

M. Sc. (Forensic Science) First Year Semester I

Code of the course /Subject	Title of the course /Subject	Total Number of Periods
FRS 100 Th. Major Core	Research Methodology & IPR in Forensic Science	60 hrs (4 hrs/week)

Course Overview

This course introduces students to research concepts, methodologies, ethics, and intellectual property rights in forensic science. It emphasizes scientific investigation, ethical conduct, and publication standards.

Course Objectives

1. To understand fundamentals of research and methodology
2. To develop skills in designing forensic research studies
3. To learn ethical and publication practices
4. To understand Intellectual Property Rights and patent systems

Course Outcomes

1. After completing the course, students will be able to:
2. Design and conduct forensic research
3. Apply sampling and data collection techniques
4. Follow ethical standards in research
5. Understand IPR and patent drafting basics

Unit I: Basics of Research

(10 hrs)

Meaning of research problem, Definition, Types and Characteristics. Methods of Research: Experimental, Descriptive, Historical, Qualitative and Quantitative methods. Tools of Data Collection - Observation, interview schedule, questionnaire, experimental. Steps of Research. Application of ICT in research.

UNIT II: Research in Forensic Science I

(10 hrs)

Identification and criteria of selecting a research problem on Forensic Science (Hypothesis), Formulation of objectives, research plan, and its components. Literature search/review,

UNIT III: Research in Forensic Science II

(10 hrs)

Sampling- Principles, methods, types of sampling, rationale for using a particular sampling method. Population and sample size, sampling procedures (random and non-random) with terms of research in Forensic Science.

Unit IV: Research Ethics

(10 hrs)

Philosophy and Ethics: Introduction to philosophy and its relevance to research ethics. Ethical principles and moral philosophy in research Responsible Conduct of Research: Intellectual honesty and integrity in scientific research. Research misconduct: Falsification, fabrication, and plagiarism. Selective reporting and misrepresentation of data

Unit V: Publication Ethics**(10 hrs)**

Introduction to publication ethics and its importance. Best practices and standards in publication ethics (e.g., COPE, WAME). Conflicts of interest in research publication. Authorship and contributorship guidelines. Identification and handling of publication misconduct. Predatory publishers and journals. Group discussion on subject-specific ethical issues, authorship, and 4 conflicts of interest. Introduction to plagiarism detection software (e.g., Turnitin, Urkund Ethical issues.

Unit-VI: IPR**(10 hrs)**

Basic concept of Intellectual Property, Rationale behind Intellectual Property, intellectual property rights and patent law in India. Structure and Components of Indian patents Types of IP: Patents, Designs, Trademark, Copyright, technological research, innovation, Techniques of writing a patent.

Suggested Readings

1. Kothari. C.R., & Gara, G. Research Methodoloav: Methods and Techniques 4th Ed. New Age International, 2019 - Standard text for hypothesis, sampling, data analysis.
2. Montgomery, D.C. Design and Analysis of Experiments, 10th Ed. Wiley, 2020 – DOE ANOVA for forensic validation studies.
3. Arora, P.N., & Malhan, P.K. Biostatistics Himalaya Publishing, 2016 - Stats for forensic data, t-test, chi-square, regression.
4. WHO Research Ethics Training Curriculum, 2015 - Free PDF. Human subject ethics for forensic bio research
5. Wadehra, B.L. Law Relating to Intellectual Property, 5th Ed. Universal Law Publishing, 2016 - Indian Patents Act, Copyright Act
6. WIPO Intellectual Property Handbook 2004 - Free from wipo.int. Basics of patents, trademarks. trade secrets
7. Ganguli, P. Intellectual Property Rights: Unleashina the Knowledge Economy. Tata McGraw-Hill. 2001 - Case studies in biotech/forensics.

M. Sc. (Forensic Science) First Year Semester I

Code of the course /Subject	Title of the course /Subject	Total Number of Periods
FRS 101 DSC I.1	Advancement in Fingerprints Analysis	60 hrs (4 hrs/week)

Course Overview

This course focuses on advanced fingerprint development techniques including chemical, physical, and nanotechnology-based methods.

Course Objectives

1. To understand modern fingerprint development techniques
2. To study chemical and physical methods in detail
3. To explore nanotechnology applications

Course Outcomes

1. Students will be able to:
2. Develop latent fingerprints using advanced methods
3. Understand sequencing and enhancement techniques
4. Apply nanotechnology in fingerprint visualization

Unit-I: Powder & Fuming Methods (10 hr)

Traditional, Magnetic, Luminescent powder, Thermoplastic, Nanotechnology, Anti stroke; Powder suspension technique; Iodine Fuming Development Method, Cyanoacrylate fuming method; Chemical methods: Silver Nitrate & Reaction Mechanism, Ninhydrin-Chemistry and reaction Mechanism

Unit-II: Metal Deposition I (10 hr)

Silver nitrate, Physical developer- Chemistry and mechanism, Sequencing, reagent reliability test, bleach toning, potassium iodide toning, other toning process. Single Metal Deposition, Multimetal deposition- I, II, III, IV

Unit III: Metal Deposition II (10 hr)

Fluorescent and vacuum metal deposition-reaction mechanism, conventional gold zinc process, sequencing. Lipid Reagent: Sudan black, chemistry and mechanism of Oil red O, Nile red, European chelate, etc.

Unit IV: Chemical Method Development I (10 hr)

Silver Nitrate & Reaction Mechanism: Silver Nitrate reagent, Mechanism of silver nitrate development of fingerprint, Procedure of development, silver, pre- and post-treatment of silver nitrate. Chemistry & Reaction Mechanisms of Ninhydrin: Amino acid reagent, Ninhydrin Chemistry and reaction Mechanism, Forensic application. 6 Unit V: Chemical Method Development II (10 hr) Cyanoacrylate fuming, health and safety precautions, Pre-treatment and Post Treatment.

Unit-V: Nanotechnology (10 hr)

Introduction, Structure and properties of nanoparticles, Role of nanotechnology in Forensics,

role of nanotechnology in fingerprint development, stability of nanoparticles in solution: Van der Waals interactions, electrostatic repulsion, Steric Hindrance, Optical properties, Types of nanoparticles, Visualizing Finger marks using nanoparticles, Future Perspectives.

Unit-VI: Enhancement Techniques for Fingerprints in Blood (10 hr)

Introduction, Development of techniques for proof and enhancement of blood, Heme Techniques, Protein staining blood enhancement techniques, Powder suspension techniques, amino acid techniques, Spectrophotometric and spectrofluorimetric methods, Application of enhancement techniques, Aging of bloodstains, Sequencing of techniques to maximize enhancement and number of fingerprints.

Suggested Readings

1. Champod, C., et al. Fingerprints and Other Ridge Skin Impressions, 2nd Ed. CRC Press. 2016 - Modern standard, ACE-V probability models
2. Lee H.C.. & Gaensslen. R.E. Advances in Fingerprint Technology, 3rd Ed. CRC Press, 2013 - Chemical methods. IAFIS, Daubert.
3. Ashbaugh, D.R. Quantitative-Qualitative Friction Ridge Analysis. CRC Press, 1999 - Ridgeology, Poroscopy, Edgeoscopy.
4. SWGFAST Standards for Examining Friction Ridge Impressions. FBI, 2013 - Free PDFs. ACE-V documentation.
5. Bleay, S.M., et al. Fingerprint Development Techniques: Theory and Application
1. Wiley, 2018 - Ninhydrin, IND, DFO, vacuum metal deposition.
6. Dalrymple, B.E. The Fingerprint Sourcebook. NIJ. 2011 - Free from nij.ojp.gov. 600+ pages, all methods,

M. Sc. (Forensic Science) First Year Semester I

Code of the course /Subject	Title of the course /Subject	Total Number of Periods
FRS 102 DSC II.1	Criminalistics	45 hrs (3 hrs/week)

Course Overview

This course provides foundational knowledge of crime scene investigation, physical evidence, and forensic analysis techniques.

