/Vis Spectrophotometer.
3. To study Beer's Lambert's law.
4. To study the Hypochromic and Bathochromic shift using a UV/Vis Spectrophotometer.
5. To study the TLC of different inks of the writing pen.
6. To perform gel electrophoresis of DNA samples
7. To analyses the given compound using FTIR spectra.
8. To perform TLC of phenolphthalein.
9. Quantitative and qualitative analysis of soils from different sources of origin.
10. Differentiation of various toxic textile dyes using FTIR analysis.

Assessment Method: As per University guidelines

Suggested Readings:

1. Skoog, D. A., Holler, F. J., & Crouch, S. R. (2021). *Principles of Instrumental Analysis* (7th ed.). Cengage Learning.
2. Hofmann, A., & Clokie, S. (2018**).** *Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology* (8th ed.). Cambridge University Press.
3. Rouessac, F., & Rouessac, A. (2021). *Chemical Analysis: Modern Instrumentation Methods and Techniques* (3rd ed.). Wiley.
4. Saferstein, R. (2023). *Criminalistics: An Introduction to Forensic Science* (13th ed.). Pearson.
5. Bell, S. (2022). *Forensic Chemistry* (3rd ed.). Pearson.
6. Houck, M. M., & Siegel, J**.** A. (2015). *Fundamentals of Forensic Science* (3rd ed.). Academic Press.
7. Peterson J.R and Mohammad A.A (2001); Clinical and Forensic Application of Capillary Electrophoresis. Springer.
8. Lurie B.J and Wittwer J.D (1983); High Performance Liquid Chromatography in Forensic Chemistry. Taylor and Francis.
9. Newman R, Gilbert M, Gilbert M.W., and Lothridge K (1997); GC-MS guide to Ignitable

Liquids. CRC Press.
10. Brown, P. R. (2004); Advances in chromatography.
11. Grahm D. (1973); The use of X-ray Techniques in Forensic Investigation.
12. Settle F.A (1997); Handbook of Instrumental Techniques for Analytical Chemistry. Prentice Hall.

DSC-8 INTRODUCTION TO DIGITAL AND CYBER FORENSICS

Paper	Total Credit	Lecture	Practical/ Practice	Pre-requisite of the course
Introduction to Digital and Cyber Forensics	**04**	**03**	**01**	Basic knowledge of Computers

Course Outcomes:

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

1. Understand the fundamental concepts of digital and cyber forensics and the nature of digital evidence.
2. Explain computer architecture, operating systems, networks, and cybercrimes from a forensic perspective.
3. Apply basic principles of digital evidence acquisition, preservation, and cyber incident investigation.
4. Understand cybersecurity principles, legal aspects, and the use of forensic tools in cybercrime investigations

Learning Objectives:

After completing this course, students will be able to:

1. Describe the fundamentals of digital forensics, cyber forensics, and digital evidence.
2. Examine computer systems, storage media, operating systems, and networks relevant to forensic investigations.
3. Identify common cybercrimes and explain basic investigation methodologies and evidence preservation procedures.
4. Apply introductory forensic tools and cybersecurity practices for analysing digital evidence and preparing forensic reports.

Unit 1 Computer Fundamentals and Digital Storage (12 Hours)

Number systems: Binary, Octal, Decimal and Hexadecimal, Conversion and Operations on Binary Number Systems, Representing Information in Hexadecimal and Binary, Logical operations on binary number systems. Computer Architecture: Components of a computer, Input Devices, Central Processing Unit, Primary and secondary Storage Devices, Output Devices. Secondary Storage Devices: Understanding Disk, Volume and Partition, HDD and SSD Structures.

Unit 2 Operating Systems and Computer Networks (11 Hours)

Role of Operating System, Boot Process, Introduction to Process and Memory Management**.** Windows OS Architecture **-** FAT and NTFS File Systems. Computer Network: Basic concepts of Computer Network, Open System Interconnection (OSI) and TCP/IP reference model, Protocols and functionalities of each layer, types of connections, networking devices

Unit 3 Cybercrime and Digital Forensics (11 Hours)

Definition of cybercrime, history, classification and types of cybercrimes (spoofing, phishing, vishing, spamming, SMS bombing, stalking, pornography, etc.), virus, worms, ransomware, malware logic/salami attacks, concept of Ponzi scheme, social media platforms and related crimes, forensic investigation of social media crime, cyber terrorism, financial frauds, portals for reporting cybercrimes in India.

Unit 4 Cyber security Fundamentals ((11 Hours)

Introduction to cyber security, Incident Response Management, cyber security, TRIAD (CIA), cyber-attack on cyber security principles, risk assessment, security audit, best security practices, web application security, network application security, Introduction to digital forensic tools (Autopsy, FTK Imager, Wireshark, and Cellebrite—overview only)

Practical's (30 Hours)

1. To perform conversion between binary, decimal, octal, and hexadecimal number systems
2. To study structure of HDD and SSD
3. To perform audio examination using forensic tools
4. To perform identification of different types of cybercrimes
5. To perform basic web/application security testing
6. To perform incident response steps in a simulated case
7. To perform basic network configuration and IP identification

Assessment Method: As per university guidelines

Suggested Readings:

1. Hayes, D. R. (2024). *A Practical Guide to Computer Forensics Investigations* (3rd ed.). Pearson.
2. Oettinger, W. (2023). *Learn Computer Forensics* (2nd ed.). Packt.
3. Carvey, H. (2023). *Investigating Windows Systems* (2nd ed.). Syngress/Elsevier.
4. Nelson, B., Phillips, A., & Steuart, C. (2022). *Guide to Computer Forensics and Investigations* (7th ed.). Cengage Learning.
5. Casey, E. (2024). *Digital Evidence and Computer Crime* (4th ed.). Academic Press.
6. Easttom, C. (2022). *Digital Forensics, Investigation, and Response* (4th ed.). Jones & Bartlett Learning.
7. Stallings, W. (2022). *Computer Organization and Architecture* (11th ed.). Pearson.
8. Stallings, W. (2021). *Network Security Essentials: Applications and Standards* (7th ed.). Pearson.
9. Carrier, B. (2005). *File System Forensic Analysis*. Addison-Wesley.
10. Casey, E. (2011). *Handbook of Digital Forensics and Investigation*. Academic Press.

DSE- 5 HUMAN GENETICS AND MOLECULAR FORENSICS

Paper	Total Credit	Lecture	Practical/ Practice	Pre-requisite of the course
Human Genetics and Molecular Forensics	**04**	**03**	**01**	Basic knowledge Forensic Science

Course Outcomes:

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

1. Understand the principles of human genetics and molecular biology relevant to forensic science.
2. Explain molecular techniques used for DNA profiling, sequencing, and genetic marker analysis.
3. Apply genetic principles for human identification, kinship analysis, and forensic investigations.
4. Evaluate the scientific, legal, and ethical aspects of forensic DNA evidence.

Learning Objectives:

After completing this course, students will be able to:

1. Explain the principles of human genetics and molecular forensic analysis.
2. Perform and interpret basic molecular techniques used in forensic DNA analysis.
3. Analyse DNA profiles for human identification, relationship testing, and biological evidence examination.
4. Evaluate the reliability, statistical significance, and legal admissibility of forensic genetic evidence.

Unit 1 Fundamentals of Human Genetics (12 Hours)

Structure and function of DNA and RNA; Chromosome organization, karyotyping, and chromosomal abnormalities; Mendelian inheritance and extensions (codominance, incomplete dominance, linkage); Population genetics: allele frequency, Hardy-Weinberg equilibrium; Genetic variation in human populations (SNPs, STRs, VNTRs, InDels)

Unit 2 Molecular Biology Techniques in Forensics (11 Hours)

DNA extraction methods (organic, Chelex, silica-based); DNA quantification techniques (spectrophotometry, real-time PCR); DNA quality assessment and contamination control; Polymerase Chain Reaction (PCR) and its types; Gel electrophoresis and capillary electrophoresis; DNA sequencing methods (Sanger and Next Generation Sequencing)

Unit 3 DNA Profiling and Human Identification (11 Hours)

Principles of DNA fingerprinting; STR profiling and CODIS markers; Mitochondrial DNA and Y-chromosome analysis; SNP Analysis; Mixed DNA profile interpretation; Statistical

interpretation of DNA Evidence: Random match probability, likelihood ratio, Paternity Index

Unit 4 Advanced Molecular Forensics and Legal Aspects (11 Hours)

Forensic applications: paternity testing, missing persons, disaster victim identification; DNA databases and their management; Epigenetics and forensic age estimation; Chain of custody and laboratory documentation, Ethical, legal, and social issues in forensic genetics; Quality assurance and accreditation in forensic laboratories.

Practical's (30 Hours)

1. Restriction digestion of DNA
2. DNA extraction from different forensic biological forensic samples
3. To perform Polymerase chain reaction
4. To perform Agarose gel electrophoresis
5. STR Profiling and report writing using simulated evidences
6. Calculation of Paternity Index and Random Match Probability.
7. Interpretation of DNA sequencing chromatograms or STR electropherograms

Assessment Method: As per University Guidelines

Suggested Readings:

1. Butler, J. M. (2023). *Advanced Topics in Forensic DNA Typing: Methodology* (2nd ed.). Academic Press.
2. Butler, J. M. (2023). *Fundamentals of Forensic DNA Typing* (2nd ed.). Academic Press.
3. Goodwin, W., Linacre, A., & Hadi, S. (2024). *An Introduction to Forensic Genetics* (4th ed.). Wiley-Blackwell.
4. Jobling, M. A., Gill, P., & Hurles, M. (2023). *Human Evolutionary Genetics* (2nd ed.). Garland Science.
5. Primorac, D., & Schanfield, M. (Eds.). (2014). *Forensic DNA Applications: An Interdisciplinary Perspective*. CRC Press. *(Classic reference.)*
6. Saferstein, R. (2023). *Criminalistics: An Introduction to Forensic Science* (13th ed.). Pearson.
7. Kayser, M., & de Knijff, P. (2011). Improving human forensics through advances in genetics, genomics and molecular biology. *Nature Reviews Genetics*, 12(3), 179–192. *(Classic review.)*
8. Rapley, R., & Whitehouse, D. (Eds.). (2007). *Molecular Forensics*. Wiley. *(Classic reference.)*
9. Arenas, M., et al. (2017). Forensic genetics and genomics: Much more than just a human affair. *PLoS Genetics*, 13(9), e1006960.
10. Kowalczyk, M., et al. (2018). Molecular markers used in forensic genetics. *Medicine, Science and the Law*, 58(4), 201–209.

DSE-6 FORENSIC GENOMICS, PROTEOMICS AND BIOINFORMATICS

Paper	Total Credit	Lecture	Practical/ Practice	Pre-requisite of the course
Forensic Genomics, Proteomics and Bioinformatics	**04**	**03**	**01**	Basic knowledge of Biology

Course Outcomes:

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

1. Understand the principles of genomics, proteomics, and bioinformatics and their applications in forensic science.
2. Explain advanced omics technologies used for human identification and biological evidence characterization.
3. Apply computational tools for biological data analysis and forensic interpretation.
4. Evaluate the scientific, ethical, legal, and societal implications of omics technologies in forensic investigations.

Learning Objectives:

After completing this course, students will be able to:

1. Explain the principles and applications of genomics, proteomics, and bioinformatics in forensic science.
2. Analyse genomic and proteomic data using appropriate computational tools and biological databases.
3. Interpret omics-based evidence for human identification and forensic investigations.
4. Evaluate the opportunities and limitations of integrated omics approaches in forensic science.

Unit 1 Forensic Genomics (12 Hours)

Introduction to genomics: structural and functional genomics; Human genome organisation and variation (SNPs, CNVs, STRs); Next Generation Sequencing (NGS) and its forensic applications; Forensic applications of genomics: ancestry inference, phenotyping (hair, eye, skin colour); Epigenomics: DNA methylation in age estimation and tissue identification

Unit 2 Forensic Proteomics (11 Hours)

Basics of proteomics: protein structure and function; Techniques in proteomics: 2D gel electrophoresis, mass spectrometry (MALDI-TOF, LC-MS/MS); Protein biomarkers in forensic science; Applications: body fluid identification, postmortem interval estimation, hair and fibre analysis, Proteomics in wildlife and species identification

Unit 3 Bioinformatics in Forensic Science (11 Hours)

Introduction to bioinformatics and biological databases (GenBank, EMBL, DDBJ); Sequence alignment tools (BLAST, ClustalW); Phylogenetic analysis and evolutionary relationships; Forensic DNA databases and data management; Software tools for STR analysis and forensic interpretation

Unit 4 Integrated Omics and Emerging Trends in Forensic Science (11 Hours)

Multi-omics integration (genomics, proteomics, transcriptomics); Microbiome forensics and its applications; Forensic applications of artificial intelligence and machine learning; Personalized forensics and predictive analysis; Ethical, legal, and privacy concerns in omics data, Future directions in forensic omics

Practicals (30 Hours)

1. Extraction of proteins from biological samples.
2. Estimation of protein concentration using standard biochemical methods.
3. Construction of a Phylogenetic tree from nucleotide and protein sequences
4. To study different protein structures
5. To study the recent advancements in Human Genome Project

Assessment Method: As per university guidelines

Suggested Readings:

1. Khan, M. S. (2025). A Comprehensive Overview of Bioinformatics Applications in Forensic Science Related to Omics and Odontology. *THE STETHO*, *6*(2), 56-70.
2. Smith, J. H., & Singh, M. (2024). Unlocking Secrets: Bioinformatics' Impact on Forensic Bio-Examinations. *Int. J. Netw. Secur. Its Appl*, *16*, 1-15.
3. Muntaha, S. T., Hasnain, M. J. U., Khan, W. A., Rafiq, F., & Pervez, M. T. (2018). Role of bioinformatics in forensic science. *FUUAST Journal of Biology*, *8*(1), 133-138.
4. Kopp, P. (2005). Genetics, genomics, proteomics, and bioinformatics. *Clinical Pediatric Endocrinology*, 18-44.
5. Duong, V. A., Park, J. M., Lim, H. J., & Lee, H. (2021). Proteomics in forensic analysis: applications for human samples. *Applied Sciences*, *11*(8), 3393.
6. Keane, R. E., Tidy, R. J., Parker, G. J., Gummer, J. P., & Priddis, C. (2024). Mass spectrometry based proteomics: changing the impact of protein analysis in forensic science. *Wiley Interdisciplinary Reviews: Forensic Science*, *6*(4), e1516.
7. Mason, K. E., Anex, D., Grey, T., Hart, B., & Parker, G. (2018). Protein-based forensic identification using genetically variant peptides in human bone. *Forensic science international*, *288*, 89-96.
8. Baniasad, M., Reed, A. J., Lai, S. M., Zhang, L., Schulte, K. Q., Smith, A. R., ... & Freitas, M. A. (2021). Optimization of proteomics sample preparation for forensic analysis of skin samples. *Journal of proteomics*, *249*, 104360.

DSE- 7 ADVANCED FORENSIC ANTHROPOLOGY

Paper	Total Credit	Lecture	Practical/ Practice	Pre-requisite of the course
Advanced Forensic Anthropology	**04**	**03**	**01**	Basic knowledge of Biology

Course Outocmes

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

1. Understand advanced concepts of human skeletal biology and their application in forensic anthropology.
2. Apply scientific methods for constructing biological profiles from human skeletal remains.
3. Analyse skeletal trauma, taphonomic changes, and postmortem alterations for medico-legal investigations.
4. Evaluate the role of forensic anthropologists in criminal investigations, disaster victim identification, and humanitarian contexts.

Learning Objectives

After completing this course, students will be able to:

1. Examine and identify human skeletal remains using osteological and anthropometric methods.
2. Estimate sex, age, stature, ancestry, and biological profile from skeletal remains.
3. Interpret skeletal trauma, decomposition, and taphonomic changes in forensic investigations.
4. Apply forensic anthropological methods in crime scene recovery, human identification, and legal proceedings.

Unit 1 Human Osteology and Skeletal Biology (12 Hours)

Detailed study of human skeletal system (axial and appendicular); Bone biology: growth, development, remodeling, and ageing; Skeletal variation and population differences; Metric and non-metric traits in identification; Histological analysis of bone, Human versus non-human skeletal differentiation

Unit 2 Biological Profile Estimation (11 Hours)

Sex determination (morphological and metric methods); Age estimation (subadult and adult skeletal indicators); Stature estimation (long bone measurements, regression formulae); Ancestry estimation and population affinity; Facial reconstruction basics

Unit 3 Forensic Taphonomy and Trauma Analysis (11 Hours)

Taphonomic processes: decomposition, burial, environmental effects; Estimation of postmortem interval (PMI); Types of traumas: blunt force, sharp force, ballistic trauma; Antemortem, perimortem, and postmortem injuries; Mass disasters and commingled remains analysis

Unit 4 Forensic Anthropology in Practice and Legal Context (11 Hours)

Crime scene recovery of skeletal remains; Documentation and chain of custody; Role of forensic

anthropologist in court; Human rights investigations and mass grave analysis; Ethical issues and professional standards.

Practicals (30 Hours)

1. Examination of skeletal remains- long bones- Femur, Humerus.
2. Identification of individuals by long bones and stature estimation
3. Determination of sex and age from Skull with mandible
4. Determination of sex from pelvis and sacrum.
5. Identification of individuals by dental examination
6. Anthropometry - Identification of individuals (in living)

Assessment Method: As per university guidelines

Suggested Readings:

1. Pink, C. M., Cornelison, J. B., & Juarez, J. K. (2025). Standardizing Advanced Training in Forensic Anthropology: Defining a Clear Path to Achieve Forensic Specialization in Biological Anthropology. *American Journal of Biological Anthropology*, *186*(4), e70055.
2. Franklin, D., & Marks, M. K. (2022). The professional practice of forensic anthropology: Contemporary developments and cross-disciplinary applications. *Wiley Interdisciplinary Reviews: Forensic Science*, *4*(2), e1442.
3. Ubelaker, D. H. (2018). Recent advances in forensic anthropology. *Forensic sciences research*, *3*(4), 275-277.
4. Christensen, A. M., Passalacqua, N. V., & Bartelink, E. J. (2019). *Forensic anthropology: current methods and practice*. Academic Press.
5. Wescott, D. J. (2018). Recent advances in forensic anthropology: decomposition research. *Forensic sciences research*, *3*(4), 278-293.
6. Passalacqua, N. V., Pilloud, M. A., & Congram, D. (2021). Forensic anthropology as a discipline. *Biology*, *10*(8), 691.

DSE-8 FORENSIC ENGINEERING

Paper	Total Credit	Lecture	Practical/ Practice	Pre-requisite of the course
Forensic Engineering	**04**	**03**	**01**	Basic knowledge of Forensic Science

Course Outcomes:

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

1. Understand the principles of engineering science applied to forensic investigations.
2. Explain methods for analysing structural, mechanical, electrical, and material failures.
3. Apply scientific approaches for accident investigation, reconstruction, and interpretation of engineering evidence.
4. Evaluate legal, ethical, and professional aspects of forensic engineering investigations.

Learning Objectives

After completing this course, students will be able to:

1. Explain the principles and methodologies of forensic engineering investigations.
2. Analyse engineering failures using appropriate scientific and technical approaches.
3. Interpret evidence from structural failures, industrial accidents, fires, and traffic collisions.
4. Prepare engineering investigation reports consistent with forensic and legal requirements.

Unit 1 Fundamentals of Forensic Engineering (12 Hours)

Definition, scope, and role of forensic engineering; Basic principles of engineering mechanics (force, stress, strain); Types of engineering failures: structural, mechanical, electrical; Modes of failure: fatigue, corrosion, fracture, overload; principle of failure analysis

Unit 2 Structural and Material Failure Analysis (11 Hours)

Structural failures: buildings, bridges, dams; Material science basics: metals, polymers, composites; Fracture mechanics and crack propagation; Corrosion and environmental degradation; Case studies of engineering failures

Unit 3 Accident Investigation and Reconstruction (11 Hours)

Road traffic accident investigation (vehicle dynamics, skid marks); Fire and explosion investigation basics; Industrial accidents and machinery failure; Electrical accidents and short-circuit analysis; Use of simulation and reconstruction tools

Unit 4 Forensic Engineering Practice and Legal Aspects (11 Hours)

Investigation protocols and documentation; Evidence collection and preservation in engineering cases; Role of expert witness in court; Standards, codes, and safety regulations; Ethics and professional responsibility.

Practical's (30 Hours)

1. Case study on structure collapse and its analysis.
2. To study burn patterns
3. Microscopic examination of fracture surfaces
4. To study skid, scuff, and yaw marks
5. Preparation of a forensic engineering report based on a given case study

Assessment Method: As per University Guidelines

Suggested Readings:

1. Petty, S. E. (2021). *Forensic engineering*. CRC Press.
2. Franck, H., & Franck, D. (2013). *Forensic engineering fundamentals*. Boca Raton, FL: CRC Press.
3. Noon, R. K. (2020). *Introduction to forensic engineering*. CRC Press.
4. Liptai, L. L. (2009). Forensic engineering and the scientific method. *Journal of the National Academy of Forensic Engineers*, *26*(1).
5. Batterman, S. C., & Batterman, S. D. (2002). Forensic engineering. *McGraw-Hill Yearbook of Science & Technology, Mcgraw-Hill*.
6. Brown, S. (2007). Forensic engineering: Reduction of risk and improving technology (for all things great and small). *Engineering Failure Analysis*, *14*(6), 1019-1037.
7. Breysse, D. (2012). Forensic engineering and collapse databases. *Proceedings of the Institution of Civil Engineers-Forensic Engineering*, *165*(2), 63-75.

DSE- 9 ADVANCED TECHNIQUES IN CRIME SCENE INVESTIGATION

Paper	Total Credit	Lecture	Practical/ Practice	Pre-requisite of the course
Advanced Techniques in Crime Scene Investigation	**04**	**03**	**01**	Basic knowledge Forensic Science

Course Outcomes:

1. To impart advanced knowledge of scientific crime scene investigation techniques.
2. To familiarize students with modern technologies used in crime scene documentation, evidence recognition, collection, preservation, and reconstruction.
3. To develop analytical skills for interpreting crime scene evidence using contemporary forensic methods.
4. To acquaint students with international standards, quality assurance, and legal aspects of crime scene investigation.

Learning Objectives:

1. Demonstrate proficiency in advanced crime scene management and evidence handling.
2. Apply modern imaging, mapping, and documentation technologies at crime scenes.
3. Analyze and reconstruct crime scenes using scientific principles and forensic evidence.
4. Evaluate complex crime scenes involving homicide, explosions, disasters, and environmental crimes.

Unit 1: Advanced Crime Scene Management (12 Hours)

Evolution and scope of crime scene investigation, classification and types of crime scenes, responsibilities of crime scene investigators, crime scene security and preservation, establishment of crime scene perimeters, systematic search methods, scene assessment and risk management, primary and secondary crime scene surveys, documentation of crime scenes through notes, photography, videography, sketching and digital recording, chain of custody, evidence integrity, standard operating procedures for crime scene investigation, Health, safety, and personal protective equipment (PPE) at crime scenes

Unit 2: Modern Crime Scene Documentation and Evidence Detection (11 Hours)

Advanced forensic photography, videography and panoramic imaging, drone-assisted crime scene documentation, photogrammetry, terrestrial laser scanning (LiDAR), three-dimensional crime scene reconstruction, Total Station Surveying, Geographic Information System (GIS) applications, alternate light sources (ALS), ultraviolet, infrared and fluorescence imaging, multispectral and

hyperspectral imaging, detection and enhancement of latent biological evidence, chemical enhancement techniques, mobile crime scene documentation technologies.

Unit 3: Crime Scene Reconstruction and Interpretation (11 Hours)

Principles of crime scene reconstruction, bloodstain pattern analysis, shooting incident reconstruction, trajectory analysis, traffic accident reconstruction, fire and explosion scene reconstruction, interpretation of footwear and tyre impressions, tool mark evidence, trace evidence reconstruction, sequence of events reconstruction, behavioral crime scene analysis, disaster and mass fatality scene management, interpretation of forensic findings through case studies.

Unit 4: Emerging Technologies in Crime Scene Investigation (11 Hours)

Application of artificial intelligence and machine learning in crime scene investigation, virtual reality and augmented reality in crime scene reconstruction, Internet of Things (IoT) evidence, wearable devices and smart surveillance systems, cyber-enabled crime scene investigation, mobile forensic evidence at crime scenes, underwater crime scene investigation, cold case review using advanced forensic technologies, international standards for crime scene investigation recent advances and future perspectives in crime scene investigation.

Practical's (30 Hours)

1. Crime scene documentation using field notes, photography, videography, and crime scene sketching.
2. Documentation of crime scenes using photogrammetry software.
3. Demonstration of 3D laser scanner/Total Station for crime scene mapping.
4. Detection and enhancement of latent bloodstains using chemical reagents
5. Recovery and casting of footwear and tyre impressions.
6. Bloodstain Pattern Analysis (BPA) at simulated crime scenes.
7. Crime scene mapping using Geographic Information System (GIS) applications.
8. Digital crime scene reconstruction using Virtual Reality (VR) or other reconstruction software

Assessment Method: As per university guidelines

Suggested Readings:

1. Fisher, B. A. J., & Fisher, D. R. (2022). *Techniques of Crime Scene Investigation* (9th ed.). CRC Press.
2. Gardner, R. M., & Bevel, T. (2021). *Practical Crime Scene Processing and Investigation* (3rd ed.). CRC Press.
3. Lee, H. C., Palmbach, T., & Miller, M. T. (2022). *Henry Lee's Crime Scene Handbook* (Revised ed.). Academic Press.
4. Saferstein, R. (2023). *Criminalistics: An Introduction to Forensic Science* (13th ed.). Pearson.
5. Houck, M. M., & Siegel, J. A. (2015). *Fundamentals of Forensic Science* (3rd ed.). Academic Press.
6. Chisum, W. J., & Turvey, B. E. (2011). *Crime Reconstruction* (2nd ed.). Academic Press. *(Classic reference.)*
7. Bevel, T., & Gardner, R. M. (2021). *Bloodstain Pattern Analysis* (4th ed.). CRC Press.

DSE- 10 DISASTER VICTIM IDENTIFICATION

Paper	Total Credit	Lecture	Practical/ Practice	Pre-requisite of the course
Disaster Victim Identification	**04**	**04**	**00**	Basic knowledge of Forensic Science

Course Outcomes:

1. To provide students basic conceptual understanding about disasters and Disaster management
2. To make students learn about the importance of the key aspect of Disaster victim identification
3. To Enhance the skill of the student's investigative procedure in mass fatality

Learning Objectives:
The students will gain knowledge of

1. Disaster Management Techniques and their application in Disaster Management.
2. Fundamentals of DVI and its application in Scene Processing and Recovery of evidences.
3. Humanitarian Approach in Disaster Management.

Unit 1 Disaster Management and Fundamentals of Disaster Victim Identification (16 Hours)
Introduction to disasters, Classification and Types of disasters, National and Global Impact of Disasters; Causes, Effects and Practical examples for all disasters.
Disaster Management Techniques: Risk and Vulnerability Analysis, its concept and Reduction, Early and Advance Warming Systems, understanding climate risk, Mapping of risk assessment, Decision making for risk reduction, Problems in risk assessment, Geographical Information System (GIS).

Unit 2 Scene Processing and Recovery Operations (15 Hours)
Disaster preparedness and Response: Overview and Understanding of Disaster Preparedness, Early Warnings and Safety Measures of Disaster, Resource Management- Financial, Medical, equipment, communication, Human, transportation, Food and essential commodity, Directing and controlling functions, Role of Government, International and NGO Bodies.
Fundamentals of DVI: Principle and Guideline of DVI, Different expertise and equipment's, Composition of Investigation team (DVI team), Health and personnel safety.

Unit 3 Scientific Methods of Victim Identification (15 Hours)
Scene Processing and Recovery: Process of DVI operation on site and Mortuary, Handling and preservation of Human and non-human remains, Documentation, Body labelling, Disaster photography/videography and their kits, Different types of coordination centre.
Investigative Process: Establishing Identifiers, Biological Profiling of Primary and Secondary Identifiers (Fingerprint, Teeth and DNA), Advance Techniques (Radiology, Scanners, 3D printers),

Different AM data collection and documentation, Different type of PM examination and Documentation, Digital data maintenance software, Reconciliation and Repatriation.

Unit 4 Humanitarian, Ethical and Legal Aspects of DVI (14 Hours)

Humanitarian Approach: Concept and Nature of ethics; Role and purpose of ethics; ethical norms and principles; International Humanitarian Law; Disaster Policy: The International Decade for Natural Disaster Reduction, Disaster Policy (National Policy on Disaster Management), Disaster Management Act 2005. National Disaster Management Plan, Role of Media and its importance, role of Fire Services, Para-military, Armed forces, presently challenging aspect of disaster management in India.

Assessment Method: As per University Guidelines

Suggested Readings:

1. James, J. P., Nordby, J. J., & Bell, S. (2025). *Forensic Science: An Introduction to Scientific and Investigative Techniques* (6th ed.). CRC Press.
2. Houck, M. M., & Siegel, J. A. (2015). *Fundamentals of Forensic Science* (3rd ed.). Academic Press.
3. Blau, S., & Ubelaker, D. H. (Eds.). (2016). *Handbook of Forensic Anthropology and Archaeology*. Routledge.
4. Prahlow, J. A. (2024). *Forensic Pathology for Police, Death Investigators, Attorneys and Forensic Scientists* (2nd ed.). Humana Press.
5. Murthy, D. B. N. (2012). *Disaster Management*. Deep & Deep Publications.
6. Staggs, S. (2005). *Crime Scene and Evidence Photographer's Guide*. Staggs Publishing. *(Useful for disaster documentation.)*
7. Patnaik, S.M. (2023). Community Participation Strategies in Nepal's Disaster Management. In: Singh, A. (eds) International Handbook of Disaster Research. Springer, Singapore. https://doi.org/10.1007/978-981-19-8388-7_112

GE-3 FUNDAMENTALS OF IMMUNOLOGICAL TECHNIQUES IN FORENSIC SCIENCE

Paper	Total Credit	Lecture	Practical/ Practice	Pre-requisite of the course
Fundamentals of Immunological Techniques in Forensic Science	**04**	**03**	**01**	Basic knowledge of Biology

Course Outcomes:

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

1. Understand the basic concepts of the immune system and antigen–antibody interactions.
2. Explain immunological techniques commonly used in forensic and diagnostic investigations.
3. Apply serological methods for the identification and analysis of biological evidence.
4. Evaluate the significance and limitations of immunological techniques in forensic science.

Learning Objectives:

After completing this course, students will be able to:

1. Explain the structure and functions of the immune system and immunological components.
2. Interpret antigen–antibody reactions and common serological tests.
3. Apply immunological techniques in the examination of forensic biological evidence.
4. Assess the reliability and medico-legal significance of immunological findings.

Unit 1 Basics of the Immune System (12 Hours)

Overview of immunity: innate and adaptive immunity; Cells of the immune system: lymphocytes, macrophages, dendritic cells, NK cells; Organs of the immune system: primary and secondary lymphoid organs; Antigens and immunogens: properties and types; Cytokines and their functions

Unit 2 Antibodies and Antigen–Antibody Reactions (11 Hours)

Structure and classes of immunoglobulins (IgG, IgM, IgA, IgE, IgD); Antigen–antibody interactions: specificity, affinity, avidity; Principles of serological reactions: precipitation, agglutination; Complement system and its pathways; Hypersensitivity reactions (Types I–IV)

Unit 3 Immunological Techniques in Forensic Science (11 Hours)

Blood group antigens and typing (ABO, Rh system); Serological methods: ELISA, RIA, immunodiffusion, immunoelectrophoresis; Immunoassays for detection of drugs, toxins, and biological fluids; Monoclonal antibodies and their applications; Use of immunology in species identification and paternity testing

Unit 4 Advanced Immunology and Clinical Relevance (11 Hours)

Major Histocompatibility Complex (MHC) and antigen presentation; Immune response regulation and tolerance; Autoimmune diseases and immunodeficiency disorders; Vaccines and immunization principles; Ethical and legal considerations in immunological testing.

Practical's (30 hours)

1. Determination of blood group using Antisera
2. To Determine the Rh factor of given blood sample
3. To perform presumptive tests for blood
4. To perform presumptive tests for saliva
5. To differentiate between Human and animal blood using precipitin test
6. Demonstration of ELISA (Enzyme-Linked Immunosorbent Assay)

Assessment Method: As per university guidelines

Suggested Readings:

1. Bier, O. G., Da Silva, W. D., Götze, D., & Mota, I. (2012). *Fundamentals of immunology*. Springer Science & Business Media.
2. Ansell, S. M. (2020). Fundamentals of immunology for understanding immunotherapy for lymphoma. *Hematology 2014, the American Society of Hematology Education Program Book*, *2020*(1), 585-589.
3. Woods, M. E. (2017). Fundamentals of immunology and inflammation. In *Nanomedicine for Inflammatory Diseases* (pp. 3-38). CRC Press.
4. Aruljothi, B., Mangala, K. J., Swain, M. P., & Sukhramani, P. S. (2023). *Basics And Fundamentals Of Immunology*. Academic Guru Publishing House.
5. Mir, M. A. (Ed.). (2020). *Basics and Fundamentals of Immunology*. Nova Medicine & Health.
6. Delves, P. J., Martin, S. J., Burton, D. R., & Roitt, I. M. (2017). *Roitt's essential immunology*. John Wiley & Sons.
7. Novotny, A. M. (2014). Fundamentals of Immunology.

GE-4 FUNDAMENTALS OF AI AND MACHINE LEARNING IN FORENSIC SCIENCE

Paper	Total Credit	Lecture	Practical/ Practice	Pre-requisite of the course
Fundamentals of AI and Machine Learning in Forensic Science	**04**	**03**	**01**	Basic knowledge of Computers

Course Outcomes:

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

1. Understand the fundamental concepts of artificial intelligence, machine learning, and data science relevant to forensic science.
2. Explain methods of data preparation, feature engineering, and predictive modelling.
3. Apply basic machine learning techniques to analyse forensic datasets and solve investigative problems.
4. Evaluate the ethical, legal, and practical implications of AI-based forensic applications.

Learning Objectives:

After completing this course, students will be able to:

1. Explain the principles of artificial intelligence, machine learning, and data analytics.
2. Prepare and preprocess forensic datasets for machine learning applications.
3. Apply supervised and unsupervised learning algorithms to forensic problems.
4. Interpret machine learning results and assess their reliability, limitations, and ethical implications.

Unit 1 Foundations of Data Science and Machine Learning (12 Hours)

Overview of Data Science: need, components, and applications; Data Science lifecycle: data collection, processing, analysis, interpretation; Introduction to Machine Learning: human vs. machine learning; Learning problem and hypothesis space; Types of Machine Learning: supervised, unsupervised, reinforcement learning; Applications of ML in forensic science (crime prediction, pattern recognition, biometrics); Issues in Machine Learning: bias, overfitting, data limitations; Tools and platforms for ML (Python, R, basic libraries)

Unit 2 Data Preparation and Feature Engineering (11 Hours)

Types of data in machine learning (structured, unstructured, categorical, numerical); Exploring data structure and datasets; Data quality issues and remediation (missing data, noise, inconsistencies); Data preprocessing: cleaning, normalization, transformation; Basics of Feature Engineering: concept and importance; Feature transformation: construction, extraction; Feature selection and dimensionality reduction

Unit 3 Supervised and Unsupervised Learning (11 Hours)

Supervised learning: classification and regression concepts; Classification models and workflow; Algorithms: k-Nearest Neighbour (k-NN), Decision Tree, Random Forest, Support Vector Machine (SVM); Regression models: Simple Linear Regression, Multiple Linear Regression, Logistic Regression; Unsupervised learning: concepts and applications; Clustering techniques and association rule mining; Comparison: supervised vs. unsupervised learning

Unit 4 Neural Networks, Modelling and Forensic Applications (11 Hours)

Model building process: selecting, training, and testing models; Model representation and evaluation metrics (accuracy, precision, recall); Artificial Neural Networks (ANN): Biological vs artificial neuron, Activation functions, Network architecture; Learning process in ANN and backpropagation algorithm; Introduction to Deep Learning; AI applications in forensic science: Face recognition and biometrics, Crime pattern analysis, Digital forensics and fraud detection; Ethical and legal considerations in AI-based forensic analysis

Practical's (30 Hours)

1. Loading and exploration of datasets
2. Basic statistical analysis and visualization of forensic datasets.
3. Data cleaning and preprocessing
4. Linear and logistic regression using forensic datasets
5. K-Means clustering.
6. Crime data analysis using real or simulated datasets.
7. Classification using Decision Tree or Random Forest.
8. Basic AI workflow using WEKA or Orange Data Mining.

Assessment Method: As per University Guidelines

Suggested Readings:

1. Müller, A. C., & Guido, S. (2022). *Introduction to Machine Learning with Python* (2nd ed.). O'Reilly.
2. Géron, A. (2023). *Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow* (3rd ed.). O'Reilly.
3. Alpaydin, E. (2021). *Introduction to Machine Learning* (4th ed.). MIT Press.
4. Russell, S., & Norvig, P. (2021). *Artificial Intelligence: A Modern Approach* (4th ed.). Pearson.
5. Datt, S., Chandramouli, S., & Das, A. *Machine Learning*. Pearson.
6. Saferstein, R. (2023). *Criminalistics: An Introduction to Forensic Science* (13th ed.). Pearson.
7. James, S. H., Nordby, J. J., & Bell, S. (2025). *Forensic Science: An Introduction to Scientific and Investigative Techniques* (6th ed.). CRC Press.
8. Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep Learning*. MIT Press.

Skill Enhancement Course

SEC-1 OPTICAL TECHNIQUES WITH LABORATORY TRAINING

Paper	Total Credit	Theory	Practical/ Practice	Pre-requisite of the course
Optical Techniques with Laboratory training	**02**	**01**	**01**	Basic knowledge of Forensic Science

Course Outcomes:

1. To understand laboratory practices, safety protocols, and quality assurance procedures associated with optical techniques in forensic science.
2. To develop practical skills in the operation, maintenance, and documentation of optical instruments used for forensic examinations.
3. To acquire competence in digital imaging, evidence documentation, and interpretation of microscopic observations.
4. To familiarize students with recent advancements and emerging optical technologies used in forensic laboratories.

Learning Objectives:
After successful completion of the course, students will be able to:

1. Demonstrate safe laboratory practices and apply quality assurance measures during forensic optical examinations.
2. Operate, maintain, and select appropriate optical instruments for the examination of different types of forensic evidence.
3. Acquire, document, interpret, and report optical observations using digital imaging and microscopy techniques.
4. Evaluate the applications and limitations of contemporary and emerging optical technologies in forensic science.

Theory

Unit I: Laboratory Practices and Optical Instrumentation (8 Hours)
Role of optical techniques in forensic laboratories; Laboratory organization and workflow; Selection of appropriate optical instruments for different types of evidence; Instrument calibration, validation and preventive maintenance; Standard Operating Procedures (SOPs); Laboratory safety and biosafety practices; Quality assurance and quality control (QA/QC); Good Laboratory Practices (GLP); Chain of custody, evidence handling, packaging and preservation during optical examination; Documentation and report writing.

Unit II: Digital Imaging, Data Interpretation and Emerging Optical Technologies (7 Hours)
Digital microscopy and image acquisition; Image enhancement, measurement and annotation; Photomicrography and forensic photography; Interpretation and limitations of optical observations; Sources of

error and quality control in microscopic examinations; Laboratory Information Management Systems (LIMS) in microscopy laboratories; Recent advances in forensic optical technologies including automated image analysis, AI-assisted microscopy, hyperspectral imaging, confocal microscopy and 3D digital microscopy; Case studies demonstrating the role of optical techniques in forensic investigations.

Practical's (30 Hours)

1. Laboratory safety, handling, and maintenance of optical instruments.
2. Examination of biological specimens under a compound microscope.
3. Identification of textile fibers using a comparison microscope.
4. Examination of hair samples for species and individual characteristics.
5. Polarized Light Microscopy (PLM) for identification of fibres and crystalline substances.
6. Stereo microscope examination of trace evidence (glass, paint, soil, pollen, and fibres).
7. Examination of questioned documents using a Stereo Zoom Microscope.
8. Digital image capture and documentation using microscope imaging systems.
9. Demonstration of Fluorescence Spectroscopy.
10. Examination of biological stains under Alternate Light Source
11. ALS Examination of security features in currency notes under UV light.
12. Optical examination of latent fingerprints using Alternate Light Source.
13. Identification of counterfeit pharmaceutical packaging using optical techniques.
14. Microscopic examination of pollen and diatoms.

Assessment Method: Internal Assessment, End term Practical Examination

Suggested Readings

1. Skoog, D.A., West, D.M., Holler, F.J., and Crouch, S.R. Fundamentals of Analytical Chemistry. 9th Edition. Cengage Learning.
2. Saferstein, R. Criminalistics: An Introduction to Forensic Science. 12th Edition. Pearson Education.
3. Houck, M.M., and Siegel, J.A. Fundamentals of Forensic Science. 4th Edition. Academic Press.
4. Hilton, O. Scientific Examination of Questioned Documents. CRC Press.
5. Osborn, A.S. Questioned Documents. Lawyers & Judges Publishing Company.
6. Sharma, B.R. Forensic Science in Criminal Investigation and Trials. Universal Law Publishing.
7. Directorate of Forensic Science Services (DFSS), Government of India. Laboratory Manuals and Standard Operating Procedures.

SEC-2 SEPARATION TECHNIQUES WITH LABORATORY TRAINING

Paper	Total Credit	Theory	Practical/ Practice	Pre-requisite of the course
Separation techniques with laboratory training	**02**	**01**	**01**	Basic knowledge of chemistry

Course Outcomes

After completion of this course, the learners will be able to:

1. To understand laboratory practices and quality assurance associated with separation techniques.
2. To develop practical skills in sample preparation and the operation of separation techniques used in forensic and analytical laboratories.
3. To acquire competency in documentation, interpretation, and reporting of laboratory results.
4. To familiarize students with recent advances and applications of separation technologies in forensic science.