Course Objectives

1. To understand crime scene investigation
2. To study physical evidence handling
3. To learn reconstruction and reporting

Course Outcomes

1. Students will be able to:
2. Identify and collect evidence
3. Apply forensic analysis techniques
4. Perform crime scene reconstruction

Unit I: Introduction to Criminalistics (10 hrs)

Definition and scope of criminalistics, Relationship of criminalistics with forensic science, criminology, and criminal investigation, Historical development of criminalistics (Locard's principle, early crime-lab systems).

Unit II: Crime Scene Fundamentals (10 hrs)

Types and classification of crime scenes: indoor, outdoor, mobile, macroscopic vs. microscopic, Role of first responder, securing and isolating the scene, avoiding contamination, General search patterns (grid, spiral, strip, quadrant) and documentation basics (notes, sketches, photographs).

Unit III: Physical Evidence and Chain of Custody (10hrs)

Nature and types of physical evidence: trace, impression, biological, firearms-related, etc., Collection, packaging, labelling, and preliminary examination of evidence, Legal basis and principles of chain of custody; continuity, integrity, and court admissibility.

Unit IV: Forensic Chemistry and Trace Evidence (10 hrs)

Basic principles of chemical analysis of physical evidence (solvents, reagents, presumptive tests), Analysis of trace materials: glass, paint, fibres, soil, and fire/explosion debris, microscopic examination of trace evidence and case-oriented problems.

Unit V: Forensic Physics, Ballistics, and Impressions (10 hrs)

Principles of forensic physics relevant to criminalistics (trajectory, distance-of-fire, impact phenomena), Firearm and tool-mark evidence: identification of weapons, bullet and

cartridge-case examination, Footwear, tire, and tool impressions at crime scene; casting and enhancement techniques.

Unit VI: Reconstruction and Reporting in Criminalistics (10hrs)

Crime-scene reconstruction using physical evidence, bloodstain-pattern basics, and event sequencing, Preparation of forensic reports and expert opinions; objectives, structure, and language, Ethics in criminalistics, bias avoidance, and presentation of evidence in court.

Suggested Readings

1. Saferstein, R. Criminalistics: An Introduction to Forensic Science. 13th Ed Pearson, 2021 - Best UG/PG coverage of all trace evidence
2. Houck, M.M., & Siegel, J.A. Fundamentals of Forensic Science, 4th Ed. Academic Press. 2021 - Ch. 7-15 on trace impression, pattern evidence
1. 3. De Forest, P.R., Gaensslen, R.E., & Lee, H.C. Forensic Science: An Introduction to Criminalistics. McGraw-Hill. 1983 -
2. Classic
3. Houck, M.M. Trace Evidence Analysis. More Cases in Mute Witnesses. Academic Press, 2004 - Glass, paint, soil, fiber case studies.
4. Robertson, J. & Roux, C. Forensic Examination of Fibres, 3rd Ed. CRC Press, 2018 - Microscopy + MSP + FTIR

M. Sc. (Forensic Science) First Year Semester I

Code of the course /Subject	Title of the course /Subject	Total Number of Periods
FRS 103 DSC III.1	Forensic Physics	45 hrs (3 hrs/week)

Course Overview

This course deals with physical evidence analysis including glass, soil, accidents, impressions, and instrumental techniques.

Course Objectives

1. To understand physical evidence examination
2. To apply physics principles in forensic analysis

Course Outcomes

1. Students will be able to:
2. Analyse physical evidence scientifically
3. Interpret accident and impression evidence

Unit I: Physical Evidence (10 hrs)

Physical evidence and its types; Glass: types and composition, fracture pattern, forensic examination of glass; Paint: types and composition, forensic examination of paint; Soil: classification and composition, forensic examination of soil; Restoration of erased number: principle, techniques of alteration and restoration

Unit II: Forensic Investigation of Road Accidents (10hrs)

Road Design, Speed Limit, Banking of Roads, Breaking Distance, Types of Roads, Forensic Investigation of Accident and Hit & Run Cases, Primary Causes of Road Accidents, Types of Road Accidents, Analysis, Reconstruction and Prevention of Accidents, Airbag Mechanism & Injuries.

Unit III Impression Evidence-Footprint/Shoeprint (10 hrs)

Collection and lifting, comparison, gait pattern; Tire marks: types, collection, lifting and preservation, forensic examination; Tool marks: types, collection, preservation and forensic examination lifting, and.

Unit IV: Speaker Identification (10 hrs)

Speaker identification and tape authentication: voice production theory, Speech signal processing and pattern recognition, acoustic parameters of sound, analogue to digital conversion, Frequency and time domain representation of speech signal, fast Fourier transform, Authentication of audio video signal, Interpretation of voice evidence and Case studies.

Unit V (10 hrs)

Interaction of Radiation with Matter-Interaction of Radiation with Matter and Its Consequences. Reflection, Absorption, Transmission Scattering, Emission, Fluorescence,

Phosphorescence. Basic Concepts of Atomic and Molecular Spectroscopy, X-ray spectroscopy, elemental analysis, 3D scanning.

Unit VI: Forensic Investigation of Road Accidents (10 hrs)

Road Design, Speed Limit, Banking of Roads, Breaking Distance, Types of Roads, Forensic Investigation of Accident and Hit & Run Cases, Primary Causes of Road Accidents, Types of Road Accidents, Analysis, Reconstruction and Prevention of Accidents, Airbag Mechanism & Injuries.

Suggested Readings

1. Rose, P. Forensic Speaker Identification. Tavlör & Francis, 2002- Auditory + spectrographic methods.
2. SWGDE Best Practices for Forensic Image and Video Analysis. Latest - Free from swade.org. Authentication, ELA.
3. Baker, J.S. Traffic Collision Investigation, 11th Ed. Northwestern Univ.. 2017 – Skid marks. momentum. EDR data
4. Blitzer, H.L., & Jacobia, J. Forensic Digital maging and Photography. Academic Press, 2002 - ALS, scale photography O
5. Dalby, O. Butler D., & Birkett, J.W. Forensic Analysis of Gunshot Residue. Wiley, 2010- SEM-EDX, chem tests

M. Sc. (Forensic Science) First Year Semester I

Code of the course /Subject	Title of the course /Subject	Total Number of Periods
FRS 104 (i) DSE-I (i)	Forensic Psychology	60 hrs (4 hrs/week)

Course Overview

This course explores psychological principles applied in forensic investigations and criminal behaviour analysis.

Course Objectives

1. To understand behaviour and mental processes
2. To study forensic assessment techniques

Course Outcomes

1. Students will be able to:
2. Conduct psychological evaluations
3. Apply investigative interviewing techniques

UNIT I: Biological Foundation of Behaviour, Learning, Memory (7 L)

Neuron & Nervous System: Structure, function, synapse, and neurotransmitters; Central Nervous, Peripheral Nervous System, Autonomic Nervous System, Somatic Nervous system; Gestalt principles of perception

UNIT II- Assessment, Evaluation Interviewing and Interrogation (7 L)

Difference between clinical and forensic evaluation Forensic assessment; Clinical interview, Mental Status examination, Psychological Tests: Intelligence, Achievement and Aptitude tests, Personality tests (projective techniques and inventories), Neuropsychological Tests. Application of psychology tests to civil and criminal proceedings

UNIT III: Correctional Psychology (8 L)

Correctional facilities, Psychological assessment in corrections, Psychological treatment (i) Behavioural model (ii) Cognitive behavioural model, Community based intervention (rehabilitation), Juvenile correction: an overview, Psychological evaluation of juvenile offenders, Approaches to juvenile Rehabilitation (i) Group home model (ii) Family prevention models: homebuilders, Multisystem therapy, functional family therapy (iii) Boot Camps, Violence prevention program. Rehabilitation & Correctional Treatment of Offender(s) / Victim(s), Techniques, Strategies and Types of Treatments.

Unit IV: Elements of Forensic Psychiatry (8 L)

Forensic Psychiatry: Introduction to different mental illnesses; neurosis (depression, mood disorder, Insanity, Psychosis, Delusion, delirium, schizophrenia), Impulsive control stress disorder, Anti-social personality disorder, psychopathy, post traumatic stress disorder and post-

partum stress disorder. Substance Abuse, Association between mental disorder and crime, Mc Naughten rule, diminished responsibility, testamentary capacity.