Learning Objectives

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

1. Demonstrate safe laboratory practices and apply quality assurance measures while performing separation techniques.
2. Select appropriate sample preparation and separation methods for different types of forensic and analytical samples.
3. Record, interpret, and report analytical findings generated through separation techniques.
4. Evaluate the applications, limitations, and recent developments in separation technologies used in forensic laboratories.

Unit I: Laboratory Practices and Quality Assurance in Separation Techniques (8 Hours)

Role of separation techniques in forensic and analytical laboratories; Sample collection, preservation, storage, and preparation for analysis; Selection of appropriate separation methods based on sample characteristics; Standard Operating Procedures (SOPs); Good Laboratory Practices (GLP); Laboratory safety and chemical handling; Instrument calibration, validation, and routine maintenance; Quality assurance and quality control (QA/QC); Chain of custody, documentation, and laboratory record management.

Unit II: Data Interpretation and Emerging Trends in Separation Science (7 Hours)

Interpretation of chromatograms, electropherograms, and separation profiles; Sources of analytical error and troubleshooting; Validation parameters for separation methods (accuracy, precision, sensitivity, selectivity, reproducibility); Digital data acquisition and laboratory information management systems (LIMS); Applications of separation techniques in forensic, environmental, pharmaceutical, and biomedical sciences; Recent advances including hyphenated techniques (GC-MS, LC-MS/MS), automated sample preparation,

microfluidic separation systems, green analytical chemistry, and AI-assisted data interpretation.

Practical's (30 Hours)

1. Determination of extraction efficiency using solvent extraction.
2. Separation of pigments by liquid-liquid extraction.
3. Solid-Liquid Extraction (Soxhlet extraction).
4. Solid Phase Extraction (SPE) of drug samples.
5. Isolation of caffeine from tea/coffee samples.
6. Separation of metallic ions by paper chromatography
7. Separation of plant pigments (chlorophylls and carotenoids) from green leaves by chromatography.
8. Demonstration of Gas Chromatography (GC).
9. Demonstration of High-Performance Liquid Chromatography (GC).
10. Determination of ion exchange capacity of a given cation or anion exchanger
11. Determination of the residual chlorine in city water supply using colorimetry

Assessment Method: As per University Guidelines

Suggested Readings

1. J. M. Miller. Chromatography Concepts and Contrasts, Wiley, 2004
2. R. W. Rousseau, Handbook of Separation Process Technology, Wiley, 1987.
3. M. K. Purkait, R. Singh, Membrane Technology in Separation Science, CRC Press, 2018.
4. Separation Process Principles, J.D. Seader and E.J.Henley, Wiley, 2nd Edition 2004
5. Transport Processes and Separation Process principles, Christie J Geankoplis Prentice-Hall of India Private Ltd, New Delhi, 4th Edition 2006

SEC-3 Foundations of Research Design

Paper	Total Credit	Theory	Practical/ Practice	Pre-requisite of the course
Foundations of Research Design	**02**	**01**	**01**	Basic knowledge of Forensic Science and Statistics

Course Outcomes

After completion of this course, the learners will be able to:

1. Understand the principles and components of research design in scientific investigations.
2. Develop competence in qualitative, quantitative, and mixed-method research approaches.
3. Apply appropriate methods for data collection, sampling, analysis, and interpretation.
4. Recognize ethical principles and good research practices in scientific research.

Learning Objectives

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

1. Formulate research problems, objectives, hypotheses, and appropriate research designs.
2. Select suitable sampling strategies and data collection methods for different research problems.
3. Apply qualitative and quantitative approaches for data analysis and interpretation.
4. Demonstrate ethical conduct and scientific integrity throughout the research process.

Unit I: Foundations of Research Design (8 Hours)

Meaning, purpose and significance of research design; Characteristics of a good research design; Types of research design—exploratory, descriptive, analytical, experimental, cross-sectional, longitudinal, case study and mixed-methods design; Formulation of research problem, research questions, objectives and hypotheses; Variables and their types; Sampling methods and sample size considerations; Reliability, validity and ethical considerations in research design.

Unit II: Data Collection, Analysis and Scientific Communication (7 Hours)

Methods of data collection—observation, interview, questionnaire, schedule and laboratory records; Qualitative and quantitative data; Data coding, tabulation and graphical presentation; Introduction to statistical software and reference management tools; Interpretation of results; Structure of scientific reports and research papers; Referencing and citation styles; Plagiarism, research integrity and responsible use of Artificial Intelligence in research.

Practical (30 Hours)

1. Identification and formulation of a research problem and preparation of research objectives.
2. Preparation of a research proposal including hypothesis and research design.
3. Designing questionnaires, interview schedules and observation checklists.
4. Selection of sampling methods and determination of sample size using case studies.
5. Collection of primary data through surveys/interviews and preparation of field records.
6. Data coding and preparation of data sheets using spreadsheet software.
7. Tabulation and graphical presentation of data.
8. Descriptive statistical analysis using MS Excel/SPSS/R (mean, median, standard deviation, charts).
9. Reference management using Mendeley/Zotero and preparation of bibliography.

10. Identification of plagiarism using plagiarism detection software and preparation of similarity reports.
11. Preparation of scientific posters and oral presentations.
12. Writing a mini research report following standard scientific format.
13. Ethical review of selected research case studies.
14. Presentation and viva voce of the mini research project.

Assessment Method: As per University guidelines

Suggested Readings

1. Kothari, C.R., & Garg, G. *Research Methodology: Methods and Techniques.* 4th Edition. New Age International Publishers.
2. Creswell, J.W., & Creswell, J.D. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches.* 6th Edition. SAGE Publications.
3. Kumar, R. *Research Methodology: A Step-by-Step Guide for Beginners.* 5th Edition. SAGE Publications.
4. Bernard, H.R. *Research Methods in Anthropology: Qualitative and Quantitative Approaches.* 6th Edition. Rowman & Littlefield.
5. Neuman, W.L. *Social Research Methods: Qualitative and Quantitative Approaches.* 8th Edition. Pearson.
6. American Psychological Association. *Publication Manual of the American Psychological Association.* 7th Edition. APA.
7. Booth, W.C., Colomb, G.G., Williams, J.M., Bizup, J., & Fitzgerald, W.T. *The Craft of Research.* 5th Edition. University of Chicago Press.
8. Singh, Y.K. *Fundamental of Research Methodology and Statistics.* New Age International Publishers.

SEM-IV

DSC-9 INSTRUMENTAL TECHNIQUES IN FORENSIC ANALYSIS - II

Paper	Total Credit	Lecture	Practical/ Practice	Pre-requisite of the course
Instrumental Techniques in Forensic Analysis II	**04**	**03**	**01**	Basic understanding of forensic science

Course Outcomes:

1. To understand basic principles of modern analytical instruments
2. To learn applications of microscopy and spectroscopy in forensics
3. To develop knowledge of material analysis techniques
4. To apply instrumental methods in forensic investigations

Learning Objectives:

Students will be able to:

1. Explain working principles of major forensic instruments
2. Identify appropriate techniques for different types of evidence
3. Interpret analytical results in forensic context
4. Apply instrumental methods in laboratory-based investigations

Unit 1 Introduction to Microscopy (12 Hours)

Introduction, theory, principles, sample preparation, and applications of electron microscope including Scanning Electron Microscope, Field Emission Scanning Electron Microscope, Transmission Electron Microscope, Energy Dispersive X Ray, Scanning Probe Microscope, Scanning, Tunnelling Electron Microscope (STEM), Atomic Force Microscope, Quantum 3D Microscope, and Confocal Microscopy, Polarizing Microscopy.

Unit 2 Atomic Spectroscopy (11 Hours)

Introduction, theory, principles, sample preparation, and applications of Atomic Absorption Spectroscopy, Graphite Furnace Atomic Absorption Spectroscopy, Atomic Emission Spectroscopy, Inductively Coupled Plasma Atomic Emission Spectroscopy, Inductively Coupled Plasma Mass Spectroscopy.

Unit 3 X-Ray Techniques (11 Hours)

Introduction, theory, principles, sample preparation, and applications of X Ray Diffraction, X Ray Fluorescence (Energy and Wavelength Dispersion), Auger Electron Spectroscopy (ESCA)

Unit 4 Thermal Techniques (11 Hours)

Introduction, theory, principles, sample preparation, and applications of Nuclear Magnetic Resonance Spectroscopy, Neutron Activation Analysis, Thermo Gravimetric Analysis, Differential Thermal Analysis. Glass Refractive Index Measurement (GRIM), Densitometer, Universal Tensile Strength testing equipment (UTM), Immunoassay and Centrifugation techniques.

Practical's (30 Hours)

1. To analyses various physical evidences using microscopes
2. To perform centrifugation of biological samples.
3. To analyses the given sample by using Mass Spectroscopy.
4. To calculate refractive index of glass by using Refractometer.
5. To analyses the given sample by using XRD and XRF
6. To understand Instrumentation and application of Raman Spectroscopy

Assessment Method: As per university guidelines

Suggested Readings:

1. Robinson J.W, Frame E.M.K and Frame II G.M (2005); Undergraduate Instrumental Analysis. M. Dekker.
2. Skoog D.A, Holler F.J & Crouch S.R (2021); Principles of Instrumental analysis: Cengage Learning Inc.
   3. Merrit W and Settle D (1981); Instrumental Methods of Analysis. Van Nostrand.
   4. Saferstein R (2015); Criminalistics An introduction to Forensic Science, Pearson.
5. Pavia D.L, Lapman G.L, Kriz G.S and Vyvyan J.R(2015); Introduction to Spectroscopy. Cengage Learning.
6. Chapmen J.R (1993); Practical Organic Mass Spectrometry- A Guide for Chemical and Biochemical Analysis. Wiley & Sons.
7. Chatwal, G.R and Anand S.K. (1984); Instrumental Methods Of Chemical Analysis. Himalaya Publishing House.

DSC-10 QUESTIONED DOCUMENTS AND MULTIMEDIA FORENSICS

Paper	Total Credit	Lecture	Practical/ Practice	Pre-requisite of the course
Questioned Documents and Multimedia Forensics	**04**	**03**	**01**	Basic Knowledge of Forensic Science

Course Outcomes:

After studying this course, the student will learn to

1. Identify the questioned document at the crime scene.
2. Examine the questioned document using different basic tools.
3. Compare various handwriting and signature samples.
4. Detect frauds and forgeries by analyzing questioned documents.

Learning Objectives:

1. To explain the nature and scope of questioned documents, including types, characteristics, and the principles of handwriting analysis.
2. To identify various types of document forgeries and alterations and assess their impact.
3. To evaluate handwriting and signature development, document features to determine authenticity.
4. To synthesize findings from document and handwriting analyses to produce comprehensive forensic reports

Unit 1: **Introduction to Questioned Documents (12 Hours)**

Nature and Scope of Questioned Documents, definition of questioned documents. Types of Document / Classification of documents, Handling and packing of documents, Procurements of standards- admitted / specimen writings. Preliminary examination of documents. Sections related to Questioned Document Examinations.

Unit 2: **Handwriting and Signature Examination (11 Hours)**

Principles of hand writing & signature identification. Class and Individual Characteristics of Handwriting. Disguise writings, Natural Variations. Basic tools needed for forensic documents' examination ultraviolet, visible, infrared and fluorescence spectroscopy, photography of questioned documents, visible spectral comparator, electrostatic detection apparatus.

Unit 3: **Document Forgery and Security Documents (11 Hours)**

Forgeries & its types and their detections, Examination of alterations, erasers, overwriting, addition and obliterations, Examination of counterfeit currency notes, passport, credit card, visa, seal and other mechanical impressions. Use of digital technology in the perpetration of white-collar crimes and their detection, digitally manipulated and machine generated documents- their nature, examination and reporting as well as evidence impact.

Unit 4: **Multimedia Forensics and Advanced Document Examination (11 Hours)**

Determination of sequence of strokes, age of document, Physical matching of Documents Printing Devices- impact and non- impact printing, Examination of modern printing techniques, Decipherment of secret & indented writings, ESDA and Examination of charred documents, Examination of typescripts, Xerox- Analog and Digital, computer printouts

Practical's (30 Hours)

1. Identification of Handwriting-general characteristics, natural variations, fundamental divergences and individual characteristics
2. To detect Simulated and traced forgeries
3. Examination of additions, erasures, and obliterations in the documents.
4. Examination of writing inks by TLC/ Paper chromatography.
5. To examine the security features of currency notes, passport, cheques etc.
6. To decipher secret writing.

Assessment Method: As per University Guidelines

Suggested Readings:

1. Albert S. Osborn; Questioned Documents, Second Ed.; Universal Law Publishing, Delhi
2. O. Hilton, *Scientific Examination of Questioned Documents*, CRC Press, Boca RatonCrime in India Reports (Annual) by the National Crime Records Bureau (NCRB)
3. R.N. Morris, Forensic Handwriting Identification: Fundamental Concepts and Principles, Academic Press, London.
4. E. David, The Scientific Examination of Documents–Methods and Techniques, 2nd Edition, Taylor & Francis, Hants.
5. Wilson R. Harrison; Suspect Documents -Their Scientific Examination; Universal Law Publishing, Delhi- please see publisher
6. Heidi H Harralson: Huber and Headrick's Handwriting Identification

DSE-11 FORENSIC TOXICOLOGY AND PHARMACOLOGY

Paper	Total Credit	Lecture	Practical/ Practice	Pre-requisite of the course
Forensic Toxicology and Pharmacology	**04**	**03**	**01**	Basic understanding of chemistry.

Course Outcomes:

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

1. Understand the principles of toxicology, pharmacology, and xenobiotic metabolism relevant to forensic science.
2. Explain the mechanisms of toxicity, drug action, and toxicological analysis of biological samples.
3. Apply analytical techniques for the detection and identification of drugs, poisons, and toxic substances.
4. Evaluate toxicological findings in medico-legal investigations and interpret laboratory reports.

Learning Objectives:

After completion of this course, students will be having

1. Basic principles of toxicology and pharmacology.
2. To help students learn about xenobiotics and toxic effects.
3. Understand the concepts of mechanism of toxicity.
4. To study and understand the action of various drugs.

Unit I: Concepts of Toxicology (12 Hours)

Toxicants and Types of Toxicants, Sources of poisoning Laws and Regulations in toxicological testing, Regulatory bodies national and International, Risk and Hazard characterization Factors affecting toxicity toxicokinetic and toxicodynamic processes, detoxification of xenobiotics, biotransformation of xenobiotics, bioaccumulation of xenobiotics, antidotal therapy.

Unit II: Post-mortem Toxicology (11 Hours)

Toxic effects of heavy metals, mechanism of heavy metal toxicity, Toxic effects of Alcohol and solvents, mechanism of poisonous liquor, Toxic effects of plant poisons, Toxic effects of insects and animal poison Methods of poison detection, chemical tests, Instrumental methods for toxicological examination, Toxicological analysis of decomposed material and body remains, challenges in forensic toxicological examination, Report Writing.

Unit III: Basic Principles of Forensic Pharmacy
(11 Hours)

Introduction to Pharmacology and Forensic Pharmacy, Schedules of Drug, classification of drugs new drug Development, Route of administration of Drugs, Factor affecting the effects of Drug, Adverse drug reactions, Drug Dependence, Rational use of Medicines. Pharmacokinetics: L-ADME, Bioavailability, Bioequivalence, Drug Receptor concept, types of receptors and mechanism of action, Pharmacokinetic drug interactions, various biological barriers, drug hypersensitivity.

Unit IV: Concepts of Pharmacology (11 Hours)

Role of Catecholamines: Serotonin, Dopamine, Norepinephrine & Epinephrine, General Anaesthetics, Sedatives, Hypnotics, antihypertensive drugs, NSAIDs, Antidepressant, CNS-Stimulants, Antipsychotics, Antiepileptics, Chemo therapeutic drugs, Anti-Biotics, Anti-Fungal, Performance Enhancement Hormone & Drugs. Methods of extraction, Colorimetric Analysis, Instrumental techniques, Immuno-assay techniques of Various drugs. Standards of Quality control & Quality assurance in the pharmaceutical analysis, National & International Notable Case Studies.

Practical's (30 Hours)

1. Plotting of calibration curve and quantification using UV-Vis Spectroscopy
2. Concept & Parts identification of GC, GCMS, HPLC
3. Identification of common plant poisons Oleander, Dhatura, Calotropis and Ricin etc. by various analytical methods
4. Extraction of heavy metals by conventional methods and analysis by color tests.
5. Identification of non-volatile poisons by UV and TLC
6. Extraction and identification of pesticides from biological matrices by TLC and GC-MS

Assessment Method: As per university guidelines

Suggested Readings

1. Curry: Analytical Methods in Human Toxicology, Part II, 1986.
2. Gupta, P.K. Fundamentals of Toxicology: Essential Concepts and Applications. India, Elsevier Science, 2016.
3. Holfmann, F.G.: Handbook of Drug and Alcohol Abuse.
4. Samford: Poisons Their Isolation Identification
5. Mule, S. J. et al.: Immunoassays for Drugs subjects to ab, CRC Press, 1974
6. Connors, K.: A text book of pharmaceuticals analysis, Interscince, New York, 1975
7. Klaassen, C. D.: Casarett and Doull's Toxicology: The Basic Science of Poisons, 5th ed,McGraw-Hill, 1995.
8. Moffat, A.C.: Osselton, D. M. Widdop, B.: Clarke's Analysis of Drugs and Poisons in Pharmaceuticals, body fluids and postmortem material, 3rd ed., PharmaceuticalPress2004.

DSE-12 FORENSIC ACCOUNTING

Paper	Total Credit	Lecture	Practical/ Practice	Pre-requisite of the course
Forensic Accounting	**04**	**04**	**00**	Basic Knowledge of Forensic Science

Course Outcomes

1. To understand the fundamental concepts and develop proficiency
2. To learn investigative techniques in the area of forensic accounting.
3. To explore specialized areas within the field of forensic accounting.

Learning Objectives

After completion of this course, the learners will be able to:

1. Explain the fundamental concepts of forensic accounting.
2. Develop expertise in investigative techniques used in forensic accounting.
3. Understand money laundering, bankruptcy investigations, and litigation support for addressing complex financial issues.
4. Apply theoretical knowledge and practical skills to analyze reports and communicate findings effectively.

Unit I: Forensic Accounting & Fraud Auditing Fundamentals (15 Hours)

Meaning, nature and scope of Forensic Accounting, Auditors liability for undetected frauds, Fraud auditing (forensic audit) phases: Recognition and planning, Understanding Fraud and Types of Financial Crimes. Evidence collection and evaluation, Communication of results. Fraud Detection and Prevention Strategies.

Unit II: Fraud Definition & Taxonomy (15 Hours)

Ingredients of fraud, why is a fraud committed and who commits a fraud? Meaning and nature of corporate fraud, concept of fraud under Companies Act 2013, frauds for and against a company, victims of fraud. Money Laundering and Terrorism Financing. Bankruptcy and Insolvency Investigations.

Unit III: Fundamentals of Penetration Testing (15 Hours)

Types of Corporate Frauds: Bribery and corruption, Misappropriation of assets, Manipulation of financial statements, Procedure-related frauds, corporate espionage, Fraud in e-commerce. Fraud Prevention- Strategies, Fraud prevention for consumers and businesses. Insurance Claims and Fraudulent Activities. Litigation Support and Expert Witness Testimony. Practical Applications -

Application of Investigative Techniques. Analysis of Financial Statements and Fraudulent Transactions.

Unit IV: Auditing (15 Hours)

Auditing Concept, Type, Principles, Internal Control- Internal Check and Internal Audit, Vouching and Verification of Assets and Liabilities. Dividend and Divisible Profits, Company Auditor: Qualifications and disqualifications, Appointment, Removal, Remuneration, Rights, Duties and Liabilities, Audit Committee, Auditor's Report: Contents and Types, Auditor's Certificates**.**

Assessment Method- Internal assessment, end-term theory examination.

Suggested Readings

1. Baldava, S., & Agarwal, D. (2021). Forensic Investigations and Fraud Reporting in India: Practical insights to Predict, Prevent, Detect and Investigate Frauds. Bloomsbury India.
2. Bansal, A. (2017). Forensic Accounting & Audit Anticipation in India. LAP Lambert Academic Publishing.
3. Devarajappa S., Gurudath A.S., Yadav R.A. (2015). Forensic Accounting and Auditing. Himalaya Publishing House Pvt. Ltd.
4. Devi, D. S. (2023). Basics of Forensic Accounting. Iterative International Publishers IIP. Joshi, A. (2012).
5. Kaur, K. (2019). Forensic Accounting and Auditing. Kanwaljeet Khorana.
6. Khan, A. (2024). Forensic Accounting, Fraud Investigation and Fraud Analytics.

DSE-13 FORENSIC ANALYTICAL CHEMISTRY

Paper	Total Credit	Lecture	Practical/ Practice	Pre-requisite of the course
Forensic Analytical Chemistry	**04**	**03**	**01**	Understanding of basic chemistry.

Course Outcomes

1. This course aims to provide comprehensive knowledge of forensic drug chemistry, petro forensics, fire chemistry, and explosives chemistry.
2. Students will learn to analyses narcotics, explosives, and petroleum products using various forensic techniques and instruments.
3. They will develop expertise in presumptive, screening, and confirmatory methods, as well as the interpretation of forensic data and report writing.
4. Additionally, students will gain an understanding of chemical warfare agents and their detection methods.

Learning Objectives

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

1. Analyze and identify various narcotic drugs and controlled substances
2. Apply presumptive and confirmatory methods,including chromatographic and spectroscopic techniques.
3. Conduct forensic analysis of petroleum products and investigate fire-related incidents.
4. Evaluate the properties and mechanisms of explosives and chemical warfare agents.

Unit I: Advanced Forensic Drug Chemistry (12 Hours)

Drug Trafficking, Forensic examination of drugs/Narcotics - Cannabis, Phenethylamines (Amphetamine, Methamphetamine), Hydroxyl derivative (Ephedrine), Ketone Derivative (Cathinone), Methoxy Derivative (Mescaline), Tertiary Amines (Cocaine and Opiates), Tryptamines (Psilocin and Psilocybin), Anabolic Steroids, Miscellaneous Controlled Substances (Barbiturates, Benzodiazepines, GHB, Ketamine and LSD).

Unit II: Detection Methods for the Narcotic Drugs (11 Hours)

Colour/spot test, microscopic examination, Microcrystalline tests, Thin-Layer Chromatography, Sample Preparation before TLC Specimen, Extraction Evaluation of TLC for Drug Screening, Immunoassay Methods other instrumental techniques (HPLC, GC, GC-MS) involved in analysis.

Determination of origin of narcotic drug by IRMS, Elemental Profiling by ICP-MS-MS Format of NDPS Report Writing & Courtroom Testimony. Case studies.

Unit III: Petro and Fire Forensics (11 Hours)

Petro Forensics: Distillation and fractionation of petroleum. Commercial uses of different petroleum fractions. Physical Properties of Petroleum Products Analytical Techniques: Quantitative and Qualitative Steps in Analysis of Petroleum, Analysis of traces of petroleum products in forensic exhibits. Case studies. Fire Chemistry: Scientific Investigation of Fire, NFPA 921 and NFPA 1033, Separation and analytical techniques of ignitable liquid residues, Interpretation of Data Obtained from Fire Debris, Quality Assurance in Fire Debris Analysis, Report Writing and Court Testimony. Case studies.

Unit IV: Explosives Chemistry (11 Hours)

Introduction and assessment of explosives, Oxygen balance, Explosive Power Index, Heat and Temperature of Explosion, Pressure of explosion, Mechanism of Ignition and hot spot formation. Thermal decomposition, physical and chemical aspects of combustion, Deflagration and Detonation, Analysis of low and high explosives by different instrumental techniques, Quality control, Proficiency Testing, Interpretation and Significance of Results. Case studies Chemical Warfare Agents: Classification, physical and biochemical properties, toxic effects detection by Biosensors and various instrumental techniques.

Practical's (30 Hours)

1. Separation of Psychotropic substance by TLC.
2. Separation of Cannabis TLC, UV, FTIR
3. Analysis of NDPS drugs and explosives by instrumental techniques
4. Analysis of high explosives by TLC, UV, FTIR
5. Qualitative Analysis of fire residues by GC-HS and GC-MS.

Assessment Method- As per University guidelines

Suggested Readings

1. Clarke's Analysis of Drugs and Poisons, (Formerly Isolation & Identification of Drugs) 3rd Ed. Vol. Set.
2. Clark, E.G.C.: Isolation and identification of Drugs, VI and Vol. II, 1966, 1975-1986.
3. Modi, Text Book of Medical Jurisprudence Forensic Medicines and Toxicology (1999) CBS Pub. New Delhi.
4. Saferstien (1982) Forensic Science, Handbook, Vol. I, II & III, Prentice Hall Inc. USA.
5. DFS -Working Procedure Manual- Narcotics.

DSE-14 CRYPTOGRAPHY & STEGANOGRAPHY

Paper	Total Credit	Lecture	Practical/ Practice	Pre-requisite of the course
Cryptography & Steganography	**04**	**03**	**01**	Basic understanding of encryption, decryption and digital forensic.

Course Outcomes:

1. To understand basics of cryptography and steganography
2. To learn how data is secured and hidden
3. To develop skills to detect encrypted and concealed information

Learning Objectives:

Students will be able to:

1. Explain basic encryption techniques
2. Understand how hidden data works
3. Identify and analyze digital evidence in simple cases

Unit I: Fundamentals of Cryptography (12 Hours)

Introduction, history, and importance of cryptography. Security goals: Confidentiality, Integrity, Authentication, Non-repudiation. Types: of Cryptography. Classical ciphers: Caesar, Vigenère, Playfair. Role of cryptography in digital forensics and cybercrime.

Unit II: Modern Cryptographic Techniques & Applications (11 Hours)

Basic ideas of Block and stream ciphers. Data Encryption Standard (DES) and Advanced Encryption Standard (AES). RSA algorithm (basic concept). Hash functions: MD5, SHA family. Digital signatures and certificates. Cryptographic protocols and secure communication.

Unit III: Cryptanalysis and Forensic Investigation (11 Hours)

Introduction to cryptanalysis. Attack methods: brute force, frequency analysis, known-plaintext attack. Password cracking and recovery techniques. Encryption in cybercrime (dark web, ransomware). Legal and ethical considerations.

Unit IV: Steganography (11 Hours)

Introduction and principles of steganography. Steganography vs cryptography. Types of Steganography: text, image, audio, video steganography. Techniques of Steganography LSB, masking, filtering, transform domain methods. Steganalysis, Tools and forensic approaches for hidden data extraction.

Practical's (30 Hours)

1. To perform AES/RSA encryption-decryption exercises.
2. Data hiding in images/audio using steganography tools.
3. Introduction to forensic tools (Autopsy, FTK basics)
4. Hashing and password cracking.

Assessment Method: As per university guidelines

Suggested Readings

1. W.Stallings - Cryptography and Network Security 6th Edition
2. Steganography: Seeing the Unseen by by Neil F. Johnson, Zoran Duric, and Sushil Jajodia
3. ***Handbook of Applied Cryptography*** by Alfred J. Menezes, Paul C. van Oorschot, and Scott A. Vanstone.
4. *Cryptography and Network Security* is a textbook by Behrouz A.

DSE-15 RESEARCH METHODOLOGY

Paper	Total Credit	Lecture	Practical/ Practice	Pre-requisite of the course
Research Methodology	**04**	**03**	**01**	Basic understanding of forensic science

Course Outcomes:

1. Understand advanced concepts and theoretical foundations of anthropological research
2. Integrate qualitative, quantitative, and holistic research methodologies
3. Develop competence in the tools and techniques used for the data collection in the field.
4. To develop competence in the advanced laboratory research techniques
5. To Apply the ethical principles in data collection and analysis.

Learning Objectives:

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

1. Explain advanced concepts and theories of anthropological research
2. Apply qualitative, quantitative, and holistic research methodologies
3. Demonstrate proficiency in advanced field data collection techniques
4. Perform advanced laboratory research techniques
5. Apply ethical principles in anthropological research

Theory

Unit 1: Foundations of Forensic Research (12 Hours)

Nature and scope of forensic research; Scientific method and evidence-based forensic science; Interdisciplinary nature of forensic investigations; Research problem identification, formulation of research questions, objectives and hypotheses; Philosophical foundations of forensic research—Positivism, Empiricism, Objectivity and Scientific Reasoning; Reliability, validity and reproducibility in forensic research; Ethics, integrity and quality assurance in forensic investigations.

Unit 2: Research Design and Methodological Approaches (12 Hours)

Research design and its types—exploratory, descriptive, analytical, experimental, cross-sectional longitudinal and case-control studies; Qualitative, quantitative and mixed-method research approaches; Sampling strategies and sample size considerations in forensic research; Experimental design and validation studies; Statistical methods for forensic research; AI, machine learning and digital technologies in forensic science research.

Unit 3: Crime Scene Research and Data Collection Techniques (10 Hours)

Advanced crime scene documentation; Photography, videography, 3D documentation and digita imaging; Development of data collection tools including observation schedules, questionnaires and interview protocols; Chain of custody and evidence documentation; Laboratory notebook maintenance; Case studies, report writing and interpretation of forensic findings; Literature review and scientific

databases.

Unit 4: Advanced Laboratory and Analytical Techniques (11 Hours)

Selection and validation of analytical methods; Instrumental techniques in forensic science; Biological, chemical and physical evidence examination; Molecular techniques, forensic DNA analysis and biomarkers; Spectroscopic and chromatographic applications; AI and machine learning in forensic data analysis; Quality assurance, quality control and accreditation (ISO/IEC 17025); Ethical and legal issues in forensic research.

Practical (30 Hours)

1. Formulation of a forensic research problem, objectives and hypotheses.
2. Preparation of a research proposal and experimental design.
3. Literature search using scientific databases and reference management software (Mendeley/Zotero).
4. Preparation of questionnaires, observation schedules and interview formats for forensic research.
5. Crime scene documentation using photography, sketching and digital recording.
6. Sampling strategies for biological, chemical and physical evidence.
7. Data coding, tabulation and descriptive statistical analysis using MS Excel/SPSS/R.
8. Interpretation of analytical data generated from forensic laboratory reports.
9. Preparation of scientific graphs, tables and data visualization.
10. Plagiarism checking and scientific referencing using APA/Vancouver style.
11. Preparation of scientific posters and oral presentations.
12. Writing a forensic research report/manuscript following standard scientific format.
13. Critical appraisal of published forensic research articles.
14. Seminar presentation and viva voce on a selected forensic research topic.

Assessment Method- As per University Guidelines

Suggested Readings

1. Houck, M.M., & Siegel, J.A. (2024). Fundamentals of Forensic Science (5th ed.). Academic Press.
2. Saferstein, R. (2023). Criminalistics: An Introduction to Forensic Science (13th ed.). Pearson.
3. Robertson, B., & Vignaux, G.A. (2016). Interpreting Evidence: Evaluating Forensic Science in the Courtroom (2nd ed.). Wiley.
4. Curran, J.M., Buckleton, J.S., & Gill, P. (2020). Forensic Interpretation of Glass Evidence. CRC Press.
5. Creswell, J.W., & Creswell, J.D. (2023). Research Design: Qualitative, Quantitative and Mixed Methods Approaches (7th ed.). Sage.
6. Kumar, R. (2020). Research Methodology: A Step-by-Step Guide for Beginners (5th ed.). Sage.
7. ISO/IEC 17025:2017. General Requirements for the Competence of Testing and Calibration Laboratories.
8. Sharma, B.R. (Latest Edition). Forensic Science in Criminal Investigation and Trials. Universal Law Publishing.

DSE-16 FORENSIC NARCOTICS ANALYSIS

Paper	Total Credit	Lecture	Practical/ Practice	Pre-requisite of the course
Forensic Narcotics Analysis	**04**	**03**	**01**	Understanding of basic chemistry

Course Outcomes:

1. Build comprehensive understanding of drugs as well as the chemistry and addiction processes involved.
2. Familiarize with the classification, effects, and legal aspects of drugs of abuse, NDPS Act and its implications.
3. Develop knowledge and skills in the chemistry and analysis of drugs of abuse, and various analytical techniques used for identification and confirmation.
4. Examine the concept of designer drugs and their chemical properties

Learning Objectives:

1. Upon successful completion of this course, students will be able to:
2. Identify the drugs and concepts of drug abuse.
3. Classify drugs of abuse based on their form, origin, and schedules, and explain their effects and legal implications.
4. Develop proficiency in the analysis of drugs of abuse, and the use of various analytical techniques.

Unit I: Drug (12 Hours)

Pharmacology of Drug, Drug Use and Misuse, Drug addiction and its problems, Drug Chemistry, Drug Dependence and Chemistry of Addiction, Drug Receptors and Brain Chemistry. Drugs as Evidence, Profiling Examples of Illegal Drugs, United Nations International Drug Control. Programme.

Unit II: Narcotic Drugs and Psychotropic Substances
(11 Hours)

Scope and significance of NDPS drugs in forensic science, NDPS Act, Classification and characterization of NDPS drugs, Drug Law Enforcement, Search & Seizure, sampling procedure, forwarding of sample to FSL, Sample preparation for analysis, Preliminary analysis of drugs, reporting of drug cases, Format of NDPS Report Writing & Court Room Testimony, Legal Implications and Data Interpretation.

Unit III: Designer drugs (11 Hours)

Definition, Analogs of Fentanyl and Meperidine (both synthetic opioids), Phencyclidine (PCP), Amphetamines and methamphetamines (which have hallucinogenic and stimulant properties). Opium and Opioids analgesics, Stimulants (Cocaine, Amphetamine & other amphetamine derivatives), Depressants (Barbiturates and Benzodiazepines), Hallucinogens (Cannabis, LSD, Psilocybine and Mescaline), OTC, Inhalant and Volatile Substances, Drugs in sexual assault.

Unit IV: Drug Abuse in Sports (11 Hours)

Drugs of Abuse: Definition, Classification based on Form and Origin, Use, Effects, Introduction, International Olympic Committee (IOC), World Anti-Doping Agency (WADA), NADA, classification of commonly prohibited substances and Performance enhancing Drugs, Steroids, Stack and Pyramid methods, Dope test and Blood Doping, Sampling techniques, analytical approaches.

Practical's (30 Hours)

1. Identification of narcotic drugs: opium and alkaloids, morphine and heroin, cannabis by TLC/ HPLC
2. Analysis of Ganja and charas by color test, TLC/HPTLC
3. Determination of barbiturate by UV -visible Spectrophotometric method.
4. Identification of unknown seized NDPS Drug by chemical methods and Instrumental techniques.
5. Extraction of drugs from hair samples.
6. To demonstrate extraction of drugs from hair samples.

Assessment Method- As per University Guidelines

Suggested Readings

1. Clarke's Analysis of Drugs and Poisons, (Formerly Isolation & Identification of Drugs) 3rd Ed. 2 Vol. Set.
2. Clark, E.G.C.: Isolation and identification of Drugs, VI and Vol. II, 1966, 1975-1986.
3. Modi, TextBook of Medical Jurisprudence Forensic Medicines and Toxicology (1999) CBS Pub. New Delhi

4. Saferstein (1982) Forensic Science, Handbook, Vol. I, II & III, Prentice Hall Inc. USA.
5. E. Stahl (1969) Thin Layer Chromatography: A Laboratory Handbook.
6. Niesink, RJM; “Toxicology- Principles and Applications”, CRC Press, 1996.
7. Chadha, PV; “Handbook of Forensic Medicine & Toxicology”, Jaypee Brothers, New Delhi, 2004.
8. Modi, JP; “Textbook of Medical Jurisprudence & Toxicology”, N.M. Tripathi Pub, 2001.

DSE-17 BIOMETRIC SYSTEMS OF IDENTIFICATION

Paper	Total Credit	Lecture	Practical/ Practice	Pre-requisite of the course
Biometric systems of Identification	**04**	**03**	**01**	General knowledge of forensic science.

Course Outcomes:

1. Identify the various biometric technologies.
2. Understand biometric technologies applicable in various organizations.
3. Evaluate various Image processing methods.
4. Apply the concept of IRIS and Sensor technologies

Learning Objectives:

1. To understand the basics of Biometrics and its functionalities
2. To learn the role of biometrics in the organization.
3. To learn various image processing techniques.
4. To understand the concept of IRIS and sensors

Unit I: Introduction (12 Hours)

Biometric fundamentals, Biometric technologies, Biometrics Vs traditional techniques, Characteristics of a good biometric system, Benefits of biometrics.
Key biometric processes: verification, identification and biometric matching. Performance measures in biometric systems, Applications of Biometric Systems, Security and Privacy Issues. Fundamentals of Image Processing: Digital Image representation - Fundamental steps in Image Processing Image Enhancement.

Unit II: Physiological Biometrics (11 Hours)

Physiological Biometrics: Leading technologies, finger scan, Facial-scan, Iris-scan, voice scan, components, working principles, competing technologies, strengths and weaknesses, Hand-scan, retina scan, components, working principles, competing technologies, strengths and weaknesses, Fingerprint Patterns, Fingerprint Features, Fingerprint Image, width between two ridges - Fingerprint Image Processing Automated fingerprint identification systems.

Unit III: Iris Biometrics (11 Hours)

Iris System Architecture, Definitions and Notations - Iris Recognition: Iris location, Doubly Dimensionless Projection, Iris code, Comparison - Coordinate System: Head Tilting Problem, Basic Eye Model, Texture Energy Feature.

Unit IV: Behavioral Biometrics (11 Hours)

Behavioral Biometrics: Leading technologies: Signature-scan, Keystroke scan: components, working principles, strengths and weaknesses. Privacy and Standards in Biometrics: Assessing the Privacy Risks of Biometrics Designing Privacy- Sympathetic Biometric Systems, Need for standards different biometric standards.

Practical's (30 Hours)

1. To study the different parameter of gait pattern.
2. To identify the thumb print or finger print by using biometry.
3. To compare the given data sample of thumb print.
4. To determine different type of iris pattern.
5. To find out the key strokes variation in the given samples.
6. To study the heart rate of a normal person and Stressed person.

Assessment Method- As per University Guidelines

Suggested Readings

1. Ames Wayman, Anilk Jain, Arun A.Ross , Karthik Nandakumar, —Introduction to Biometrics‖
2. John Vacca "Biometrics Technologies and Verification Systems" Elsevier 2007
3. James Wayman,Anil Jain, David MAltoni, DasioMaio(Eds) "Biometrics Systems Technology", Design and Performance Evalution. Springer 2005
4. Khalid Saeed with Marcin Adamski, Tapalina Bhattasali, Mohammed K. Nammous, Piotrpanasiuk, mariusz Rybnik and soharabh Sgaikh, —New Directions in Behavioral Biometrics‖, CRC Press 2017
5. Paul Reid "Biometrics for Network Security "Person Education 2004

GE-5 FUNDAMENTALS OF NANOTECHNOLOGY

Paper	Total Credit	Lecture	Practical/ Practice	Pre-requisite of the course
Fundamentals of Nanotechnology	**04**	**03**	**01**	**Basic knowledge of science and chemistry.**

Course Outcomes:

1. Explain fundamentals of nanoscience and nanotechnology
2. Understand synthesis and properties of nanomaterials
3. Identify tools used for nanomaterial characterization
4. Apply nanotechnology in forensic investigations

Learning Objectives:

1. To introduce basic concepts of nanotechnology
2. To understand synthesis and properties of nanomaterials
3. To explore characterization techniques
4. To study applications of nanotechnology in forensic science

Unit I: Introduction to nanotechnology (12 Hours)

Definition and history of nanotechnology, Nanoscale and its importance, Classification of nanomaterials (0D, 1D, 2D, 3D), Unique properties of nanoparticles: optical, electrical, mechanical, chemical. Surface area to volume ratio and quantum effects. Applications of nanotechnology in general science.

Unit II: Synthesis of Nanomaterials (11 Hours)

Top-down and bottom-up approaches of Nanoparticle synthesis. Synthesis of nanoparticles by Physical methods (ball milling, lithography), Chemical methods (sol-gel, precipitation, chemical vapor deposition), Biological or green synthesis (plant extracts, microbes). Factors affecting nanoparticle synthesis. Safety and toxicity of nanomaterials.

Unit III: Characterization Techniques (11 Hours)

Introduction and importance of characterization Microscopy techniques: Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM), Atomic Force Microscope (AFM). Spectroscopy techniques: UV–Visible Spectroscopy, X-ray Diffraction (XRD), Fourier Transform Infrared Spectroscopy (FTIR). Particle size and surface analysis.

Unit IV: Forensic Applications of Nanotechnology
(11 Hours)

Role of Nanotechnology in crime detection, Fingerprint detection using nanoparticles, Drug and explosive detection, DNA analysis and biosensors, Nanotechnology in toxicology, Future trends and challenges in forensic nanotechnology.

Practical's ((30 Hours)

1. Preparation of simple nanoparticles by biological matrix
2. Study of nanoparticle properties using basic techniques
3. Case studies on forensic applications
4. Visualisation of different types of nanoparticles in microscopy/spectroscopy tools.

Assessment Method- As per university guidelines

Suggested Readings

1. Introduction to Nanotechnology by *Charles P. Poole Jr.* and *Frank J. Owens*. Publisher John Wiley & Sons in 2003.
2. *Nanotechnology: Principles and Practices* is a textbook authored by S. K. Kulkarni
3. *Nanotechnology: A Gentle Introduction to the Next Big Idea*, 2002 by physicist Mark A. Ratner and engineer Daniel Ratner.
4. *Forensic Science: An Introduction to Scientific and Investigative Techniques* a comprehensive textbook edited by Stuart H. James.