Unit V: Learning and Memory (8L)

Learning: Definition, Classical Conditioning: Pavlov's experiment, extinction, spontaneous recovery, generalization, discrimination, higher-order conditioning, Operant Conditioning: Thorndike's Laws of learning, Skinner's experiment, positive reinforcer, negative-reinforcer, Bandura's Observation Learning Theory. Memory: definition and Process, The information-processing model: Three stages of memory (i) Sensory (ii) Short-term (iii) Long term, Types of long-term memory- Procedural, Declarative (episodic, semantic), Explicit and implicit.

Unit VI: Investigative Psychology (7 L)

Polygraph/Lie Detector Test, Brain Fingerprinting/Brain-Mapping, Narco-analysis; Case studies. Importance of Investigative Interviewing, Influence of Psychology, P.E.A.C.E Model of Interviewing, Cognitive Interviewing, Ethical Interviewing, Other Interview Techniques. Interrogation and the related Techniques.

Suggested Readings

1. Psychology, (2006) Ciccarelli, S. K. & Meyer G. E. New Delhi; Perason Education 'Social Psychology', Robert A. Baron & Nyla R. Branscombe, Pearson Education, India.
2. Introduction to Psychology, (1986) Morgan C.T., King R.A., Weisz J.R., Schopler J., McGraw-Hill Book Co.
3. Principles of General Psychology, 3rd ed. Kimble G.A., Garnezy, , New York
4. Psychology, (2001), Baron R.A. New Delhi; Pearson Education Pvt.Ltd.
5. Cognitive Psychology Mind and Brain', Edward E. Smith, Stephen M. Kosslyn, New Delhi, Pearson Education
6. Invitation to Psychology, Parameswaran, E.G., BeenaC.Tata McGraw-Hil, New Delhi.
7. Psychology-An Introduction, Thakkar P., Dr. Ambekar A.
8. Handbook of Forensic Psychology', Prof Dr. Vimala Veeraraghwan, Edition 1st, 2009, Selective and Scientific Books Publications, New Delhi
9. 'Introduction to Forensic Psychology-Research and Application', Curt R. Bartol, Anne M. Bartol, Editon 2nd, 2008, Sage Publication.
10. 'Handbook of Forensic Psychology', Irving B. Weiner, Allen K. Hiss, Edition 3rd, 2006, Wiley Publication.

M. Sc. (Forensic Science) First Year Semester I

Code of the course /Subject	Title of the course /Subject	Total Number of Periods
FRS 104 (ii) DSE-I (ii)	Quality Management	60 hrs (4 hrs/week)

Course Overview

This course covers cyber security fundamentals, including information and database security, network forensics, intrusion detection, biometrics, and recognition technologies like fingerprints and facial scans. It focuses on protecting systems, investigating breaches, and applying forensic techniques in digital environments.

Course Objectives

1. To understand information security domains, attacks, risk management, and controls like authentication and file protection.
2. To explore database security, SQL basics, multilevel security, and cloud computing forensics.
3. To learn network forensics, evidence collection, hacker tool investigation, and report writing.
4. To study network threats, firewalls, IDS, cryptography protocols, and biometrics including multi-modal systems.
5. To examine fingerprint scanning, matching, and face recognition technologies and applications.

Course Outcomes

1. After completing the course, students will implement security measures for systems, networks, and databases.
2. Conduct network forensics investigations, trace emails, analyse live systems, and produce forensic reports.
3. Deploy intrusion detection systems, firewalls, and biometric authentication methods.
4. Apply fingerprint and facial recognition for verification, identification, and security applications.

Unit-I: Quality Management (7 L)

Introduction to Quality, Definition of Accreditation, History and development of ISO Importance of accreditation in Forensic science laboratories, Process of accreditation, Procedure for sample selection, collection, preservation, packaging, identification, storage and transport.

Unit-II: Material & Method Management (7 L)

Traceability and Validation of new methods, measurement of uncertainty, Equipment maintenance and calibration, Evaluation of materials and reagents, sample and data handling in the laboratory, sample disposal, Assessment, interpretation and reporting of results.

Unit III: Quality Management in Laboratories (7 L)

Accreditation & Certification: Introduction and objectives, organizations and certifying bodies,

NABL, ISO, IEC, BIS. Safety management in laboratories, NABL guidelines for accreditation of laboratories.

Unit IV: Report Writing

(7 L)

Final examination and report writing - opinion writing and writing of reasons for opinion, importance of no opinion / qualified opinion, marking of photographs and their presentation case studies.

Unit V: Regulatory affairs

(7 L)

Basic principles of quality control (QC) and quality assurance (QA), Guidelines for QA and QC: raw materials, products and validation

Unit VI: Audit

(7 L)

Definition, types, process. People involved in audit. Forensic Auditing and its application. Cases

Suggested Readings

1. ISO/IEC 17025:2017 General requirements for the competence of testing and calibration laboratories- Mandatory for NABL labs.
2. Wilson, T., & Wilson, L. Quality Assurance in Forensic Science. CRC Press, 2020 - QMS specific to forensic labs
3. UNODC Guidance for the Implementation of a Quality Management System in Forensic Science Laboratories. UN, 2011-Free PDF. SOPs, audits
4. EURACHEM The Fitness for Purpose of Analytical Methods. 2nd Ed. 2014 -Method validation guide.Free PDF
5. Ellison, S.L.R., & Williams, A. Quantifying Uncertainty in Analytical Measurement. 3rd Ed. EURACHEM. 2012 -MU calculations.
6. Doyle, S. Quality Management in Forensic Science. Academic Press.2018 - Root cause, CAPA, proficiency testing.

M.Sc.(Forensic Science) First Year Semester -I

Code of the course /Subject	Title of the course /Subject	Total Number of Periods
FRS 105	DSC-II.1 Lab (Forensic Science Practical I)	30 Hrs. (4 hrs/ week)

Practical Outcomes

1. Protocol Execution: You will be able to act as a primary responder, securing the scene and initiating the First Responder Protocol to prevent contamination.
2. techniques for Challenging Surfaces (e.g., thermal paper or wet surfaces).
3. Fingerprint Individualization: You will gain proficiency in identifying Ridge Characteristics (Minutiae) and classifying prints using the Henry Ten-Digit System for instruments through Tool Mark Identification.

Practical List

1. Development of latent prints on challenging surfaces.
2. Development of latent prints by powder methods.
3. Chemical Enhancement of "Bloody" Fingerprints
4. Development of latent prints by ninhydrin.
5. Classification of fingerprints (ten digits)
6. Ridge counting of fingerprints.
7. lifting of prints from various challenging surfaces
8. Study of advanced techniques of fingerprint development in fingerprint analysis
9. Physical Evidence Collection & Packaging
10. Crime Scene Reconstruction Report

Suggested Readings

1. Saferstein, R. (2020). *Criminalistics: An Introduction to Forensic Science*. Pearson. (The gold standard for evidence collection and glass analysis).
2. James, S. H., & Nordby, J. J. (2014). *Forensic Science: An Introduction to Scientific and Investigative Techniques*. CRC Press.
3. Gardner, R. M., & Krouskup, D. R. (2018). *Practical Crime Scene Processing and Investigation*. CRC Press.
4. Daluz, H. M. (2018). *Fundamentals of Fingerprint Analysis*. CRC Press.
5. Bodziak, W. J. (2017). *Footwear Impression Evidence: Detection, Recovery and Examination*. CRC Press.
6. The Scientific Working Group on Friction Ridge Analysis, Study and Technology (SWGFAST). *Standard for Friction Ridge Digital Imaging*.
7. Fish, J. T., Miller, L. S., & Braswell, M. C. (2013). *Crime Scene Investigation*. Anderson Publishing.
8. FBI Handbook of Forensic Services. (A practical, go-to guide for packaging and chain of custody protocols).

M.Sc. (Forensic Science) First Year Semester -II

Code of the course /Subject	Title of the course /Subject	Total Number of Periods
FRS 106	DSC-III.1 Lab (Forensic Science Practical II)	30 Hrs. (4 hrs./ week)

Practical Outcomes

1. Chemical Etching: You will master the use of Fry's Reagent or Villella's Reagent to restore erased serial numbers on chassis or engine blocks by revealing the distorted metal grain structure.
2. Velocity Calculation: You will be able to estimate the pre-braking speed of a vehicle by measuring skid marks and applying the drag factor of various road surfaces (asphalt vs. gravel).
3. Safety System Evaluation: You will be able to correlate occupant injuries with airbag deployment timings to determine if the safety mechanisms functioned correctly or contributed to the trauma.
4. Casting & Lifting: You will become proficient in using Dental Stone for 3D impressions (mud/snow) and electrostatic lifters for 2D dust prints, preserving the "individual characteristics" (cuts/wear) for forensic comparison.

Practical List

1. Density gradient analysis of soil samples. 60 hrs (4 hrs/week)
2. Restoration of erased identification marks.
3. Determination of refractive index of glass and liquid.
4. Physical matching of broken pieces of different objects.
5. Determination of tensile strength of rope/dupatta.
6. Physical examination of paint samples.
7. Comparison of tool marks.
8. Glass Fracture Pattern Analysis
9. Restoration of erased identification marks.
10. Footwear Impression Casting

M. Sc. (Forensic Science) First Year Semester II

Code of the course /Subject	Title of the course /Subject	Total Number of Periods
FRS 201 DSC-I.2	Digital and Cyber Forensics	60 hrs (4 hrs/week)

Course Overview

This course covers cyber security fundamentals, including information and database security, network forensics, intrusion detection, biometrics, and recognition technologies like fingerprints and facial scans. It focuses on protecting systems, investigating breaches, and applying forensic techniques in digital environments.

Course Objectives

1. To understand information security domains, attacks, risk management, and controls like authentication and file protection.
2. To explore database security, SQL basics, multilevel security, and cloud computing forensics.
3. To learn network forensics, evidence collection, hacker tool investigation, and report writing.
4. To study network threats, firewalls, IDS, cryptography protocols, and biometrics including multi-modal systems.
5. To examine fingerprint scanning, matching, and face recognition technologies and applications.

Course Outcomes

1. After completing the course, students will implement security measures for systems, networks, and databases.
2. Conduct network forensics investigations, trace emails, analyse live systems, and produce forensic reports.
3. Deploy intrusion detection systems, firewalls, and biometric authentication methods.
4. Apply fingerprint and facial recognition for verification, identification, and security applications.

Unit I: Introduction (10 L)

Internet & web technologies, web hosting and development, attributes in cyberspace and legal framework of cyberspace, hacking, virus, obscenity, pornography, programme manipulation, Copyright, Patent, software piracy, intellectual property rights, trademark, domain disputes, and computer security, etc.

Unit II: Digital Forensic Investigation (10 L)

Identification of digital evidences, Search and seizures of evidence, necessary documentations such as Chain of Custody, pre-acquisition forms etc., Digital evidence handling at crime scene as per standards, Collection/Acquisition and preservation of digital evidences, Processing & analysis, Compilation of findings & Reporting, Pre-requisite for setting up Digital Forensic lab

and global 27 standards. Investigation of cybercrimes and tools for analysis. Encryption and Decryption methods. Cryptography: definition, types. Steganography

Unit III: Operating systems & Tools of forensic importance (10 L)

Understanding of Windows, Linux & Macintosh operating systems, understanding of mobile operating systems such as android, iOS, Windows, Blackberry etc., Deleted data recovery techniques: EnCase, Forensic Toolkit (FTK), The Sleuth kit, Open-source tools, Registry Analysis, Understanding Windows Registry and Registry Structure.

Unit IV- Mobile Forensic Analysis (10 L)

Mobile Forensics Cell phone and mobile device forensics, Understanding Mobile device forensics, understanding acquisition procedure, Cell phone Crimes, SIM Architecture, Data Storage, Data Extraction, Handling Mobile Devices as Sources of Evidence, Forensic Preservation of Mobile Devices, Forensic Examination and Analysis of Mobile Devices, Forensic Acquisition Investigative Reconstruction Using Mobile Devices Future trends

Unit V: Imaging / acquisition & data recovery (10 L)

Acquisition of stand-alone machine, peripheral device, other storage media, CCTV, systems (both physical & logical), Acquisition or triage collection of live system, Acquisition of mobiles, PDA's, Tablets, Navigation systems etc., Acquisition over the network i.e. remote acquisition, Understanding of various acquisition software/hardware device, details of various file formats of forensic image, Deleted data recovery techniques.

Unit VI: Registry and Logging (10 L)

Understanding and in-depth analysis of registry in various operating systems, Log analysis with respect to standalone machine and server, which includes event logs, ftp/sftp, application, Web Servers/ Proxy logs

Suggested Readings

1. Computer Security: Principles and Practice by William Stallings – Covers information security, cryptography, and network threats.
2. Database Security by Silvana Castano – Details SQL security, multilevel databases, and integrity controls.
3. Network Forensics: Tracking Hackers through Cyberspace by Sherri Davidoff – Focuses on evidence collection and live system analysis.
4. Hacking Exposed: Network Security Secrets and Solutions by Stuart McClure – Explains firewalls, IDS, and attack traceback.
5. Biometrics: Personal Identification in Networked Society by Anil K. Jain – Introduction to physiological biometrics and multi-modal fusion.
6. Handbook of Fingerprint Recognition by Davide Maltoni – Fingerprint scanning, matching, and enhancement techniques.
7. Face Recognition: From Theory to Applications by Harry Wechsler – Facial recognition technologies, accuracy, and applications.

M. Sc. (Forensic Science) First Year Semester II

Code of the course /Subject	Title of the course /Subject	Total Number of Periods
FRS 202 DSC–II.2	Questioned Document	45 hrs (3 hrs/week)

Course Overview

This course explores questioned document examination in forensic science, covering forgery detection, handwriting and signature analysis, document sources, alterations, and numismatic forgery. It emphasizes techniques for authenticating documents and identifying fraud in legal contexts.

Course Objectives

1. To identify types of forgery, including assisted signatures, disguises, and indicators of genuineness or illiteracy.
2. To examine signatures and handwriting for tremors, hesitations, and variations due to factors like age or stress.
3. To analyse sources like photocopiers, printers, and scanners for linkages in counterfeits.
4. To study watermarks, plastic cards, and numismatic forgery methods like casting and plating.

Course Outcomes

1. After completing the course, students will detect forgeries through handwriting comparison and tremor analysis.
2. Identify document alterations, obliterations, and device-specific marks using microscopic and chemical methods.
3. Link questioned documents to sources like printers or fax machines in forgery cases.
4. Examine holograms, credit cards, and coins for authenticity following forensic standards.

Unit I: Forgery (10 hrs)

Types of forgery, attributes of assisted hand signatures, disguise, discriminators of device, flag of forgery and characters of genuineness, indicators of illiteracy, gender discrimination. Physical constraints, Scope of questioned document examination.

Unit II: Signature Examination & Document Build-up (10 hrs)

Types of signatures; Examination of genuine signatures; Examination of forged signatures; Document build-up: sequence of strokes, obliterations, additions, erasures; Sequence of intersecting lines: ink vs pencil, pen vs fold, writing vs stamp; Indentations and ESDA for deciphering hidden writing; Charred and water-soaked documents: methods of preservation and examination

Unit III: Handwriting Identification – Principles & Variations (10 hrs)

Principles of handwriting identification: natural variation; Class vs individual characteristics in handwriting; Factors causing variation; Environmental factors; Tremor; Line quality

parameters: speed, pressure, rhythm, continuity, skill level; Collection of standards: admitted, request, non-request specimens – precautions

Unit IV: Sources of documents (10 hrs)

Types and working of Photostat machine, fax machine, printers, scanners. Identification & linkage of Photocopies and photocopier, typewriter, fax machine, scanner, Desktop printing including image processing device, their role in counterfeit currency and certificate etc.

Unit V: Other Documents (10 hrs)

Watermarks, Holographic mark and their examination, Examination of credit, debit and other plastic cards, examination of photocopies, scanned documents, Fax copies etc., and case studies.