GE-6 FORENSIC MEDICINE

Paper	Total Credit	Lecture	Practical/ Practice	Pre-requisite of the course
Forensic Medicine	**04**	**03**	**01**	Basic knowledge of forensic science

Course Outcomes:

1. Identify, examine and prepare report or certificate in medico-legal cases/situations in accordance with the law of land.
2. Examination of the death body on hanging, and suicide case.
3. Emerging trend for the investigation of death body for justice.
4. To identify the manner of death.

Learning Objectives:

After studying this paper, the students will know

1. The duties of the first responding officer who receives a call on homicide or suicide case.
2. The steps involved in processing the death scene.
3. The importance of ascertaining whether the crime was staged to appear as suicide or accident.
4. The importance of bloodstain patterns in reconstructing the crime scene.

Unit I: Forensic Medicine/Medico legal investigation (12 Hours)

Medical jurisprudence, Objectives of medico legal investigation, Death and its causes, types of death, Signs of death. Post mortem changes: classification, manner of death, Estimation of time since death, Post mortem biochemistry of the body fluids, Modern techniques used for the estimation of time since deaths, exhumation,

Unit II: Death and its Investigation (11 Hours)

Forensic Entomology: Identification of specific insects and their developmental stages (life cycles), Medico legal importance, Crimes against women Introduction to sexual offences, Natural and unnatural sexual offences, Abortion & Infanticide & SIDS, Deaths from starvation. Classification of asphyxia deaths: Hanging, Strangulation, evidence collection and analysis,

establishing manner of deaths, Suffocation, Drowning and traumatic asphyxia, medico legal importance of diatoms, medico legal importance.

Unit III: Medicolegal Aspects of Injuries (11 Hours)

Mechanical Injuries: Abrasions, Bruises, Lacerations, Incised wounds, Stab wounds, Firearm injuries, Defence injuries, fabricated injuries, vital clues for establishing the manner of deaths due to various injuries, Traffic accident injuries, Thermal injuries, Deaths due to electrocution - lightning, Electricity, Deaths due to explosions, Deaths due to Chemical trauma, Artificial Injuries.

Unit IV: Death Investigation (11 Hours)

Process of investigation and approach of investigator at the scene of death. Dying declaration. Dying deposition. Identifying of possible suspects and their interview. Interview of possible suspects, witnesses, and onlookers. Suspect in custody – initial interrogation and searching for evidence.

Practical's (30 Hours)

1. Test to differentiate between methanol and ethanol.
2. Extraction of poison by different techniques
3. Postmortem examination in various Asphyxial deaths.
4. Postmortem examination of various homicidal/ accidental injuries.
5. Microscopic Examination of Diatoms.
6. To Study the cases of drowning
7. To study the Cases of hanging

Assessment Method- As per University Guidelines

Suggested Readings

1. Sharma, B.R.; "Forensic Science in Criminal Investigation & Trials", Universal Publishing Co., New Delhi,
2. Chadha, PV; "Handbook of Forensic Medicine & Toxicology", Jaypee Brothers, New Delhi,
3. O"Hara CE and Osterburg, JW; "An Introduction to Criminalistics", Indiana Univ. Press, London,
4. J. Dix, Handbook for Death Scene Investigations, CRC Press, Boca Raton.
5. H.B. Baldwin and C.P. May in, Encyclopedia in Forensic Science Volume 1, J.A. Siegel, P.J. Saukko and G.C. Knupfer (Eds.), Academic Press, London.
6. V.J. Geberth, Practical Homicide Investigation, CRC Press, Boca Raton.

Skill Based/Workshop/Specialized Laboratory/Hands on Learning

SEC-4 DIGITAL EVIDENCE ANALYSIS WITH LABORATORY TRAINING

Paper	Total Credit	Theory	Practical/ Practice	Pre-requisite of the course
Digital Evidence Analysis with Laboratory training	**02**	**01**	**01**	Basic knowledge of computers

Course Outcomes

After completion of this course, the learners will be able to:

1. To understand the principles, legal requirements, and best practices for handling digital evidence.
2. To develop practical skills in the acquisition, preservation, examination, and documentation of digital evidence using forensic tools.
3. To acquire competency in the interpretation and reporting of digital forensic findings.
4. To familiarize students with emerging trends and technologies in digital forensic investigations.

Learning Objectives

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

1. Demonstrate safe laboratory practices and follow standard operating procedures during digital evidence examination.
2. Acquire, preserve, document, and examine digital evidence using appropriate forensic software and tools.
3. Interpret and report digital forensic findings while maintaining the integrity and admissibility of evidence.
4. Evaluate the applications, limitations, and recent developments in digital forensic technologies.

Theory

Unit I: Fundamentals of Digital Evidence Management (8 Hours)

Nature and characteristics of digital evidence; Types and sources of digital evidence; Digital evidence lifecycle; Identification, collection, packaging, preservation, acquisition, and documentation of digital evidence; Chain of custody; Standard Operating Procedures (SOPs); Good Laboratory Practices (GLP); Legal and ethical considerations; Overview of national and international guidelines for digital evidence handling.

Unit II: Digital Forensic Reporting and Emerging Technologies (7 Hours)

Digital forensic workflow; Documentation and report writing; Interpretation and presentation of digital evidence; Validation and verification of forensic tools; Quality assurance and quality control in digital forensic laboratories; Challenges in cloud computing, mobile devices, Internet of Things (IoT), and social media investigations; Artificial Intelligence and automation in digital forensics; Recent trends and future directions in digital evidence analysis.

Practical 30 hours

1. Laboratory safety, ethics, and standard operating procedures in digital forensics.
2. Identification, collection, packaging, preservation, and documentation of digital evidence.
3. Acquisition of forensic images using FTK Imager.
4. Recovery of deleted files using forensic software.
5. Email header analysis and email artefact examination.
6. Keyword searching and indexing using forensic tools.
7. Introduction to cloud evidence acquisition.
8. Basic packet capture using Wireshark.
9. Steganography detection using forensic tools.
10. Password recovery techniques (Demonstration).
11. Hash database creation and duplicate file identification.

Laboratory Tools/Software

- FTK Imager
- Autopsy
- EnCase
- X-Ways Forensics
- Wireshark
- OSForensics
- Registry Viewer
- HashCalc/HashMyFiles
- ExifTool
- Bulk Extractor

Assessment Method- As per University Guidelines

Suggested Readings

1. Nelson, B., Phillips, A., and Steuart, C. Guide to Computer Forensics and Investigations. 6th Edition. Cengage Learning.

1. Sammons, J. The Basics of Digital Forensics: The Primer for Getting Started in Digital Forensics. 3rd Edition. Syngress/Elsevier.
2. Bureau of Police Research and Development (BPR&D). Manual on Cyber Crime Investigation.
3. Directorate of Forensic Science Services (DFSS), Government of India. Standard Operating Procedures for Digital Evidence Examination.
4. ISO/IEC 27037. Guidelines for Identification, Collection, Acquisition, and Preservation of Digital Evidence.

SEC-5 EVIDENCE HANDLING WITH LABORATORY TRAINING

Paper	Total Credit	Theory	Practical/ Practice	Pre-requisite of the course
Evidence Handling with Laboratory training	**02**	**01**	**01**	Basic knowledge of forensic science

Course Outcomes

After completion of this course, the learners will be able to:

1. To understand the principles and procedures involved in the handling, preservation, and management of forensic evidence.
2. To develop practical skills in the collection, packaging, labeling, transportation, and documentation of different types of forensic evidence.
3. To acquire competency in maintaining the integrity and continuity of evidence throughout the forensic process.
4. To familiarize students with legal, ethical, and quality assurance practices in evidence handling.

Learning Objectives

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

1. Demonstrate safe laboratory and crime scene practices while handling forensic evidence.
2. Collect, package, preserve, document, and transport different types of forensic evidence following standard protocols.
3. Maintain chain of custody and prepare appropriate documentation to ensure the integrity and admissibility of evidence.
4. Evaluate the importance of quality assurance, legal requirements, and ethical considerations in evidence handling.

Theory

Unit I: Principles of Evidence Handling and Management (8 Hours)

Introduction to forensic evidence and its significance; Classification of physical, biological, chemical, and digital evidence; Principles of evidence recognition, collection, packaging, labeling, sealing, preservation, storage, and transportation; Chain of custody and continuity of evidence; Standard Operating Procedures (SOPs); Good Laboratory Practices (GLP); Biosafety, laboratory safety, and use of Personal Protective Equipment (PPE); Prevention of contamination and cross-contamination.

Unit II: Documentation, Quality Assurance and Legal Considerations (7 Hours)

Crime scene documentation; Preparation of field notes, evidence inventory, sketches, photography, and videography; Evidence submission and forwarding procedures; Laboratory documentation and record management; Quality assurance and quality control in evidence handling; Accreditation standards and best practices; Legal admissibility of evidence; Ethical considerations; Common errors in evidence handling and their impact on forensic investigations; Case studies.

Practical

(30 Hours)

1. Laboratory safety, biosafety, and use of personal protective equipment (PPE).
2. Demonstration of crime scene security, protection, and documentation.
3. Preparation of crime scene sketches, field notes, and evidence inventory.
4. Photography and videography of simulated crime scenes.
5. Collection, packaging, labeling, and sealing of biological evidence (blood, saliva, semen, hair, and tissues).
6. Collection, packaging, and preservation of toxicological and narcotic samples.
7. Collection and packaging of latent fingerprint evidence.
8. Collection and preservation of footwear and tyre impression evidence.
9. Collection, packaging, and forwarding of questioned documents.
10. Identification and prevention of evidence contamination and cross-contamination.
11. Preparation of evidence labels, seals, and forwarding letters.
12. Case study presentation on evidence handling protocols and common errors.

Assessment Method- As per University Guidelines

Suggested Readings

1. Saferstein, R. Criminalistics: An Introduction to Forensic Science. 12th Edition. Pearson Education.
2. Houck, M.M., and Siegel, J.A. Fundamentals of Forensic Science. 4th Edition. Academic Press.
3. Bell, S. Forensic Science: An Introduction to Scientific and Investigative Techniques. 5th Edition. CRC Press.
4. James, S.H., Nordby, J.J., and Bell, S. Forensic Science: An Introduction to Scientific and Investigative Techniques. 5th Edition. CRC Press.
5. Fisher, B.A.J., and Fisher, D.R. Techniques of Crime Scene Investigation. 9th Edition. CRC Press.
6. Sharma, B.R. Forensic Science in Criminal Investigation and Trials. 5th Edition. Universal Law Publishing.

SEC-6 Big Data Analysis in Forensic Science

Paper	Total Credit	Theory	Practical/ Practice	Pre-requisite of the course
Big Data Analysis in Forensic Science	**02**	**01**	**01**	Basic knowledge of forensic science

Course Outcomes

After completion of this course, the learners will be able to:

1. To understand the concepts and applications of big data in forensic science.
2. To develop practical skills in the collection, organization, visualization, and analysis of forensic datasets.
3. To acquire competency in using data analysis tools for pattern recognition and forensic decision-making.
4. To familiarize students with ethical, legal, and security issues associated with forensic data analytics.

Learning Objectives

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

1. Explain the role and significance of big data analytics in forensic science.
2. Organize, visualize, and analyse forensic datasets using appropriate software tools.
3. Interpret analytical results to identify patterns and support forensic investigations.
4. Apply ethical principles and data security practices while handling forensic data.

Theory

Unit I: Fundamentals of Big Data in Forensic Science (8 Hours)

Introduction to big data and forensic data analytics; Characteristics of big data (Volume, Velocity, Variety, Veracity and Value); Sources of forensic data including crime records, digital evidence, DNA databases, biometric databases, CCTV, social media, and cybercrime data; Data acquisition, cleaning, preprocessing, storage, and management; Introduction to data visualization and forensic intelligence.

Unit II: Applications of Big Data Analytics in Forensic Science (7 Hours)

Descriptive and predictive analytics in forensic investigations; Pattern recognition and trend analysis; Crime mapping and hotspot analysis; Introduction to machine learning and artificial intelligence in forensic science; Data privacy, cybersecurity, ethical and legal issues in forensic data analysis; Emerging trends in forensic big data analytics.

Practical (30 Hours)

1. Introduction to laboratory safety, ethics, and data security in forensic data analysis.
2. Collection and organization of forensic datasets using spreadsheets.
3. Data cleaning, formatting, and preprocessing of forensic datasets.
4. Data visualization using charts, graphs, and dashboards in Microsoft Excel.
5. Statistical summary and descriptive analysis of forensic datasets.
6. Crime trend analysis using publicly available crime statistics.
7. Preparation of pivot tables and dashboards for forensic data.
8. Geographic visualization of crime data using open-source mapping tools.
9. Introduction to data analysis using Python (Pandas) or R (Demonstration).
10. Pattern identification using clustering and filtering techniques.
11. Introduction to machine learning applications in forensic science (Demonstration).

12. Social media and cybercrime data exploration using publicly available datasets.
13. Preparation and presentation of a forensic data analytics report.
14. Case study presentation on the application of big data analytics in forensic investigations.

Laboratory Tools/Software

- Microsoft Excel
- Google Sheets
- Python (Pandas, Matplotlib) *(Demonstration)*
- R Programming *(Demonstration)*
- Tableau Public / Microsoft Power BI
- OpenRefine
- QGIS (Basic Crime Mapping)

Assessment Method: As per University guidelines

Suggested Readings

1. Zikopoulos, P., Eaton, C., deRoos, D., Deutsch, T., & Lapis, G. *Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data.* McGraw-Hill.
2. Provost, F., & Fawcett, T. *Data Science for Business.* O'Reilly Media.
3. Bruce, P., Bruce, A., & Gedeck, P. *Practical Statistics for Data Scientists.* O'Reilly Media.
4. Houck, M.M., & Siegel, J.A. *Fundamentals of Forensic Science.* Academic Press.
5. Saferstein, R. *Criminalistics: An Introduction to Forensic Science.* Pearson Education.
6. National Crime Records Bureau (NCRB). *Crime in India* (Latest Annual Report).
7. ISO/IEC 27001. *Information Security Management Systems – Requirements.*

	Curriculum Structure of 2nd Year of PG for Two years PG Programme (3+2) OR							
	One Year PG Programme After Completion of Four-Year UG Programme (4+1)							
	Structure-2 (Level-6.5): PG Curriculum Structure with Course Work + Research							
Level-6.5	**Year-2**				**Year-2**			
			Paper	**Credits**			**Paper**	**Credits**
	Semester-3	**DSC-7**	Instrumental Techniques in Forensic Analysis -I	4	**Semester-4**	**DSC-9**	Instrumental Techniques in Forensic Analysis- II	4
		DSC-8	Introduction to Digital and Cyber Forensics	4		**DSC-10**	Questioned Documents and Multimedia Forensics	4
				8				**8**
		OPT for either 2 New DSEs OR DSE & GE				**OPT for either 2 New DSEs OR** DSE & GE		
		DSE-5	Human Genetics and Molecular Forensics	4		**DSE-11**	Toxicology and Pharmacology	4
		DSE-6	Forensic Genomics, Proteomics and Bioinformatics			**DSE-12**	Forensic Accounting	
		DSE-7	Advanced Forensic Anthropology			**DSE-13**	Forensic Analytical Chemistry	
		DSE-8	Forensic Engineering			**DSE-14**	Cryptography & Steganography	
						DSE 15	Research Methodology	
		GE-3	Fundamentals of Immunological techniques in Forensic science	4		**GE-5**	Fundamentals of Nanotechnology	4
		GE-4	Fundamentals of AI and Machine Learning in Forensic science			**GE-6**	Forensic Medicine	
				8				**8**
		Dissertation (Original Work)				**Dissertation (Original Work)**		
			Minor Project based on police training/ Laboratory training /court room ethnography for three weeks	**6**			Dissertation: on any specialized field of Forensic Science	**6**
				22				**22**

Structure 2 (Course Work + Research)

SEM-III

DSC - 7 INSTRUMENTAL TECHNIQUES IN FORENSIC ANALYSIS - I

Paper	Total Credit	Lecture	Practical/ Practice	Pre-requisite of the course
Instrumental Techniques in Forensic Analysis - I	**04**	**03**	**01**	Basic knowledge of Forensic Science

Course Outcomes:

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

1. Understand the principles and working mechanisms of major instrumental techniques used in forensic science.
2. Explain the applications of microscopy, spectroscopy, electrophoresis, and chromatography in forensic evidence analysis.
3. Develop practical skills in the operation of basic analytical instruments and interpretation of analytical data.
4. Evaluate the suitability, accuracy, and limitations of instrumental techniques for forensic investigations

Learning Objectives:

After completing the course, students will be able to:

1. Explain the principles and instrumentation of commonly used forensic analytical techniques.
2. Select appropriate instrumental methods for the examination of different types of forensic evidence.
3. Interpret analytical results obtained from spectroscopic, chromatographic, microscopic, and electrophoretic techniques.
4. Demonstrate laboratory competency in sample preparation, instrument handling, and forensic data interpretation.

Unit 1 Light Microscopy (12 Hours)

Introduction to microscopy, theory and principles of microscopy, Construction, working, and applications of Simple, Compound, Comparison, Fluorescence, Polarized, Stereo and infrared microscopes, Digital microscopy and image analysis in forensic examinations.

Unit 2 Molecular Spectroscopy (11 Hours)

Introduction to molecular microscopy, theory, principles and application of UV, VIS spectroscopy, IR spectroscopy, Fourier Transform Infrared spectroscopy (FTIR) and Raman spectroscopy, Applications of molecular spectroscopy in forensic examination of drugs, fibers, paints, inks, and

explosives.

Unit 3 Electrophoresis (11 Hours)

Introduction, theory, principle and application of Cross-over electrophoresis, Agarose gel electrophoresis, Polyacrylamide gel electrophoresis, Sodium dodecyl sulphate (SDS) polyacrylamide gel electrophoresis, Pulse field gel electrophoresis, Capillary electrophoresis, Immuno- electrophoresis, Iso-electric focusing.

Unit 4 Chromatography (11 Hours)

Introduction, theory, principle, instrumentation, and forensic applications of Thin Layer Chromatography (TLC), HPTLC, Paper and Column chromatography, High performance liquid chromatography, LC-MS, Ion chromatography. Gas chromatography: Pyrolysis GC, GC-MS, Introduction to Headspace Gas Chromatography (HS-GC) for alcohol and volatile poison analysis.

Practical's (30 Hours)

1. Identification of natural and synthetic fibers using a microscope.
2. To find out the unknown concentration of the given sample using a UV/Vis Spectrophotometer.
3. To study Beer's Lambert's law.
4. To study the Hypochromic and Bathochromic shift using a UV/Vis Spectrophotometer.
5. To study the TLC of different inks of the writing pen.
6. To perform gel electrophoresis of DNA samples
7. To analyses the given compound using FTIR spectra.
8. To perform TLC of phenolphthalein.
9. Quantitative and qualitative analysis of soils from different sources of origin.
10. Differentiation of various toxic textile dyes using FTIR analysis.

Assessment Method: As per University guidelines

Suggested Readings:

1. Skoog, D. A., Holler, F. J., & Crouch, S. R. (2021). *Principles of Instrumental Analysis* (7th ed.). Cengage Learning.
2. Hofmann, A., & Clokie, S. (2018**).** *Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology* (8th ed.). Cambridge University Press.
3. Rouessac, F., & Rouessac, A. (2021). *Chemical Analysis: Modern Instrumentation Methods and Techniques* (3rd ed.). Wiley.
4. Saferstein, R. (2023). *Criminalistics: An Introduction to Forensic Science* (13th ed.). Pearson.
5. Bell, S. (2022). *Forensic Chemistry* (3rd ed.). Pearson.
6. Houck, M. M., & Siegel, J**.** A. (2015). *Fundamentals of Forensic Science* (3rd ed.). Academic Press.
7. Peterson J.R and Mohammad A.A (2001); Clinical and Forensic Application of Capillary Electrophoresis. Springer.
8. Lurie B.J and Wittwer J.D (1983); High Performance Liquid Chromatography in Forensic Chemistry. Taylor and Francis.
9. Newman R, Gilbert M, Gilbert M.W., and Lothridge K (1997); GC-MS guide to Ignitable Liquids. CRC Press.
10. Brown, P. R. (2004); Advances in chromatography.

11. Grahm D. (1973); The use of X-ray Techniques in Forensic Investigation.
12. Settle F.A (1997); Handbook of Instrumental Techniques for Analytical Chemistry. Prentice Hall.

DSC-8 INTRODUCTION TO DIGITAL AND CYBER FORENSICS

Paper	Total Credit	Lecture	Practical/ Practice	Pre-requisite of the course
Introduction to Digital and Cyber Forensics	**04**	**03**	**01**	Basic knowledge of Computers

Course Outcomes:

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

1. Understand the fundamental concepts of digital and cyber forensics and the nature of digital evidence.
2. Explain computer architecture, operating systems, networks, and cybercrimes from a forensic perspective.
3. Apply basic principles of digital evidence acquisition, preservation, and cyber incident investigation.
4. Understand cybersecurity principles, legal aspects, and the use of forensic tools in cybercrime investigations

Learning Objectives:

After completing this course, students will be able to:

1. Describe the fundamentals of digital forensics, cyber forensics, and digital evidence.
2. Examine computer systems, storage media, operating systems, and networks relevant to forensic investigations.
3. Identify common cybercrimes and explain basic investigation methodologies and evidence preservation procedures.
4. Apply introductory forensic tools and cybersecurity practices for analysing digital evidence and preparing forensic reports.