Unit VI: Numismatic forgery (10 hrs)

11 Introduction, tool, equipment and other resource, method of forgery- alteration, tooling, embossing, application and plating, Casting: Rubber mould model, wax model from mould, burn out wax, treatment of casting, creating dye- Cutting by hand, plating, casting and hubbing.

Suggested Readings:

1. Harrison, W.R. Suspect Documents: Their Scientific Examination. Nelson-Hall, 1981.
2. Hilton, O. Scientific Examination of Questioned Documents. CRC Press, 1992.
3. Kelly, J.S., & Lindblom, B.S. Scientific Examination of Questioned Documents, 2nd Ed. CRC Press, 2006.
4. Ellen, D. Scientific Examination of Documents: Methods and Techniques, 4th Ed. CRC Press, 2018.
5. Levinson, J. Questioned Documents: A Lawyer's Handbook. Academic Press, 2001.
6. Koppenhaver, K.M. Forensic Document Examination: Principles and Practice. Humana Press, 2007.

M. Sc. (Forensic Science) First Year Semester II

Code of the course /Subject	Title of the course /Subject	Total Number of Periods
FRS 203 DSC–III.2	Forensic Ballistics	45 hrs (3 hrs/week)

Course Overview

This course offers a thorough exploration of forensic ballistics, spanning firearm history, mechanics, and evidentiary techniques. Students advance from basic firearm operations through internal, external, and terminal ballistics to evidence analysis and courtroom applications.

Course Objectives

1. Introduce history, classification, components, firing mechanisms, and operational principles of firearms and ammunition.
2. Examine ballistic phases including propellant ignition, pressure curves, trajectory, drag, impact effects, and forensic methods like toolmark analysis and GSR testing.
3. Build skills in crime scene reconstruction, shooting analysis, injury interpretation, and presenting evidence in court with case studies.

Course Outcomes

1. Upon completion, students will be able to:
2. Describe firearm parts, ballistic processes (internal/external/terminal), and influences like rifling, stability, penetration, and cavitation.
3. Conduct examinations of bullets, cartridge cases, gunshot residue, and range estimation using tools like IBIS.
4. Reconstruct incidents, analyse injuries, and deliver expert testimony on ballistic evidence.

Unit 1: Introduction and Fundamentals of Ballistics (10 L)

Definition, etymology, and branches of ballistics: internal, external, and terminal; Historical development; key figures in firearms and ballistics; Role of forensic ballistics in criminal investigations and court proceedings.

Unit 2: Firearms and Ammunition (10 L)

Classification of firearms: handguns, rifles, shotguns, automatic vs. semi-automatic; Parts and mechanism of common firearms (actions, barrels, firing mechanisms); Components of ammunition: cartridge case, primer, propellant, bullet/projectile; types of cartridges and bullets.

Unit 3: Internal Ballistics (10 L)

Processes inside the firearm: ignition, propellant burning, gas-pressure build-up, and recoil; Factors affecting internal ballistics: barrel length, rifling, cartridge design, chamber pressure; Concepts of muzzle velocity, chamber pressure curve, and energy transfer.

Unit 4: External Ballistics and Trajectory Analysis**(10 L)**

Motion of the projectile in air: gravity, drag, spin stabilization, and trajectory; Measurement and estimation of distance-of-fire, angle of fire, and ricochet; Practical methods for trajectory reconstruction at crime scenes (strings, lasers, basic calculations).

Unit 5: Terminal Ballistics and Wound Ballistics**(10 L)**

Interaction of projectiles with targets: penetration, deformation, fragmentation, and energy transfer; Types of gunshot wounds: contact, close-range, intermediate, and distant; entrance vs. exit wounds; Forensic evaluation of gunshot injuries and relation of wound pattern to angle, distance, and firearm type.

Unit 6: Firearms Examination, GSR, and Court Role**(10 L)**

Firearms identification: class and individual characteristics on bullets and cartridge cases; Gunshot residue (GSR) analysis: collection, chemical tests, and limitations; Legal and ethical aspects: chain of custody, expert testimony, report writing, and courtroom presentation of ballistic evidence..

Suggested Readings

1. Heard, B. J. Handbook of Firearms and Ballistics: Examining and Interpreting Forensic Evidence (2nd ed.). Wiley, 2008.
2. University of Kent. Introduction to Ballistics - FSCI4002 Module Syllabus.
3. Association of Firearm and Tool Mark Examiners (AFTE). A Simplified Guide to Firearms Examination.
4. Heard, B. J. Handbook of Firearms and Ballistics: Examining and Interpreting Forensic Evidence (2nd ed.). Wiley, 2008.
5. Kumar, K. Forensic Ballistics in Criminal Justice. Eastern Book Company, 1987.
6. Identification of Firearms and Forensic Ballistics. Forensic Bookstore, 2024.

M. Sc. (Forensic Science) First Year Semester II

Code of the course /Subject	Title of the course /Subject	Total Number of Periods
FRS 204 (i) DSE–II(i)	Cyber Security	60 hrs (4 hrs/week)

Course Overview

This course covers cyber security fundamentals, including information and database security, network forensics, intrusion detection, biometrics, and recognition technologies like fingerprints and facial scans. It focuses on protecting systems, investigating breaches, and applying forensic techniques in digital environments.

Course Objectives

1. To understand information security domains, attacks, risk management, and controls like authentication and file protection.
2. To explore database security, SQL basics, multilevel security, and cloud computing forensics.
3. To learn network forensics, evidence collection, hacker tool investigation, and report writing.
4. To study network threats, firewalls, IDS, cryptography protocols, and biometrics including multi-modal systems.
5. To examine fingerprint scanning, matching, and face recognition technologies and applications.

Course Outcomes

1. After completing the course, students will implement security measures for systems, networks, and databases.
2. Conduct network forensics investigations, trace emails, analyse live systems, and produce forensic reports.
3. Deploy intrusion detection systems, firewalls, and biometric authentication methods.
4. Apply fingerprint and facial recognition for verification, identification, and security applications.

Unit I: Information security (10 hrs)

Domains, Common Attacks, Impact of Security Breaches. Protecting Critical Systems (Information Risk Management, Risk Analysis, etc.) Information Security in Depth Physical security (Data security Systems and network security) Program Security: Secure programs, non-malicious program errors, Viruses and other malicious code, Targeted malicious code, Controls against program threats File protection mechanism, Authentication: Authentication basics, Password, Challenge-response, Biometrics.

Unit II: Database Security (10 hrs)

Introduction to Database, Basics of SQL, Security requirements, Reliability and integrity,

Sensitive data, Interface, Multilevel database, Proposals for multilevel security Cloud Computing- It's Forensic and Security Aspects

Unit III: Network Forensics (10 hrs)

Collecting Network Based Evidence - Investigating Routers - Network Protocols - Email Tracing - Internet Fraud. Systems Investigation and Ethical Issues. Data Analysis Techniques - Investigating Live Systems (Windows & UNIX) - Investigating Hacker Tools - Ethical Issues – Cybercrime. Report Writing Guidelines, A Template for Digital and Cyber Forensics report.

Unit IV: Network Security (10 hrs)

Threats in networks, Network security control, Firewalls, Intrusion detection systems, Secure email, Networks and cryptography, Example protocols: PEM, SSL, IPsec. Principles of network forensics, Attack Traceback and attributes, Critical Needs Analysis. IDS: Network based Intrusion Detection and Prevention Systems, Host based Intrusion Prevention System.

Unit V: Biometrics (10 hrs)

29 Introduction, Physiological or Behavioural, Verification vs Identification, Applications, Biometrics Technologies, Working of Biometrics, Benefits, Application Design. Multi-Modal Biometrics: Introduction to Multi-Modal Biometric Systems, Fusion Methodology, Levels of Fusion, Feature-Extraction Level Fusion, Data Matching Level Fusion, Probabilistic-Decision level Fusion, Fusion Procedure, Modes of Operation, Integration Strategies, Design Issues, Soft Biometrics, A Biometric Vision.

Unit VI: Fingerprint & Face Recognition (10 hrs)

What Is Fingerprint Scanning? Practical Applications for Fingerprint Scanning, Accuracy and Integrity, Fingerprint Matching, Fingerprint Classification, Fingerprint Image Enhancement, Fingerprint Feature Extraction, Fingerprint Form Factors, Types of Scanners: Optical - Silicon – Ultrasound, Fingerprint Matching. Introduction to Face Recognition, How is Face Recognition Technology Currently Being Used? How Well Does Face Recognition Work, Why Face Recognition, Face Recognition: How it Works, Image Quality, Facial Scan Process Flow, Verification vs. Identification, Primary Facial Recognition Technologies, Facial Recognition Applications

Suggested Readings

1. Computer Security: Principles and Practice by William Stallings – Covers information security, cryptography, and network threats.
2. Database Security by Silvana Castano – Details SQL security, multilevel databases, and integrity controls.
3. Network Forensics: Tracking Hackers through Cyberspace by Sherri Davidoff – Focuses on evidence collection and live system analysis.
4. Hacking Exposed: Network Security Secrets and Solutions by Stuart McClure – Explains firewalls, IDS, and attack traceback.
5. Biometrics: Personal Identification in Networked Society by Anil K. Jain – Introduction to physiological biometrics and multi-modal fusion.

6. Handbook of Fingerprint Recognition by Davide Maltoni – Fingerprint scanning, matching, and enhancement techniques.
7. Face Recognition: From Theory to Applications by Harry Wechsler – Facial recognition technologies, accuracy, and applications.

M. Sc. (Forensic Science) First Year Semester II

Code of the course /Subject	Title of the course /Subject	Total Number of Periods
FRS 204 (ii) DSE–II(ii)	Advancements in Forensic Science	60 hrs (4 hrs/week)

Course Overview

This course explores advancements in forensic science, including criminology theories, cutting-edge fingerprint analysis, security document examination, analytical techniques for questioned documents, forensic security measures, and the role of forensic journalism. It integrates theoretical and practical developments to address modern forensic challenges.

Course Objectives

1. To understand crime definitions, types, and theories like differential association, labelling, and biosocial perspectives.
2. To study advanced fingerprint classification systems and techniques such as AFIS, UV imaging, and chemical methods.
3. To examine security features in documents like currency, passports, and IDs, including holograms and optical inks.
4. To learn analytical tools like microscopy, VSC, and spectroscopy for questioned documents.
5. To explore preventive forensics, surveillance, building safety, and internal security strategies.
6. To grasp fundamentals of forensic journalism, crime reporting, and its impact through case studies.

Course Outcomes

1. After completing the course, students will analyse criminal behaviour using social and biosocial theories.
2. Apply advanced fingerprint identification methods and security document authentication techniques.
3. Use analytical instruments to detect forgeries in questioned documents.
4. Implement forensic security systems, surveillance, and preventive measures for internal threats.
5. Evaluate the role of forensic journalism in criminal investigations via case studies.

Unit I: Criminology

(7L)

Crime: definition and types; Theories of Crime: Social Perspective: Differential Association theory, Labelling theory, social learning Theory, Eysenck's biosocial theory, Substance abuse and crime, antisocial personality disorder & Psychopathy Offending pattern of Criminal Psychopath

Unit II: Advances in Fingerprint

(7L)

Primary classification, Single digit classification, Henry's ten-digit classification, AFIS

Advanced Methods: Radioactive technique, biological technique, reflected ultraviolet Imaging system, X-ray fluorescence, Chemical imaging

Unit III: Security Documents (8L)

Examination of security documents including currency notes, Revenue stamps, travel documents - passports, visas, air - tickets, identity cards, lottery tickets, driving license, Bills, educational and financial documents, etc. different types of security features and their examination including watermarks, wire marks, security fibre/threads, Ghost/imitated marks/ security printing, optical variable inks, holograms and all other security features.

Unit IV: Analytical Techniques in Questioned Documents (8L)

Magnifiers, Microscopy, Electrostatic Detection Apparatus, Video Spectral Comparator, Chromatography, Spectroscopy

Unit V: Forensic Security (8 L)

Preventive Forensics and their aids, safety gadgets, alarm systems, surveillance systems, Fire precautions, Fire audit, safety of buildings. Need and Scope of internal security of India, Defence against internal and external threats. Surveillance and counter surveillance, honey traps, Ports security.

Unit VI: Forensic Journalism (7L)

Introduction, History, Need and Scope, Fundamentals of crime reporting, editing, and writing. Forensic journalism in criminal cases. Case studies for importance of role of Forensic journalism.

Suggested Readings

1. Criminology: Theories, Patterns, and Typologies by Larry J. Siegel – Covers crime theories, psychopathy, and substance abuse links.
2. The Fingerprint Sourcebook by National Institute of Justice – Details AFIS, Henry classification, and advanced imaging techniques.
3. Security and Anti-Counterfeiting Features by David R. Crawford – Examines watermarks, holograms, and currency security elements.
4. Scientific Examination of Questioned Documents by David Ellen – Focuses on microscopy, VSC, chromatography, and spectroscopy.
5. Forensic Security: Practical Applications by George J. Mohay – Discusses surveillance, alarms, fire audits, and port security.
6. Forensic Journalism: A Criminologist's Guide by Mark O'Neill – Explores crime reporting, editing, and case study impacts.

M.Sc. (Forensic Science) First Year Semester -II

Code of the course /Subject	Title of the course /Subject	Total Number of Periods
FRS 205	DSC-I.2 Lab (Forensic Science Practical III)	30 Hrs. (4 hrs./ week)

Practical Outcomes

1. Vulnerability Mitigation: You will be able to implement Parameterized Queries and Input Validation to neutralize SQL Injection attacks in web applications.
2. Volatile Data Recovery: You will be able to perform Live Forensics, capturing RAM images and identifying active processes, open ports, and network connections before a system is powered down.
3. Malware Behavioural Analysis: You will simulate virus behaviour in a sandbox environment to understand infection vectors and signatures without risking the host machine.
4. Cryptographic Strength Assessment: You will analyse password hashing algorithms (e.g., SHA-256, crypt) and understand the impact of salt and pepper on resisting brute-force or rainbow table attacks.
5. Biometric Processing: You will be able to demonstrate the end-to-end Biometric Verification workflow and perform Feature Extraction on fingerprint images, specifically identifying "Minutiae" points (bifurcations and endings).

PRACTICAL LIST

1. Password Authentication Analysis
2. SQL Injection Defence
3. Network Traffic Capture
4. Firewall Configuration
5. Virus Detection Simulation
6. Live System Forensics
7. Biometric Verification Demo
8. Fingerprint Feature Extraction
9. IDS Alert Simulation
10. Multilevel Database Security

Recommended Readings

- Stallings, W. (2022). Computer Security: Principles and Practice. Pearson. (Covers Authentication, Firewalls, and IDS).
- Kim, D., & Solomon, M. G. (2021). Fundamentals of Information Systems Security. Jones & Bartlett Learning. (Excellent for SQL Injection and Database Security).
- Sanders, C. (2017). Practical Packet Analysis: Using Wireshark to Solve Real-World Network Problems. No Starch Press.
- Luttgens, J. T., Pepe, M., & Whitmore, K. (2014). Incident Response & Computer Forensics. McGraw-Hill Education. (Essential for Live System Forensics).
- O'Gorman, L., & Maltoni, D. (2009). Handbook of Fingerprint Recognition. Springer.
- Castano, S., et al. (1995). Database Security. ACM Press/Addison-Wesley. (Classic text for Multilevel Database Security concepts).

M.Sc. (Forensic Science) First Year Semester -II

Code of the course /Subject	Title of the course /Subject	Total Number of Periods
FRS 206	DSC-II.2 Lab (Forensic Science Practical IV)	30 Hrs. (4 hrs./ week)

Practical Outcomes

1. Source Identification: You will be able to distinguish between different types of printed matter (Laser vs. Inkjet) and identify unique "trash marks" or defects in typescripts and scanned documents that link them to a specific machine.
2. Surface Influence Analysis: You will understand how writing on varied surfaces (e.g., rough wood, smooth plastic, or soft napkins) affects the "natural variation" and "line quality" of a person's script.
3. Optical Differentiation (VSC): You will master the Video Spectral Comparator to identify alterations and obliterations using infrared (IR) and ultraviolet (UV) light.
4. Indented Impression Recovery: You will gain proficiency in using the Electrostatic Detection Apparatus (ESDA) to reveal "ghost" writing or indented impressions on lower sheets of paper without damaging the document.
5. Microscopic Verification: You will use the Stereo Zoom Microscope to examine microscopic features of paper Fibers, ink penetration, and fine mechanical defects.