Unit 1 Computer Fundamentals and Digital Storage (12 Hours)

Number systems: Binary, Octal, Decimal and Hexadecimal, Conversion and Operations on Binary Number Systems, Representing Information in Hexadecimal and Binary, Logical operations on binary number systems. Computer Architecture: Components of a computer, Input Devices, Central Processing Unit, Primary and secondary Storage Devices, Output Devices. Secondary Storage Devices: Understanding Disk, Volume and Partition, HDD and SSD Structures.

Unit 2 Operating Systems and Computer Networks (11 Hours)

Role of Operating System, Boot Process, Introduction to Process and Memory Management**.** Windows OS Architecture **-** FAT and NTFS File Systems. Computer Network: Basic concepts of Computer Network, Open System Interconnection (OSI) and TCP/IP reference model, Protocols and functionalities of each layer, types of connections, networking devices

Unit 3 Cybercrime and Digital Forensics (11 Hours)

Definition of cybercrime, history, classification and types of cybercrimes (spoofing, phishing, vishing, spamming, SMS bombing, stalking, pornography, etc.), virus, worms, ransomware, malware logic/salami attacks, concept of Ponzi scheme, social media platforms and related crimes, forensic investigation of social media crime, cyber terrorism, financial frauds, portals for reporting cybercrimes in India.

Unit 4 Cyber security Fundamentals ((11 Hours)

Introduction to cyber security, Incident Response Management, cyber security, TRIAD (CIA), cyber-attack on cyber security principles, risk assessment, security audit, best security practices, web application security, network application security, Introduction to digital forensic tools (Autopsy, FTK Imager, Wireshark, and Cellebrite—overview only)

Practical's (30 Hours)

1. To perform conversion between binary, decimal, octal, and hexadecimal number systems
2. To study structure of HDD and SSD
3. To perform audio examination using forensic tools
4. To perform identification of different types of cybercrimes
5. To perform basic web/application security testing
6. To perform incident response steps in a simulated case
7. To perform basic network configuration and IP identification

Assessment Method: As per university guidelines

Suggested Readings:

1. Hayes, D. R. (2024). *A Practical Guide to Computer Forensics Investigations* (3rd ed.). Pearson.
2. Oettinger, W. (2023). *Learn Computer Forensics* (2nd ed.). Packt.
3. Carvey, H. (2023). *Investigating Windows Systems* (2nd ed.). Syngress/Elsevier.
4. Nelson, B., Phillips, A., & Steuart, C. (2022). *Guide to Computer Forensics and Investigations* (7th ed.). Cengage Learning.
5. Casey, E. (2024). *Digital Evidence and Computer Crime* (4th ed.). Academic Press.
6. Easttom, C. (2022). *Digital Forensics, Investigation, and Response* (4th ed.). Jones & Bartlett Learning.
7. Stallings, W. (2022). *Computer Organization and Architecture* (11th ed.). Pearson.
8. Stallings, W. (2021). *Network Security Essentials: Applications and Standards* (7th ed.). Pearson.
9. Carrier, B. (2005). *File System Forensic Analysis*. Addison-Wesley.
10. Casey, E. (2011). *Handbook of Digital Forensics and Investigation*. Academic Press.

DSE- 5 HUMAN GENETICS AND MOLECULAR FORENSICS

Paper	Total Credit	Lecture	Practical/ Practice	Pre-requisite of the course
Human Genetics and Molecular Forensics	**04**	**03**	**01**	Basic knowledge Forensic Science

Course Outcomes:

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

1. Understand the principles of human genetics and molecular biology relevant to forensic science.
2. Explain molecular techniques used for DNA profiling, sequencing, and genetic marker analysis.
3. Apply genetic principles for human identification, kinship analysis, and forensic investigations.
4. Evaluate the scientific, legal, and ethical aspects of forensic DNA evidence.

Learning Objectives:

After completing this course, students will be able to:

1. Explain the principles of human genetics and molecular forensic analysis.
2. Perform and interpret basic molecular techniques used in forensic DNA analysis.
3. Analyse DNA profiles for human identification, relationship testing, and biological evidence examination.
4. Evaluate the reliability, statistical significance, and legal admissibility of forensic genetic evidence.

Unit 1 Fundamentals of Human Genetics (12 Hours)

Structure and function of DNA and RNA; Chromosome organization, karyotyping, and chromosomal abnormalities; Mendelian inheritance and extensions (codominance, incomplete dominance, linkage); Population genetics: allele frequency, Hardy-Weinberg equilibrium; Genetic variation in human populations (SNPs, STRs, VNTRs, InDels)

Unit 2 Molecular Biology Techniques in Forensics (11 Hours)

DNA extraction methods (organic, Chelex, silica-based); DNA quantification techniques (spectrophotometry, real-time PCR); DNA quality assessment and contamination control; Polymerase Chain Reaction (PCR) and its types; Gel electrophoresis and capillary electrophoresis; DNA sequencing methods (Sanger and Next Generation Sequencing)

Unit 3 DNA Profiling and Human Identification (11 Hours)

Principles of DNA fingerprinting; STR profiling and CODIS markers; Mitochondrial DNA and Y-chromosome analysis; SNP Analysis; Mixed DNA profile interpretation; Statistical interpretation of DNA Evidence: Random match probability, likelihood ratio, Paternity Index

Unit 4 Advanced Molecular Forensics and Legal Aspects (11 Hours)

Forensic applications: paternity testing, missing persons, disaster victim identification; DNA databases and their management; Epigenetics and forensic age estimation; Chain of custody and laboratory documentation, Ethical, legal, and social issues in forensic genetics; Quality assurance and accreditation in forensic laboratories.

Practical's (30 Hours)

1. Restriction digestion of DNA
2. DNA extraction from different forensic biological forensic samples
3. To perform Polymerase chain reaction
4. To perform Agarose gel electrophoresis
5. STR Profiling and report writing using simulated evidences
6. Calculation of Paternity Index and Random Match Probability.
7. Interpretation of DNA sequencing chromatograms or STR electropherograms

Assessment Method: As per University Guidelines

Suggested Readings:

1. Butler, J. M. (2023). *Advanced Topics in Forensic DNA Typing: Methodology* (2nd ed.). Academic Press.
2. Butler, J. M. (2023). *Fundamentals of Forensic DNA Typing* (2nd ed.). Academic Press.
3. Goodwin, W., Linacre, A., & Hadi, S. (2024). *An Introduction to Forensic Genetics* (4th ed.). Wiley-Blackwell.
4. Jobling, M. A., Gill, P., & Hurles, M. (2023). *Human Evolutionary Genetics* (2nd ed.). Garland Science.
5. Primorac, D., & Schanfield, M. (Eds.). (2014). *Forensic DNA Applications: An Interdisciplinary Perspective*. CRC Press. *(Classic reference.)*
6. Saferstein, R. (2023). *Criminalistics: An Introduction to Forensic Science* (13th ed.). Pearson.
7. Kayser, M., & de Knijff, P. (2011). Improving human forensics through advances in genetics, genomics and molecular biology. *Nature Reviews Genetics*, 12(3), 179–192. *(Classic review.)*
8. Rapley, R., & Whitehouse, D. (Eds.). (2007). *Molecular Forensics*. Wiley. *(Classic reference.)*
9. Arenas, M., et al. (2017). Forensic genetics and genomics: Much more than just a human affair. *PLoS Genetics*, 13(9), e1006960.
10. Kowalczyk, M., et al. (2018). Molecular markers used in forensic genetics. *Medicine, Science and the Law*, 58(4), 201–209.

DSE-6 FORENSIC GENOMICS, PROTEOMICS AND BIOINFORMATICS

Paper	Total Credit	Lecture	Practical/ Practice	Pre-requisite of the course
Forensic Genomics, Proteomics and Bioinformatics	**04**	**03**	**01**	Basic knowledge of Biology

Course Outcomes:

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

1. Understand the principles of genomics, proteomics, and bioinformatics and their applications in forensic science.
2. Explain advanced omics technologies used for human identification and biological evidence characterization.
3. Apply computational tools for biological data analysis and forensic interpretation.
4. Evaluate the scientific, ethical, legal, and societal implications of omics technologies in forensic investigations.

Learning Objectives:

After completing this course, students will be able to:

1. Explain the principles and applications of genomics, proteomics, and bioinformatics in forensic science.
2. Analyse genomic and proteomic data using appropriate computational tools and biological databases.
3. Interpret omics-based evidence for human identification and forensic investigations.
4. Evaluate the opportunities and limitations of integrated omics approaches in forensic science.

Unit 1 Forensic Genomics (12 Hours)

Introduction to genomics: structural and functional genomics; Human genome organisation and variation (SNPs, CNVs, STRs); Next Generation Sequencing (NGS) and its forensic applications; Forensic applications of genomics: ancestry inference, phenotyping (hair, eye, skin colour); Epigenomics: DNA methylation in age estimation and tissue identification

Unit 2 Forensic Proteomics (11 Hours)

Basics of proteomics: protein structure and function; Techniques in proteomics: 2D gel electrophoresis, mass spectrometry (MALDI-TOF, LC-MS/MS); Protein biomarkers in forensic science; Applications: body fluid identification, postmortem interval estimation, hair and fibre analysis, Proteomics in wildlife and species identification

Unit 3 Bioinformatics in Forensic Science (11 Hours)

Introduction to bioinformatics and biological databases (GenBank, EMBL, DDBJ); Sequence alignment tools (BLAST, ClustalW); Phylogenetic analysis and evolutionary relationships; Forensic DNA databases and data management; Software tools for STR analysis and forensic interpretation

Unit 4 Integrated Omics and Emerging Trends in Forensic Science (11 Hours)

Multi-omics integration (genomics, proteomics, transcriptomics); Microbiome forensics and its applications; Forensic applications of artificial intelligence and machine learning; Personalized forensics and predictive analysis; Ethical, legal, and privacy concerns in omics data, Future directions in forensic omics

Practicals (30 Hours)

1. Extraction of proteins from biological samples.
2. Estimation of protein concentration using standard biochemical methods.
3. Construction of a Phylogenetic tree from nucleotide and protein sequences
4. To study different protein structures
5. To study the recent advancements in Human Genome Project

Assessment Method: As per university guidelines

Suggested Readings:

1. Khan, M. S. (2025). A Comprehensive Overview of Bioinformatics Applications in Forensic Science Related to Omics and Odontology. *THE STETHO*, *6*(2), 56-70.
2. Smith, J. H., & Singh, M. (2024). Unlocking Secrets: Bioinformatics' Impact on Forensic Bio-Examinations. *Int. J. Netw. Secur. Its Appl*, *16*, 1-15.
3. Muntaha, S. T., Hasnain, M. J. U., Khan, W. A., Rafiq, F., & Pervez, M. T. (2018). Role of bioinformatics in forensic science. *FUUAST Journal of Biology*, *8*(1), 133-138.
4. Kopp, P. (2005). Genetics, genomics, proteomics, and bioinformatics. *Clinical Pediatric Endocrinology*, 18-44.
5. Duong, V. A., Park, J. M., Lim, H. J., & Lee, H. (2021). Proteomics in forensic analysis: applications for human samples. *Applied Sciences*, *11*(8), 3393.
6. Keane, R. E., Tidy, R. J., Parker, G. J., Gummer, J. P., & Priddis, C. (2024). Mass spectrometry based proteomics: changing the impact of protein analysis in forensic science. *Wiley Interdisciplinary Reviews: Forensic Science*, *6*(4), e1516.
7. Mason, K. E., Anex, D., Grey, T., Hart, B., & Parker, G. (2018). Protein-based forensic identification using genetically variant peptides in human bone. *Forensic science international*, *288*, 89-96.
8. Baniasad, M., Reed, A. J., Lai, S. M., Zhang, L., Schulte, K. Q., Smith, A. R., ... & Freitas, M. A. (2021). Optimization of proteomics sample preparation for forensic analysis of skin samples. *Journal of proteomics*, *249*, 104360.

DSE- 7 ADVANCED FORENSIC ANTHROPOLOGY

Paper	Total Credit	Lecture	Practical/ Practice	Pre-requisite of the course
Advanced Forensic Anthropology	**04**	**03**	**01**	Basic knowledge of Biology

Course Outocmes

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

1. Understand advanced concepts of human skeletal biology and their application in forensic anthropology.
2. Apply scientific methods for constructing biological profiles from human skeletal remains.
3. Analyse skeletal trauma, taphonomic changes, and postmortem alterations for medico-legal investigations.
4. Evaluate the role of forensic anthropologists in criminal investigations, disaster victim identification, and humanitarian contexts.

Learning Objectives

After completing this course, students will be able to:

1. Examine and identify human skeletal remains using osteological and anthropometric methods.
2. Estimate sex, age, stature, ancestry, and biological profile from skeletal remains.
3. Interpret skeletal trauma, decomposition, and taphonomic changes in forensic investigations.
4. Apply forensic anthropological methods in crime scene recovery, human identification, and legal proceedings.

Unit 1 Human Osteology and Skeletal Biology (12 Hours)

Detailed study of human skeletal system (axial and appendicular); Bone biology: growth, development, remodeling, and ageing; Skeletal variation and population differences; Metric and non-metric traits in identification; Histological analysis of bone, Human versus non-human skeletal differentiation

Unit 2 Biological Profile Estimation (11 Hours)

Sex determination (morphological and metric methods); Age estimation (subadult and adult skeletal indicators); Stature estimation (long bone measurements, regression formulae); Ancestry estimation and population affinity; Facial reconstruction basics

Unit 3 Forensic Taphonomy and Trauma Analysis (11 Hours)

Taphonomic processes: decomposition, burial, environmental effects; Estimation of postmortem interval (PMI); Types of traumas: blunt force, sharp force, ballistic trauma; Antemortem, perimortem, and postmortem injuries; Mass disasters and commingled remains analysis

Unit 4 Forensic Anthropology in Practice and Legal Context (11 Hours)

Crime scene recovery of skeletal remains; Documentation and chain of custody; Role of forensic

anthropologist in court; Human rights investigations and mass grave analysis; Ethical issues and professional standards.

Practicals (30 Hours)

1. Examination of skeletal remains- long bones- Femur, Humerus.
2. Identification of individuals by long bones and stature estimation
3. Determination of sex and age from Skull with mandible
4. Determination of sex from pelvis and sacrum.
5. Identification of individuals by dental examination
6. Anthropometry - Identification of individuals (in living)

Assessment Method: As per university guidelines

Suggested Readings:

1. Pink, C. M., Cornelison, J. B., & Juarez, J. K. (2025). Standardizing Advanced Training in Forensic Anthropology: Defining a Clear Path to Achieve Forensic Specialization in Biological Anthropology. *American Journal of Biological Anthropology*, *186*(4), e70055.
2. Franklin, D., & Marks, M. K. (2022). The professional practice of forensic anthropology: Contemporary developments and cross-disciplinary applications. *Wiley Interdisciplinary Reviews: Forensic Science*, *4*(2), e1442.
3. Ubelaker, D. H. (2018). Recent advances in forensic anthropology. *Forensic sciences research*, *3*(4), 275-277.
4. Christensen, A. M., Passalacqua, N. V., & Bartelink, E. J. (2019). *Forensic anthropology: current methods and practice*. Academic Press.
5. Wescott, D. J. (2018). Recent advances in forensic anthropology: decomposition research. *Forensic sciences research*, *3*(4), 278-293.
6. Passalacqua, N. V., Pilloud, M. A., & Congram, D. (2021). Forensic anthropology as a discipline. *Biology*, *10*(8), 691.

DSE-8 FORENSIC ENGINEERING

Paper	Total Credit	Lecture	Practical/ Practice	Pre-requisite of the course
Forensic Engineering	**04**	**03**	**01**	Basic knowledge of Forensic Science

Course Outcomes:

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

1. Understand the principles of engineering science applied to forensic investigations.
2. Explain methods for analysing structural, mechanical, electrical, and material failures.
3. Apply scientific approaches for accident investigation, reconstruction, and interpretation of engineering evidence.
4. Evaluate legal, ethical, and professional aspects of forensic engineering investigations.

Learning Objectives

After completing this course, students will be able to:

1.Explain the principles and methodologies of forensic engineering investigations.

2.Analyse engineering failures using appropriate scientific and technical approaches.

3.Interpret evidence from structural failures, industrial accidents, fires, and traffic collisions.

4.Prepare engineering investigation reports consistent with forensic and legal requirements.

Unit 1 Fundamentals of Forensic Engineering (12 Hours)

Definition, scope, and role of forensic engineering; Basic principles of engineering mechanics (force, stress, strain); Types of engineering failures: structural, mechanical, electrical; Modes of failure: fatigue, corrosion, fracture, overload; principle of failure analysis

Unit 2 Structural and Material Failure Analysis (11 Hours)

Structural failures: buildings, bridges, dams; Material science basics: metals, polymers, composites; Fracture mechanics and crack propagation; Corrosion and environmental degradation; Case studies of engineering failures

Unit 3 Accident Investigation and Reconstruction (11 Hours)

Road traffic accident investigation (vehicle dynamics, skid marks); Fire and explosion investigation basics; Industrial accidents and machinery failure; Electrical accidents and short-circuit analysis; Use of simulation and reconstruction tools

Unit 4 Forensic Engineering Practice and Legal Aspects (11 Hours)

Investigation protocols and documentation; Evidence collection and preservation in engineering cases; Role of expert witness in court; Standards, codes, and safety regulations; Ethics and

professional responsibility.

Practical's (30 Hours)

1. Case study on structure collapse and its analysis.
2. To study burn patterns
3. Microscopic examination of fracture surfaces
4. To study skid, scuff, and yaw marks
5. Preparation of a forensic engineering report based on a given case study

Assessment Method: As per University Guidelines

Suggested Readings:

1. Petty, S. E. (2021). *Forensic engineering*. CRC Press.
2. Franck, H., & Franck, D. (2013). *Forensic engineering fundamentals*. Boca Raton, FL: CRC Press.
3. Noon, R. K. (2020). *Introduction to forensic engineering*. CRC Press.
4. Liptai, L. L. (2009). Forensic engineering and the scientific method. *Journal of the National Academy of Forensic Engineers*, *26*(1).
5. Batterman, S. C., & Batterman, S. D. (2002). Forensic engineering. *McGraw-Hill Yearbook of Science & Technology, Mcgraw-Hill*.
6. Brown, S. (2007). Forensic engineering: Reduction of risk and improving technology (for all things great and small). *Engineering Failure Analysis*, *14*(6), 1019-1037.
7. Breysse, D. (2012). Forensic engineering and collapse databases. *Proceedings of the Institution of Civil Engineers-Forensic Engineering*, *165*(2), 63-75

GE-3 FUNDAMENTALS OF IMMUNOLOGICAL TECHNIQUES IN FORENSIC SCIENCE

Paper	Total Credit	Lecture	Practical/ Practice	Pre-requisite of the course
Fundamentals of Immunological Techniques in Forensic Science	**04**	**03**	**01**	Basic knowledge of Biology

Course Outcomes:

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

1. Understand the basic concepts of the immune system and antigen–antibody interactions.
2. Explain immunological techniques commonly used in forensic and diagnostic investigations.
3. Apply serological methods for the identification and analysis of biological evidence.
4. Evaluate the significance and limitations of immunological techniques in forensic science.

Learning Objectives:

After completing this course, students will be able to:

1. Explain the structure and functions of the immune system and immunological components.
2. Interpret antigen–antibody reactions and common serological tests.
3. Apply immunological techniques in the examination of forensic biological evidence.
4. Assess the reliability and medico-legal significance of immunological findings.

Unit 1 Basics of the Immune System (12 Hours)

Overview of immunity: innate and adaptive immunity; Cells of the immune system: lymphocytes, macrophages, dendritic cells, NK cells; Organs of the immune system: primary and secondary lymphoid organs; Antigens and immunogens: properties and types; Cytokines and their functions

Unit 2 Antibodies and Antigen–Antibody Reactions (11 Hours)

Structure and classes of immunoglobulins (IgG, IgM, IgA, IgE, IgD); Antigen–antibody interactions: specificity, affinity, avidity; Principles of serological reactions: precipitation, agglutination; Complement system and its pathways; Hypersensitivity reactions (Types I–IV)

Unit 3 Immunological Techniques in Forensic Science (11 Hours)

Blood group antigens and typing (ABO, Rh system); Serological methods: ELISA, RIA, immunodiffusion, immunoelectrophoresis; Immunoassays for detection of drugs, toxins, and biological fluids; Monoclonal antibodies and their applications; Use of immunology in species identification and paternity testing

Unit 4 Advanced Immunology and Clinical Relevance (11 Hours)

Major Histocompatibility Complex (MHC) and antigen presentation; Immune response regulation and tolerance; Autoimmune diseases and immunodeficiency disorders; Vaccines and immunization principles; Ethical and legal considerations in immunological testing.