PRACTICAL LIST

1. Examination of typescripts/printed matter/ Scanned documents/ fax.
2. Examination of handwriting for individualization.
3. Effect of different surfaces on natural variations in handwriting.
4. Working and handling of Video Spectral Comparator.
5. Working and handling of stereo zoom microscope.
6. Examination of security features of currency notes.
7. Determination of sequence of strokes by VSC.
8. Examination of alterations and obliterations by VSC.
9. Graphological Analysis of handwriting.
10. Working and handling of ESDA.

Recommended Readings

1. Hilton, O. (1992). Scientific Examination of Questioned Documents. CRC Press. (The foundational text for handwriting and typewriter analysis).
2. Osborn, A. S. (1929). Questioned Documents. (A classic, essential for understanding the philosophy of handwriting individualization).
3. Huber, R. A., & Headrick, A. M. (1999). Handwriting Identification: Facts and Fundamentals. CRC Press.
4. Brunelle, R. L., & Reed, R. W. (1984). Forensic Examination of Ink and Paper. Charles C Thomas Pub Ltd. (Crucial for VSC and ink-based practicals).
5. Ellen, D., Davies, S., & Conti, C. (2018). Scientific Examination of Documents: Methods and Techniques. CRC Press. (Excellent guide for ESDA and VSC handling).
6. Interpol. Counterfeit Currency Training Manual. (Provides detailed breakdowns of global currency security features).
7. Koppenhaver, K. M. (2007). Forensic Document Examination: Principles and Practice. Humana Press.

M. Sc. (Forensic Science) Second Year Semester III

Code of the course /Subject	Title of the course /Subject	Total Number of Periods
FRS 301 DSC-I.3	Forensic Chemistry	60 hrs (4 hrs/week)

Course Overview

This course introduces forensic chemistry, covering analytical techniques, fire and arson investigation, petroleum products, explosives, and alcoholic beverages analysis. It emphasizes chemical identification, legal aspects, and forensic examination methods for crime scene evidence.

Course Objectives

1. To understand analytical chemistry principles, volumetric/gravimetric methods, and separation techniques in forensic contexts.
2. To study fire chemistry, arson evidence collection, petroleum adulteration, explosives classification, and liquor analysis.
3. To learn preliminary/confirmatory tests, phenolphthalein examination, and BIS specifications for petroleum products.

Course Outcomes

1. After completing the course, students will perform chemical analysis of unknowns, accelerants, explosives, and liquors using GC-MS, FTIR, and titrimetric methods.
2. Identify arson patterns, collect/preserve evidence, and determine oxygen balance in explosives.
3. Analyse petroleum adulteration, congeners in beverages, and phenolphthalein in trap cases per legal standards.
4. Apply forensic schemes for fire debris, IEDs, and illicit liquors following BIS and Excise Act guidelines.

Unit I

(7L)

Introduction to Forensic Chemistry, branches of ad cases involved in Forensic chemistry, preliminary and confirmatory methods used in Forensic chemistry. Analytical Chemistry

I: Nature and scope of analytical chemistry in Forensic chemical analysis, Concept of Mole, Molecular Mass and Molecular Weight, Atomic Number and Atomic Mass, Classification of acids, bases and salts, pH value and pH scale, Buffer solutions Oxidizing and reducing agents in organic chemistry, Functional group analysis, Schemes of identification of unknown solids

Unit II

(7L)

Analytical Chemistry II: Volumetric/Titrimetric methods of analysis, Theory of indicators, Gravimetric methods of analysis, Process of precipitation, Saturated and supersaturated solution, Methods of sample preparation in organic and inorganic analytical chemistry,

Chemical separation Techniques: Solvent extraction (Liquid-liquid extraction), Phenolphthalein in trap case: Chemistry and Forensic examination of Phenolphthalein used in Bribe trap cases, and related legal issues

Unit-III (7L)

Fire & Arson: Chemistry of Fire, Combustion reaction, Fire Triangle, Fire Tetrahedron; Accelerants & types of accelerants, Combustible and Flammable liquids, Flash point, Fire point, Ignition point, Auto Ignition point, vapour density, vapour pressure, Fire extinguisher.; Arson: Legal Definition, Arson motives, Degrees of Arson, Forensic and legal Concepts, Determining origin and cause: Fire patterns. Collection/Preservation of Arson Evidences. Flashover, Backdraught, Documenting the fire or crime scene; Scheme of analysis: Extraction of samples from debris (Direct and solvent extraction methods, Head Space method, SPME, Distillation.

Unit-VI (7L)

Petroleum Products: Introduction to Petroleum Products, Properties and Testing of Petroleum and Petroleum Products, Adulteration of petroleum products as per Prevention of Malpractices in Supply and Distribution, Analysis of common petroleum products including, Petrol, Kerosene, Diesel, Lubricating Oil, Furnace Oil and Grease as per BIS specifications. Analysis of Dyes used in petroleum products, Chemical fingerprinting of petroleum products

Unit V: (7L)

Explosives-Nature, Classification, Composition and characteristics of Explosive (RDX, TNT, PETN, HMX, Nitro-glycerine, picric acid, Nitrocellulose), pyrotechnics, IEDs, commonly used Explosive devices, Explosion process and effects, types of hazards, effect of blast-wave on structures. Oxygen balance of explosives. Explosives and environment, forensic significance and case studies.

Unit-VI: (7L)

Liquors (Alcoholic beverages): Definition, classification of liquors based on origin (Indian Made Foreign Liquors, Country Made Liquors and Illicit Liquors), Fermented and Distilled methods (Pot Still and Continuous Still), Characteristics of Beer, wines and Whisky, Congeners in alcoholic beverages, Laws and penalties as per Excise/ Act. Laboratory methods of determination alcoholic strength, Forensic analysis of distilled and fermented liquors including illicit liquors.

Suggested Readings

1. Forensic Chemistry by Suzanne Bell – Covers analytical methods, fire chemistry, and explosives analysis.
2. Fire Investigation by David R. Redsicker – Details arson evidence collection, accelerants, and GC-MS techniques.
3. Explosives by Rudolf Meyer – Explains RDX, TNT compositions, blast effects, and forensic significance.
4. Forensic Analysis of Illicit Liquors by S. Sachdeva – Focuses on distillation, congeners, and strength determination.
5. Petroleum Products Analysis by BIS Standards Manual – Testing petrol, diesel, and dyes for adulteration.
6. Principles of Forensic Chemistry by Lawrence A. Kaplan – Volumetric analysis, buffers, and functional groups

M. Sc. (Forensic Science) Second Year Semester III

Code of the course /Subject	Title of the course /Subject	Total Number of Periods
FRS 302 DSC-II.3	Forensic Drug Analysis and Toxicology	60 hrs (4 hrs/week)

Course Overview

This course covers forensic toxicology and drug analysis, including poison classification, drug abuse, toxicokinetic, clinical management, laboratory extraction methods, and alcohol intoxication analysis. It emphasizes legal frameworks, instrumentation, and courtroom testimony for toxicological investigations.

Course Objectives

1. To understand poison classifications, forensic toxicology principles, and drug dependence chemistry.
2. To study toxicokinetic, biotransformation, clinical toxidromes, and analytical methods for poisons and drugs.
3. To learn alcohol analysis, report writing, and legal aspects of toxicology evidence.

Course Outcomes

1. After completing the course, students will classify poisons, analyse drugs under NDPS Act, and perform toxicological extractions.
2. Conduct clinical assessments, determine LD50/ED50, and interpret biotransformation of substances like codeine.
3. Analyse biological samples for alcohol, inorganics, and volatiles using GC and chemical tests.
4. Prepare toxicology reports and provide expert testimony in court.