Practical's (30 hours)

1. Determination of blood group using Antisera
2. To Determine the Rh factor of given blood sample
3. To perform presumptive tests for blood
4. To perform presumptive tests for saliva
5. To differentiate between Human and animal blood using precipitin test
6. Demonstration of ELISA (Enzyme-Linked Immunosorbent Assay)

Assessment Method: As per university guidelines

Suggested Readings:

1. Bier, O. G., Da Silva, W. D., Götze, D., & Mota, I. (2012). *Fundamentals of immunology*. Springer Science & Business Media.
2. Ansell, S. M. (2020). Fundamentals of immunology for understanding immunotherapy for lymphoma. *Hematology 2014, the American Society of Hematology Education Program*

Book, *2020*(1), 585-589.
3. Woods, M. E. (2017). Fundamentals of immunology and inflammation. In *Nanomedicine for Inflammatory Diseases* (pp. 3-38). CRC Press.
4. Aruljothi, B., Mangala, K. J., Swain, M. P., & Sukhramani, P. S. (2023). *Basics And Fundamentals Of Immunology*. Academic Guru Publishing House.
5. Mir, M. A. (Ed.). (2020). *Basics and Fundamentals of Immunology*. Nova Medicine & Health.
6. Delves, P. J., Martin, S. J., Burton, D. R., & Roitt, I. M. (2017). *Roitt's essential immunology*. John Wiley & Sons.
7. Novotny, A. M. (2014). Fundamentals of Immunology.

GE-4 FUNDAMENTALS OF AI AND MACHINE LEARNING IN FORENSIC SCIENCE

Paper	Total Credit	Lecture	Practical/ Practice	Pre-requisite of the course
Fundamentals of AI and Machine Learning in Forensic Science	**04**	**03**	**01**	Basic knowledge of Computers

Course Outcomes:

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

1. Understand the fundamental concepts of artificial intelligence, machine learning, and data science relevant to forensic science.
2. Explain methods of data preparation, feature engineering, and predictive modelling.
3. Apply basic machine learning techniques to analyse forensic datasets and solve investigative problems.
4. Evaluate the ethical, legal, and practical implications of AI-based forensic applications.

Learning Objectives:

After completing this course, students will be able to:

1. Explain the principles of artificial intelligence, machine learning, and data analytics.
2. Prepare and preprocess forensic datasets for machine learning applications.
3. Apply supervised and unsupervised learning algorithms to forensic problems.
4. Interpret machine learning results and assess their reliability, limitations, and ethical implications.

Unit 1 Foundations of Data Science and Machine Learning (12 Hours)

Overview of Data Science: need, components, and applications; Data Science lifecycle: data collection, processing, analysis, interpretation; Introduction to Machine Learning: human vs. machine learning; Learning problem and hypothesis space; Types of Machine Learning: supervised, unsupervised, reinforcement learning; Applications of ML in forensic science (crime prediction, pattern recognition, biometrics); Issues in Machine Learning: bias, overfitting, data limitations; Tools and platforms for ML (Python, R, basic libraries)

Unit 2 Data Preparation and Feature Engineering (11 Hours)

Types of data in machine learning (structured, unstructured, categorical, numerical); Exploring data structure and datasets; Data quality issues and remediation (missing data, noise, inconsistencies); Data preprocessing: cleaning, normalization, transformation; Basics of Feature Engineering: concept and importance; Feature transformation: construction, extraction; Feature selection and dimensionality reduction

Unit 3 Supervised and Unsupervised Learning (11 Hours)

Supervised learning: classification and regression concepts; Classification models and workflow; Algorithms: k-Nearest Neighbour (k-NN), Decision Tree, Random Forest, Support Vector Machine (SVM); Regression models: Simple Linear Regression, Multiple Linear Regression, Logistic Regression; Unsupervised learning: concepts and applications; Clustering techniques and association rule mining; Comparison: supervised vs. unsupervised learning

Unit 4 Neural Networks, Modelling and Forensic Applications (11 Hours)

Model building process: selecting, training, and testing models; Model representation and evaluation metrics (accuracy, precision, recall); Artificial Neural Networks (ANN): Biological vs artificial neuron, Activation functions, Network architecture; Learning process in ANN and backpropagation algorithm; Introduction to Deep Learning; AI applications in forensic science: Face recognition and biometrics, Crime pattern analysis, Digital forensics and fraud detection; Ethical and legal considerations in AI-based forensic analysis

Practical's (30 Hours)

1. Loading and exploration of datasets
2. Basic statistical analysis and visualization of forensic datasets.
3. Data cleaning and preprocessing
4. Linear and logistic regression using forensic datasets
5. K-Means clustering.
6. Crime data analysis using real or simulated datasets.
7. Classification using Decision Tree or Random Forest.
8. Basic AI workflow using WEKA or Orange Data Mining.

Assessment Method: As per University Guidelines

Suggested Readings:

1. Müller, A. C., & Guido, S. (2022). *Introduction to Machine Learning with Python* (2nd ed.). O'Reilly.
2. Géron, A. (2023). *Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow* (3rd ed.). O'Reilly.
3. Alpaydin, E. (2021). *Introduction to Machine Learning* (4th ed.). MIT Press.
4. Russell, S., & Norvig, P. (2021). *Artificial Intelligence: A Modern Approach* (4th ed.). Pearson.
5. Datt, S., Chandramouli, S., & Das, A. *Machine Learning*. Pearson.
6. Saferstein, R. (2023). *Criminalistics: An Introduction to Forensic Science* (13th ed.). Pearson.
7. James, S. H., Nordby, J. J., & Bell, S. (2025). *Forensic Science: An Introduction to Scientific and Investigative Techniques* (6th ed.). CRC Press.
8. Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep Learning*. MIT Press.

MINOR PROJECT BASED ON POLICE TRAINING/ LABORATORY TRAINING /COURT ROOM ETHNOGRAPHY FOR THREE WEEKS

Paper	Total Credit	Lecture	Practical/ Practice	Pre-requisite of the course
Minor Project	**06**	**00**	**06**	Basic Knowledge of Forensic Science

Course Outcomes: The Minor Project aims to provide students with an opportunity to undertake independent research in a specialized area of forensic science. The course is designed to develop scientific inquiry, critical thinking, problem-solving abilities, and research ethics through the application of theoretical knowledge to practical forensic problems. Students will gain experience in research planning, experimental design, data collection, analysis, interpretation, scientific writing, and presentation while working under the guidance of a faculty supervisor. The project also seeks to enhance laboratory competence, familiarize students with contemporary forensic techniques and instrumentation, and prepare them for professional careers in forensic science, research, and academia.

Learning Objectives:

- Identify and formulate a research problem relevant to forensic science.
- Conduct a comprehensive review of scientific literature and identify research gaps.
- Design and execute experimental studies using appropriate forensic methodologies.
- Apply laboratory techniques, analytical instruments, and statistical tools for data collection and analysis.
- Interpret experimental findings critically and draw scientifically valid conclusions.
- Demonstrate adherence to research ethics, laboratory safety, and quality assurance practices.
- Prepare a scientific dissertation following standard academic and research guidelines.
- Communicate research findings effectively through oral presentations, seminars, and viva-voce examinations.

Minor Project Guidelines:

The Minor Project shall be undertaken individually by each student under the supervision of a faculty member of the Department.

The project topic should be selected from any specialized area of forensic science, including but not limited to forensic biology, forensic chemistry, forensic toxicology, forensic anthropology, questioned documents, fingerprint science, digital forensics, crime scene investigation, forensic psychology, forensic medicine, forensic ballistics, forensic entomology, forensic nanotechnology, environmental forensics, wildlife forensics, or other emerging areas.

Students shall prepare a research proposal containing the title, objectives, literature review, research methodology, expected outcomes, and timeline of work. The proposal shall be approved before commencement of experimental work.

The project shall involve literature review, experimental investigation and/or field study, data analysis, interpretation of results, and preparation of a dissertation. Students are expected to maintain a project diary/laboratory record documenting experimental procedures, observations, and progress throughout the project period.

SEM-IV

DSC-9 INSTRUMENTAL TECHNIQUES IN FORENSIC ANALYSIS - II

Paper	Total Credit	Lecture	Practical/ Practice	Pre-requisite of the course
Instrumental Techniques in Forensic Analysis II	**04**	**03**	**01**	Basic understanding of forensic science

Course Outcomes:

1. To understand basic principles of modern analytical instruments
2. To learn applications of microscopy and spectroscopy in forensics
3. To develop knowledge of material analysis techniques
4. To apply instrumental methods in forensic investigations

Learning Objectives:

Students will be able to:

1. Explain working principles of major forensic instruments
2. Identify appropriate techniques for different types of evidence
3. Interpret analytical results in forensic context
4. Apply instrumental methods in laboratory-based investigations

Unit 1 Introduction to Microscopy (12 Hours)

Introduction, theory, principles, sample preparation, and applications of electron microscope including Scanning Electron Microscope, Field Emission Scanning Electron Microscope, Transmission Electron Microscope, Energy Dispersive X Ray, Scanning Probe Microscope, Scanning, Tunnelling Electron Microscope (STEM), Atomic Force Microscope, Quantum 3D Microscope, and Confocal Microscopy, Polarizing Microscopy.

Unit 2 Atomic Spectroscopy (11 Hours)

Introduction, theory, principles, sample preparation, and applications of Atomic Absorption Spectroscopy, Graphite Furnace Atomic Absorption Spectroscopy, Atomic Emission Spectroscopy, Inductively Coupled Plasma Atomic Emission Spectroscopy, Inductively Coupled Plasma Mass Spectroscopy.

Unit 3 X-Ray Techniques (11 Hours)

Introduction, theory, principles, sample preparation, and applications of X Ray Diffraction, X Ray Fluorescence (Energy and Wavelength Dispersion), Auger Electron Spectroscopy (ESCA)

Unit 4 Thermal Techniques (11 Hours)

Introduction, theory, principles, sample preparation, and applications of Nuclear Magnetic Resonance Spectroscopy, Neutron Activation Analysis, Thermo Gravimetric Analysis, Differential Thermal Analysis. Glass Refractive Index Measurement (GRIM), Densitometer, Universal Tensile Strength testing equipment (UTM), Immunoassay and Centrifugation techniques.

Practical's (30 Hours)

1. To analyses various physical evidences using microscopes
2. To perform centrifugation of biological samples.
3. To analyses the given sample by using Mass Spectroscopy.
4. To calculate refractive index of glass by using Refractometer.
5. To analyses the given sample by using XRD and XRF
6. To understand Instrumentation and application of Raman Spectroscopy

Assessment Method: As per university guidelines

Suggested Readings:

1. Robinson J.W, Frame E.M.K and Frame II G.M (2005); Undergraduate Instrumental Analysis. M. Dekker.
2. Skoog D.A, Holler F.J & Crouch S.R (2021); Principles of Instrumental analysis: Cengage Learning Inc.
   3. Merrit W and Settle D (1981); Instrumental Methods of Analysis. Van Nostrand.
   4. Saferstein R (2015); Criminalistics An introduction to Forensic Science, Pearson.
5. Pavia D.L, Lapman G.L, Kriz G.S and Vyvyan J.R(2015); Introduction to Spectroscopy. Cengage Learning.
6. Chapmen J.R (1993); Practical Organic Mass Spectrometry- A Guide for Chemical and Biochemical Analysis. Wiley & Sons.
7. Chatwal, G.R and Anand S.K. (1984); Instrumental Methods Of Chemical Analysis. Himalaya Publishing House.

DSC-10 QUESTIONED DOCUMENTS AND MULTIMEDIA FORENSICS

Paper	Total Credit	Lecture	Practical/ Practice	Pre-requisite of the course
Questioned Documents and Multimedia Forensics	**04**	**03**	**01**	Basic Knowledge of Forensic Science

Course Outcomes:

After studying this course, the student will learn to

1. Identify the questioned document at the crime scene.
2. Examine the questioned document using different basic tools.
3. Compare various handwriting and signature samples.
4. Detect frauds and forgeries by analyzing questioned documents.

Learning Objectives:

1. To explain the nature and scope of questioned documents, including types, characteristics, and the principles of handwriting analysis.
2. To identify various types of document forgeries and alterations and assess their impact.
3. To evaluate handwriting and signature development, document features to determine authenticity.
4. To synthesize findings from document and handwriting analyses to produce comprehensive forensic reports

Unit 1: **Introduction to Questioned Documents (12 Hours)**

Nature and Scope of Questioned Documents, definition of questioned documents. Types of Document / Classification of documents, Handling and packing of documents, Procurements of standards- admitted / specimen writings. Preliminary examination of documents. Sections related to Questioned Document Examinations.

Unit 2: **Handwriting and Signature Examination (11 Hours)**

Principles of hand writing & signature identification. Class and Individual Characteristics of Handwriting. Disguise writings, Natural Variations. Basic tools needed for forensic documents' examination ultraviolet, visible, infrared and fluorescence spectroscopy, photography of questioned documents, visible spectral comparator, electrostatic detection apparatus.

Unit 3: **Document Forgery and Security Documents (11 Hours)**

Forgeries & its types and their detections, Examination of alterations, erasers, overwriting, addition and obliterations, Examination of counterfeit currency notes, passport, credit card, visa, seal and other mechanical impressions. Use of digital technology in the perpetration of white-collar crimes and their detection, digitally manipulated and machine generated documents- their nature, examination and reporting as well as evidence impact.

Unit 4: **Multimedia Forensics and Advanced Document Examination (11 Hours)**

Determination of sequence of strokes, age of document, Physical matching of Documents Printing Devices- impact and non- impact printing, Examination of modern printing techniques, Decipherment of secret & indented writings, ESDA and Examination of charred documents, Examination of typescripts, Xerox- Analog and Digital, computer printouts

Practical's (30 Hours)

1. Identification of Handwriting-general characteristics, natural variations, fundamental divergences and individual characteristics
2. To detect Simulated and traced forgeries
3. Examination of additions, erasures, and obliterations in the documents.
4. Examination of writing inks by TLC/ Paper chromatography.
5. To examine the security features of currency notes, passport, cheques etc.
6. To decipher secret writing.

Assessment Method: As per University Guidelines

Suggested Readings:

1. Albert S. Osborn; Questioned Documents, Second Ed.; Universal Law Publishing, Delhi
2. O. Hilton, *Scientific Examination of Questioned Documents*, CRC Press, Boca RatonCrime in India Reports (Annual) by the National Crime Records Bureau (NCRB)
3. R.N. Morris, Forensic Handwriting Identification: Fundamental Concepts and Principles, Academic Press, London.
4. E. David, The Scientific Examination of Documents–Methods and Techniques, 2nd Edition, Taylor & Francis, Hants.
5. Wilson R. Harrison; Suspect Documents -Their Scientific Examination; Universal Law Publishing, Delhi- please see publisher
6. Heidi H Harralson: Huber and Headrick's Handwriting Identification

DSE-11 FORENSIC TOXICOLOGY AND PHARMACOLOGY

Paper	Total Credit	Lecture	Practical/ Practice	Pre-requisite of the course
Forensic Toxicology and Pharmacology	**04**	**03**	**01**	Basic understanding of chemistry.

Course Outcomes:

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

1. Understand the principles of toxicology, pharmacology, and xenobiotic metabolism relevant to forensic science.
2. Explain the mechanisms of toxicity, drug action, and toxicological analysis of biological samples.

3. Apply analytical techniques for the detection and identification of drugs, poisons, and toxic substances.
4. Evaluate toxicological findings in medico-legal investigations and interpret laboratory reports.

Learning Objectives:

After completion of this course, students will be having

1. Basic principles of toxicology and pharmacology.
2. To help students learn about xenobiotics and toxic effects.
3. Understand the concepts of mechanism of toxicity.
4. To study and understand the action of various drugs.

Unit I: Concepts of Toxicology (12 Hours)

Toxicants and Types of Toxicants, Sources of poisoning Laws and Regulations in toxicological testing, Regulatory bodies national and International, Risk and Hazard characterization Factors affecting toxicity toxicokinetic and toxicodynamic processes, detoxification of xenobiotics, biotransformation of xenobiotics, bioaccumulation of xenobiotics, antidotal therapy.

Unit II: Post-mortem Toxicology (11 Hours)

Toxic effects of heavy metals, mechanism of heavy metal toxicity, Toxic effects of Alcohol and solvents, mechanism of poisonous liquor, Toxic effects of plant poisons, Toxic effects of insects and animal poison Methods of poison detection, chemical tests, Instrumental methods for toxicological examination, Toxicological analysis of decomposed material and body remains, challenges in forensic toxicological examination, Report Writing.

Unit III: Basic Principles of Forensic Pharmacy (11 Hours)

Introduction to Pharmacology and Forensic Pharmacy, Schedules of Drug, classification of drugs new drug Development, Route of administration of Drugs, Factor affecting the effects of Drug, Adverse drug reactions, Drug Dependence, Rational use of Medicines. Pharmacokinetics: L-ADME, Bioavailability, Bioequivalence, Drug Receptor concept, types of receptors and mechanism of action, Pharmacokinetic drug interactions, various biological barriers, drug hypersensitivity.

Unit IV: Concepts of Pharmacology (11 Hours)

Role of Catecholamines: Serotonin, Dopamine, Norepinephrine & Epinephrine, General Anaesthetics, Sedatives, Hypnotics, antihypertensive drugs, NSAIDs, Antidepressant, CNS-Stimulants, Antipsychotics, Antiepileptics, Chemo therapeutic drugs, Anti-Biotics, Anti-Fungal, Performance Enhancement Hormone & Drugs. Methods of extraction, Colorimetric Analysis, Instrumental techniques, Immuno-assay techniques of Various drugs. Standards of Quality control & Quality assurance in the pharmaceutical analysis, National & International Notable Case Studies.

Practical's (30 Hours)

1. Plotting of calibration curve and quantification using UV-Vis Spectroscopy
2. Concept & Parts identification of GC, GCMS, HPLC
3. Identification of common plant poisons Oleander, Dhatura, Calotropis and Ricin etc. by various analytical methods
4. Extraction of heavy metals by conventional methods and analysis by color tests.
5. Identification of non-volatile poisons by UV and TLC
6. Extraction and identification of pesticides from biological matrices by TLC and GC-MS

Assessment Method: As per university guidelines

Suggested Readings

1. Curry: Analytical Methods in Human Toxicology, Part II, 1986.
2. Gupta, P.K. Fundamentals of Toxicology: Essential Concepts and Applications. India, Elsevier Science, 2016.
3. Holfmann, F.G.: Handbook of Drug and Alcohol Abuse.
4. Samford: Poisons Their Isolation Identification
5. Mule, S. J. et al.: Immunoassays for Drugs subjects to ab, CRC Press, 1974
6. Connors, K.: A text book of pharmaceuticals analysis, Interscince, New York, 1975
7. Klaassen, C. D.: Casarett and Doull's Toxicology: The Basic Science of Poisons, 5th ed,McGraw-Hill, 1995.
8. Moffat, A.C.: Osselton, D. M. Widdop, B.: Clarke's Analysis of Drugs and Poisons in Pharmaceuticals, body fluids and postmortem material, 3rd ed., PharmaceuticalPress2004.

DSE-12 FORENSIC ACCOUNTING

Paper	Total Credit	Lecture	Practical/ Practice	Pre-requisite of the course
Forensic Accounting	**04**	**04**	**00**	Basic Knowledge of Forensic Science

Course Outcomes

1. To understand the fundamental concepts and develop proficiency
2. To learn investigative techniques in the area of forensic accounting.
3. To explore specialized areas within the field of forensic accounting.

Learning Objectives

After completion of this course, the learners will be able to:

1. Explain the fundamental concepts of forensic accounting.
2. Develop expertise in investigative techniques used in forensic accounting.
3. Understand money laundering, bankruptcy investigations, and litigation support for addressing complex financial issues.
4. Apply theoretical knowledge and practical skills to analyze reports and communicate findings effectively.

Unit I: Forensic Accounting & Fraud Auditing Fundamentals (15 Hours)

Meaning, nature and scope of Forensic Accounting, Auditors liability for undetected frauds, Fraud auditing (forensic audit) phases: Recognition and planning, Understanding Fraud and Types of Financial Crimes. Evidence collection and evaluation, Communication of results. Fraud Detection and Prevention Strategies.

Unit II: Fraud Definition & Taxonomy (15 Hours)

Ingredients of fraud, why is a fraud committed and who commits a fraud? Meaning and nature of corporate fraud, concept of fraud under Companies Act 2013, frauds for and against a company, victims of fraud. Money Laundering and Terrorism Financing. Bankruptcy and Insolvency Investigations.

Unit III: Fundamentals of Penetration Testing (15 Hours)

Types of Corporate Frauds: Bribery and corruption, Misappropriation of assets, Manipulation of financial statements, Procedure-related frauds, corporate espionage, Fraud in e-commerce. Fraud Prevention- Strategies, Fraud prevention for consumers and businesses. Insurance Claims and Fraudulent Activities. Litigation Support and Expert Witness Testimony. Practical Applications -

Application of Investigative Techniques. Analysis of Financial Statements and Fraudulent Transactions.

Unit IV: Auditing (15 Hours)

Auditing Concept, Type, Principles, Internal Control- Internal Check and Internal Audit, Vouching and Verification of Assets and Liabilities. Dividend and Divisible Profits, Company Auditor: Qualifications and disqualifications, Appointment, Removal, Remuneration, Rights, Duties and Liabilities, Audit Committee, Auditor's Report: Contents and Types, Auditor's Certificates**.**

Assessment Method- Internal assessment, end-term theory examination.

Suggested Readings

1. Baldava, S., & Agarwal, D. (2021). Forensic Investigations and Fraud Reporting in India: Practical insights to Predict, Prevent, Detect and Investigate Frauds. Bloomsbury India.
2. Bansal, A. (2017). Forensic Accounting & Audit Anticipation in India. LAP Lambert Academic Publishing.
3. Devarajappa S., Gurudath A.S., Yadav R.A. (2015). Forensic Accounting and Auditing. Himalaya Publishing House Pvt. Ltd.
4. Devi, D. S. (2023). Basics of Forensic Accounting. Iterative International Publishers IIP. Joshi, A. (2012).
5. Kaur, K. (2019). Forensic Accounting and Auditing. Kanwaljeet Khorana.
6. Khan, A. (2024). Forensic Accounting, Fraud Investigation and Fraud Analytics.

DSE-13 FORENSIC ANALYTICAL CHEMISTRY

Paper	Total Credit	Lecture	Practical/ Practice	Pre-requisite of the course
Forensic Analytical Chemistry	**04**	**03**	**01**	Understanding of basic chemistry.

Course Outcomes

1. This course aims to provide comprehensive knowledge of forensic drug chemistry, petro forensics, fire chemistry, and explosives chemistry.
2. Students will learn to analyses narcotics, explosives, and petroleum products using various forensic techniques and instruments.
3. They will develop expertise in presumptive, screening, and confirmatory methods, as well as the interpretation of forensic data and report writing.
4. Additionally, students will gain an understanding of chemical warfare agents and their detection methods.

Learning Objectives

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

1. Analyze and identify various narcotic drugs and controlled substances
2. Apply presumptive and confirmatory methods,including chromatographic and spectroscopic techniques.
3. Conduct forensic analysis of petroleum products and investigate fire-related incidents.
4. Evaluate the properties and mechanisms of explosives and chemical warfare agents.

Unit I: Advanced Forensic Drug Chemistry (12 Hours)

Drug Trafficking, Forensic examination of drugs/Narcotics - Cannabis, Phenethylamines (Amphetamine, Methamphetamine), Hydroxyl derivative (Ephedrine), Ketone Derivative (Cathinone), Methoxy Derivative (Mescaline), Tertiary Amines (Cocaine and Opiates), Tryptamines (Psilocin and Psilocybin), Anabolic Steroids, Miscellaneous Controlled Substances (Barbiturates, Benzodiazepines, GHB, Ketamine and LSD).

Unit II: Detection Methods for the Narcotic Drugs (11 Hours)

Colour/spot test, microscopic examination, Microcrystalline tests, Thin-Layer Chromatography, Sample Preparation before TLC Specimen, Extraction Evaluation of TLC for Drug Screening, Immunoassay Methods other instrumental techniques (HPLC, GC, GC-MS) involved in analysis.

Determination of origin of narcotic drug by IRMS, Elemental Profiling by ICP-MS-MS Format of NDPS Report Writing & Courtroom Testimony. Case studies.

Unit III: Petro and Fire Forensics (11 Hours)

Petro Forensics: Distillation and fractionation of petroleum. Commercial uses of different petroleum fractions. Physical Properties of Petroleum Products Analytical Techniques: Quantitative and Qualitative Steps in Analysis of Petroleum, Analysis of traces of petroleum products in forensic exhibits. Case studies. Fire Chemistry: Scientific Investigation of Fire, NFPA 921 and NFPA 1033, Separation and analytical techniques of ignitable liquid residues, Interpretation of Data Obtained from Fire Debris, Quality Assurance in Fire Debris Analysis, Report Writing and Court Testimony. Case studies.

Unit IV: Explosives Chemistry (11 Hours)

Introduction and assessment of explosives, Oxygen balance, Explosive Power Index, Heat and Temperature of Explosion, Pressure of explosion, Mechanism of Ignition and hot spot formation. Thermal decomposition, physical and chemical aspects of combustion, Deflagration and Detonation, Analysis of low and high explosives by different instrumental techniques, Quality control, Proficiency Testing, Interpretation and Significance of Results. Case studies Chemical Warfare Agents: Classification, physical and biochemical properties, toxic effects detection by Biosensors and various instrumental techniques.

Practical's (30 Hours)

1. Separation of Psychotropic substance by TLC.
2. Separation of Cannabis TLC, UV, FTIR
3. Analysis of NDPS drugs and explosives by instrumental techniques
4. Analysis of high explosives by TLC, UV, FTIR
5. Qualitative Analysis of fire residues by GC-HS and GC-MS.

Assessment Method- As per University guidelines

Suggested Readings

1. Clarke's Analysis of Drugs and Poisons, (Formerly Isolation & Identification of Drugs) 3rd Ed. Vol. Set.
2. Clark, E.G.C.: Isolation and identification of Drugs, VI and Vol. II, 1966, 1975-1986.
3. Modi, Text Book of Medical Jurisprudence Forensic Medicines and Toxicology (1999) CBS Pub. New Delhi.
4. Saferstien (1982) Forensic Science, Handbook, Vol. I, II & III, Prentice Hall Inc. USA.
5. DFS -Working Procedure Manual- Narcotics.

DSE-14 CRYPTOGRAPHY & STEGANOGRAPHY

Paper	Total Credit	Lecture	Practical/ Practice	Pre-requisite of the course
Cryptography & Steganography	**04**	**03**	**01**	Basic understanding of encryption, decryption and digital forensic.

Course Outcomes:

1. To understand basics of cryptography and steganography
2. To learn how data is secured and hidden
3. To develop skills to detect encrypted and concealed information

Learning Objectives:

Students will be able to:

1. Explain basic encryption techniques
2. Understand how hidden data works
3. Identify and analyze digital evidence in simple cases

Unit I: Fundamentals of Cryptography (12 Hours)

Introduction, history, and importance of cryptography. Security goals: Confidentiality, Integrity, Authentication, Non-repudiation. Types: of Cryptography. Classical ciphers: Caesar, Vigenère, Playfair. Role of cryptography in digital forensics and cybercrime.

Unit II: Modern Cryptographic Techniques & Applications (11 Hours)

Basic ideas of Block and stream ciphers. Data Encryption Standard (DES) and Advanced Encryption Standard (AES). RSA algorithm (basic concept). Hash functions: MD5, SHA family. Digital signatures and certificates. Cryptographic protocols and secure communication.

Unit III: Cryptanalysis and Forensic Investigation (11 Hours)

Introduction to cryptanalysis. Attack methods: brute force, frequency analysis, known-plaintext attack. Password cracking and recovery techniques. Encryption in cybercrime (dark web, ransomware). Legal and ethical considerations.

Unit IV: Steganography (11 Hours)

Introduction and principles of steganography. Steganography vs cryptography. Types of Steganography: text, image, audio, video steganography. Techniques of Steganography LSB, masking, filtering, transform domain methods. Steganalysis, Tools and forensic approaches for hidden data extraction.

Practical's (30 Hours)

1. To perform AES/RSA encryption-decryption exercises.
2. Data hiding in images/audio using steganography tools.
3. Introduction to forensic tools (Autopsy, FTK basics)
4. Hashing and password cracking.

Assessment Method: As per university guidelines

Suggested Readings

1. W.Stallings - Cryptography and Network Security 6th Edition
2. Steganography: Seeing the Unseen by by Neil F. Johnson, Zoran Duric, and Sushil Jajodia
3. ***Handbook of Applied Cryptography*** by Alfred J. Menezes, Paul C. van Oorschot, and Scott A. Vanstone.
4. *Cryptography and Network Security* is a textbook by Behrouz A.

DSE-15 RESEARCH METHODOLOGY

Paper	Total Credit	Lecture	Practical/ Practice	Pre-requisite of the course
Research Methodology	**04**	**03**	**01**	Basic understanding of forensic science

Course Outcomes:

1. Understand advanced concepts and theoretical foundations of anthropological research
2. Integrate qualitative, quantitative, and holistic research methodologies
3. Develop competence in the tools and techniques used for the data collection in the field.
4. To develop competence in the advanced laboratory research techniques
5. To Apply the ethical principles in data collection and analysis.

Learning Objectives:

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

1. Explain advanced concepts and theories of anthropological research
2. Apply qualitative, quantitative, and holistic research methodologies
3. Demonstrate proficiency in advanced field data collection techniques
4. Perform advanced laboratory research techniques
5. Apply ethical principles in anthropological research

Theory

Unit 1: Foundations of Forensic Research (12 Hours)

Nature and scope of forensic research; Scientific method and evidence-based forensic science; Interdisciplinary nature of forensic investigations; Research problem identification, formulation of research questions, objectives and hypotheses; Philosophical foundations of forensic research—Positivism, Empiricism, Objectivity and Scientific Reasoning; Reliability, validity and reproducibility in forensic research; Ethics, integrity and quality assurance in forensic investigations.

Unit 2: Research Design and Methodological Approaches (12 Hours)

Research design and its types—exploratory, descriptive, analytical, experimental, cross-sectional longitudinal and case-control studies; Qualitative, quantitative and mixed-method research approaches; Sampling strategies and sample size considerations in forensic research; Experimental design and validation studies; Statistical methods for forensic research; AI, machine learning and digital technologies in forensic science research.

Unit 3: Crime Scene Research and Data Collection Techniques (10 Hours)

Advanced crime scene documentation; Photography, videography, 3D documentation and digita imaging; Development of data collection tools including observation schedules, questionnaires and interview protocols; Chain of custody and evidence documentation; Laboratory notebook maintenance; Case studies, report writing and interpretation of forensic findings; Literature review and scientific

databases.

Unit 4: Advanced Laboratory and Analytical Techniques (11 Hours)

Selection and validation of analytical methods; Instrumental techniques in forensic science; Biological, chemical and physical evidence examination; Molecular techniques, forensic DNA analysis and biomarkers; Spectroscopic and chromatographic applications; AI and machine learning in forensic data analysis; Quality assurance, quality control and accreditation (ISO/IEC 17025); Ethical and legal issues in forensic research.

Practical (30 Hours)

1. Formulation of a forensic research problem, objectives and hypotheses.
2. Preparation of a research proposal and experimental design.
3. Literature search using scientific databases and reference management software (Mendeley/Zotero).
4. Preparation of questionnaires, observation schedules and interview formats for forensic research.
5. Crime scene documentation using photography, sketching and digital recording.
6. Sampling strategies for biological, chemical and physical evidence.
7. Data coding, tabulation and descriptive statistical analysis using MS Excel/SPSS/R.
8. Interpretation of analytical data generated from forensic laboratory reports.
9. Preparation of scientific graphs, tables and data visualization.
10. Plagiarism checking and scientific referencing using APA/Vancouver style.
11. Preparation of scientific posters and oral presentations.
12. Writing a forensic research report/manuscript following standard scientific format.
13. Critical appraisal of published forensic research articles.
14. Seminar presentation and viva voce on a selected forensic research topic.

Assessment Method- As per University Guidelines

Suggested Readings

1. Houck, M.M., & Siegel, J.A. (2024). Fundamentals of Forensic Science (5th ed.). Academic Press.
2. Saferstein, R. (2023). Criminalistics: An Introduction to Forensic Science (13th ed.). Pearson.
3. Robertson, B., & Vignaux, G.A. (2016). Interpreting Evidence: Evaluating Forensic Science in the Courtroom (2nd ed.). Wiley.
4. Curran, J.M., Buckleton, J.S., & Gill, P. (2020). Forensic Interpretation of Glass Evidence. CRC Press.
5. Creswell, J.W., & Creswell, J.D. (2023). Research Design: Qualitative, Quantitative and Mixed Methods Approaches (7th ed.). Sage.
6. Kumar, R. (2020). Research Methodology: A Step-by-Step Guide for Beginners (5th ed.). Sage.
7. ISO/IEC 17025:2017. General Requirements for the Competence of Testing and Calibration Laboratories.
8. Sharma, B.R. (Latest Edition). Forensic Science in Criminal Investigation and Trials. Universal Law Publishing.

GE-5 FUNDAMENTALS OF NANOTECHNOLOGY

Paper	Total Credit	Lecture	Practical/ Practice	Pre-requisite of the course
Fundamentals of Nanotechnology	**04**	**03**	**01**	**Basic knowledge of science and chemistry.**

Course Outcomes:

1. Explain fundamentals of nanoscience and nanotechnology
2. Understand synthesis and properties of nanomaterials
3. Identify tools used for nanomaterial characterization
4. Apply nanotechnology in forensic investigations

Learning Objectives:

1. To introduce basic concepts of nanotechnology
2. To understand synthesis and properties of nanomaterials
3. To explore characterization techniques
4. To study applications of nanotechnology in forensic science

Unit I: Introduction to nanotechnology (12 Hours)

Definition and history of nanotechnology, Nanoscale and its importance, Classification of nanomaterials (0D, 1D, 2D, 3D), Unique properties of nanoparticles: optical, electrical, mechanical, chemical. Surface area to volume ratio and quantum effects. Applications of nanotechnology in general science.

Unit II: Synthesis of Nanomaterials (11 Hours)

Top-down and bottom-up approaches of Nanoparticle synthesis. Synthesis of nanoparticles by Physical methods (ball milling, lithography), Chemical methods (sol-gel, precipitation, chemical vapor deposition), Biological or green synthesis (plant extracts, microbes). Factors affecting nanoparticle synthesis. Safety and toxicity of nanomaterials.

Unit III: Characterization Techniques (11 Hours)

Introduction and importance of characterization Microscopy techniques: Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM), Atomic Force Microscope (AFM). Spectroscopy techniques: UV–Visible Spectroscopy, X-ray Diffraction (XRD), Fourier Transform Infrared Spectroscopy (FTIR). Particle size and surface analysis.

Unit IV: Forensic Applications of Nanotechnology (11 Hours)

Role of Nanotechnology in crime detection, Fingerprint detection using nanoparticles, Drug and explosive detection, DNA analysis and biosensors, Nanotechnology in toxicology, Future trends and challenges in forensic nanotechnology.

Practical's ((30 Hours)

1. Preparation of simple nanoparticles by biological matrix
2. Study of nanoparticle properties using basic techniques
3. Case studies on forensic applications
4. Visualisation of different types of nanoparticles in microscopy/spectroscopy tools.

Assessment Method- As per university guidelines

Suggested Readings

1. Introduction to Nanotechnology by *Charles P. Poole Jr.* and *Frank J. Owens*. Publisher John Wiley & Sons in 2003.
2. *Nanotechnology: Principles and Practices* is a textbook authored by S. K. Kulkarni
3. *Nanotechnology: A Gentle Introduction to the Next Big Idea*, 2002 by physicist Mark A. Ratner and engineer Daniel Ratner.
4. *Forensic Science: An Introduction to Scientific and Investigative Techniques* a comprehensive textbook edited by Stuart H. James.

GE-6 FORENSIC MEDICINE

Paper	Total Credit	Lecture	Practical/ Practice	Pre-requisite of the course
Forensic Medicine	**04**	**03**	**01**	Basic knowledge of forensic science

Course Outcomes:

1. Identify, examine and prepare report or certificate in medico-legal cases/situations in accordance with the law of land.
2. Examination of the death body on hanging, and suicide case.
3. Emerging trend for the investigation of death body for justice.
4. To identify the manner of death.

Learning Objectives:

After studying this paper, the students will know

1. The duties of the first responding officer who receives a call on homicide or suicide case.
2. The steps involved in processing the death scene.
3. The importance of ascertaining whether the crime was staged to appear as suicide or accident.
4. The importance of bloodstain patterns in reconstructing the crime scene.

Unit I: Forensic Medicine/Medico legal investigation (12 Hours)

Medical jurisprudence, Objectives of medico legal investigation, Death and its causes, types of death, Signs of death. Post mortem changes: classification, manner of death, Estimation of time since death, Post mortem biochemistry of the body fluids, Modern techniques used for the estimation of time since deaths, exhumation,

Unit II: Death and its Investigation (11 Hours)

Forensic Entomology: Identification of specific insects and their developmental stages (life cycles), Medico legal importance, Crimes against women Introduction to sexual offences, Natural and unnatural sexual offences, Abortion & Infanticide & SIDS, Deaths from starvation. Classification of asphyxia deaths: Hanging, Strangulation, evidence collection and analysis,

establishing manner of deaths, Suffocation, Drowning and traumatic asphyxia, medico legal importance of diatoms, medico legal importance.

Unit III: Medicolegal Aspects of Injuries (11 Hours)

Mechanical Injuries: Abrasions, Bruises, Lacerations, Incised wounds, Stab wounds, Firearm injuries, Defence injuries, fabricated injuries, vital clues for establishing the manner of deaths due to various injuries, Traffic accident injuries, Thermal injuries, Deaths due to electrocution - lightning, Electricity, Deaths due to explosions, Deaths due to Chemical trauma, Artificial Injuries.

Unit IV: Death Investigation (11 Hours)

Process of investigation and approach of investigator at the scene of death. Dying declaration. Dying deposition. Identifying of possible suspects and their interview. Interview of possible suspects, witnesses, and onlookers. Suspect in custody – initial interrogation and searching for evidence.

Practical's (30 Hours)

Test to differentiate between methanol and ethanol.

1. Extraction of poison by different techniques
2. Postmortem examination in various Asphyxial deaths.
3. Postmortem examination of various homicidal/ accidental injuries.
4. Microscopic Examination of Diatoms.
5. To Study the cases of drowning
6. To study the Cases of hanging

Assessment Method- As per University Guidelines

Suggested Readings

1. Sharma, B.R.; "Forensic Science in Criminal Investigation & Trials", Universal Publishing Co., New Delhi,
2. Chadha, PV; "Handbook of Forensic Medicine & Toxicology", Jaypee Brothers, New Delhi,
3. O"Hara CE and Osterburg, JW; "An Introduction to Criminalistics", Indiana Univ. Press, London,
4. J. Dix, Handbook for Death Scene Investigations, CRC Press, Boca Raton.
5. H.B. Baldwin and C.P. May in, Encyclopedia in Forensic Science Volume 1, J.A. Siegel,P.J. Saukko and G.C. Knupfer (Eds.), Academic Press, London.
6. V.J. Geberth, Practical Homicide Investigation, CRC Press, Boca Raton.

DISSERTATION: ON ANY SPECIALIZED FIELD OF FORENSIC SCIENCE

Paper	Total Credit	Lecture	Practical/ Practice	Pre-requisite of the course
DISSERTATION: ON ANY SPECIALIZED FIELD OF FORENSIC SCIENCE	**06**	**00**	**06**	**NIL**

Course Outcomes: The Dissertation aims to provide students with an opportunity to undertake independent research in a specialized area of forensic science. The course is designed to develop scientific inquiry, critical thinking, problem-solving abilities, and research ethics through the application of theoretical knowledge to practical forensic problems. Students will gain experience in research planning, experimental design, data collection, analysis, interpretation, scientific writing, and presentation while working under the guidance of a faculty supervisor. The project also seeks to enhance laboratory competence, familiarize students with contemporary forensic techniques and instrumentation, and prepare them for professional careers in forensic science, research, and academia.

Learning Objectives

- Identify and formulate a research problem relevant to forensic science.
- Conduct a comprehensive review of scientific literature and identify research gaps.
- Design and execute experimental studies using appropriate forensic methodologies.
- Apply laboratory techniques, analytical instruments, and statistical tools for data collection and analysis.
- Interpret experimental findings critically and draw scientifically valid conclusions.
- Demonstrate adherence to research ethics, laboratory safety, and quality assurance practices.
- Prepare a scientific dissertation following standard academic and research guidelines.
- Communicate research findings effectively through oral presentations, seminars, and viva-voce examinations.

Dissertation Guidelines:

The Dissertation shall be undertaken individually by each student under the supervision of a faculty member of the Department.

The research topic should be selected from any specialized area of forensic science, including but not limited to forensic biology, forensic chemistry, forensic toxicology, forensic anthropology,

questioned documents, fingerprint science, digital forensics, crime scene investigation, forensic psychology, forensic medicine, forensic ballistics, forensic entomology, forensic nanotechnology, environmental forensics, wildlife forensics, or other emerging areas.

Students shall prepare a research proposal containing the title, objectives, literature review, research methodology, expected outcomes, and timeline of work. The proposal shall be approved before commencement of experimental work.

The dissertation shall involve literature review, experimental investigation and/or field study, data analysis, interpretation of results, and preparation of a dissertation. Students are expected to maintain a project diary/laboratory record documenting experimental procedures, observations, and progress throughout the project period.