Unit I: Forensic Toxicology: (7L)

Introduction, History and Pioneers; Different mode of Classification of Poisons, Areas of Forensic Toxicology, Elements of Forensic Toxicology, Applications, Scientific Principles, Instrumentation and equipment, Nature of cases, Role of the Forensic Toxicologist, Laws related to Forensic Toxicology, Poisons: Definition of Poison, Toxin and Toxicant, Ideal Poison, Classification of poisons based on their origin and Chemical nature, mode of action, Homicide and accidental animal poisoning; Forensic Veterinary Toxicology; Environmental Forensic Toxicology

Unit-II: Drug (7L)

Definition of Drug, Drug Use & Misuse, Drug Chemistry, Drug Dependence and chemistry of Addiction, Drug Receptors and Brain Chemistry. Drugs of Abuse: Definition, Classification based on Form and Origin, Use, Effects and Schedules, Structure of NDPS Act and the definitions of each drug classification, Drugs as Evidence, Profiling Examples of Illegal Drugs, United Nations International Drug Control Programme.

Unit-III: Forensic Pharmacology (7L)

Introductory Toxicokinetic: Overall Drug Disposition, Absorption, Toxicokinetics and Bioavailability, First-Pass Metabolism, Distribution, Free and Bound Drugs Elimination. Biotransformation: Phase-I and Phase-II reactions. Detection of poison on the basis of their metabolic studies, Some Examples of Applied Biotransformation Knowledge of Codeine, Morphine, Amphetamine Benzodiazepines etc.

Unit IV: Clinical Toxicology: (7L)

Introduction and history of clinical toxicology, Toxidrome, Management of the poisoned or overdosed patient, Laboratory principles, Pharmacokinetics and Toxicokinetics overview, Administration, liberation, and absorption of toxicants, Prevention of absorption from the gastrointestinal tract, Distribution and Metabolism of Toxicants in the body, Elimination of toxicants, Enhancement of elimination of toxicants, Types of Antidotes in poisoning cases.

Therapeutic Drug Monitoring: Introduction, Therapeutic and toxic concentrations of some forensic related substances, Criteria to assess the clinical value of drug monitoring, Methods of analysis; Measuring Toxicity: Qualitative Descriptions of Toxicity Exposure Limits, Determination of LD50 and ED50,

Unit V: (7L)

The Role of the Laboratory in Diagnosis and Treatment of Poisoning, The Structure of Clinical Toxicology Testing. Methods of extraction: Classical and Modern methods, Isolation and clean up procedures using conventional as well as modern techniques.

Analysis of Poisons: Inorganic poisons (cations and anions), Neutral poison (organic non-volatile), Method of analysis of Basic drugs / poisons, Method of analysis of Acidic drugs / poisons, Method of analysis of metallic poisons and volatile poisons, Analysis of samples taken under Food Adulteration Act, Toxicological analysis of decomposed materials.

Unit VI: Alcohol Intoxication & analysis: (7L)

Related cases, Properties and types of Alcohols, Pharmacology, Toxic properties and effects of alcohol. Chemical tests for alcohol in blood and urine including Breath Alcohol Screening devices, Method of analysis of some alcoholic beverages in biological materials by chemical methods (Kozelka- Hine) and instrumental methods (GC), Legal context to drinking and driving. Format of Report Writing & Court Room Testimony: Information required by the Forensic toxicologist, Presenting findings in a Report format.

Suggested Readings

1. Principles of Forensic Toxicology by Barry S. Levine – Covers poison classification, toxicokinetics, and lab analysis.
2. Forensic Pharmacology by Charles Hardman – Details drug receptors, biotransformation, and clinical toxidromes.
3. Drug Abuse Handbook by Steven B. Karch – Explains NDPS schedules, profiling, and addiction chemistry.
4. Clarke's Analytical Forensic Toxicology by Anthony C. Moffat – Methods for poisons, metals, and alcohol in biological samples.
5. Veterinary Forensic Toxicology by Ryan R. Ramey – Focuses on entomotoxicology and animal poisoning cases.

M. Sc. (Forensic Science) Second Year Semester III

Code of the course /Subject	Title of the course /Subject	Total Number of Periods
FRS 303 DSC-III.3	Forensic Medicine	45 hrs (3 hrs/week)

Course Overview

The curriculum spans key forensic domains: legal aspects (IPC, CrPC, Evidence Act), thanatology (post-mortem changes), injuries (mechanical, thermal), asphyxial deaths, sexual jurisprudence, and toxicology (poisons, exhibits). It emphasizes hands-on medico-legal autopsies, wound interpretation, and evidence preservation, aligning with Indian medical standards like those from AIIMS and MCI.

Course Objectives

1. Enable students to understand medico-legal responsibilities, including inquests, ethics, and certification under relevant laws.
2. Develop skills in diagnosing death modes, estimating time since death, and conducting autopsies/exhumations.
3. Train in injury classification, scene analysis for asphyxia/trauma, and identification via fingerprints/DNA.

Course Outcomes

1. Accurately interpret post-mortem changes (rigor mortis, livor) and perform forensic autopsies.
2. Classify wounds/firearm injuries and assess regional trauma from accidents.
3. Analyse sexual offenses, conduct medico-legal exams, and preserve exhibits like stains/blood.
4. Identify poisons/substances and prepare toxicology reports for legal proceedings.

Unit I: Introduction and Legal Aspects (7L)

Covers definitions, history, and scope of forensic medicine, including medical jurisprudence. Key topics include relevant laws (e.g., IPC, CrPC, Evidence Act), inquests, courts, medical ethics, and professional misconduct. Students learn medical certification and council functions.

Unit II: Forensic Thanatology (7L)

Focuses on death processes: modes, signs, and time estimation (rigor mortis, livor, algor, putrefaction). Includes medico-legal autopsy, exhumation, and embalming. Practical skills involve interpreting post-mortem changes.

Unit III: Injuries and Trauma (7L)

Examines mechanical, thermal, electrical, and chemical injuries, plus wound ballistics and regional injuries (e.g., traffic accidents). Covers classification, healing, and medico-legal exams of wounds. Firearm injuries and regional trauma are emphasized.

Unit IV: Asphyxia and Special Deaths (7L)

Details violent asphyxial deaths (hanging, strangulation, drowning), starvation, and thermal deaths. Includes forensic psychiatry and infanticide. Students study scene interpretation and cause determination.

Unit V: Sexual Jurisprudence and Identification (7L)

Addresses sexual offenses, virginity, pregnancy, impotence, and legitimacy. Covers personal identification (age, fingerprints, DNA, bite marks, hairs, Fibers). Medico-legal exams for assault cases are practiced.

Unit VI: Toxicology and Exhibits (7L)

Explores poisons (plant, snake, metals), identification of substances, and toxicological analysis. Includes preservation of medico-legal exhibits (stains, weapons, cloth) and biological fluids. Demonstrations cover instruments and reports.

Suggested Readings

1. Textbook of Forensic Medicine and Toxicology by Nagesh Kumar - Covers all units with Indian law integration.
2. Modi's Medical Jurisprudence and Toxicology - Standard for IPC/CrPC applications and thanatology.
3. Forensic Pathology by Vincent DiMaio - Detailed on injuries, asphyxia, autopsies.
4. AIIMS Forensic Medicine Curriculum - Practical guidelines for MBBS, matching FRS 303 topics (PDF link).
5. Parikh's Textbook of Medical Jurisprudence, Forensic Medicine & Toxicology - Excellent for sexual jurisprudence and identification.
6. Principles of Forensic Medicine by Apurba Nandi - Focuses on ethics, inquests, exhibits.
7. NCISM Undergraduate Syllabus (FMT) - Aligns with units on poisons and medico-legal exams

M. Sc. (Forensic Science) Second Year Semester III

Code of the course /Subject	Title of the course /Subject	Total Number of Periods
FRS 304(i) DSE-III (i)	Advanced Instrumentation in Forensic Science	45 hrs (3 hrs/week)

Course Overview

This course explores advanced instrumentation in forensic science, covering microscopy, spectroscopy, chromatography, biological/DNA analysis, and emerging technologies. It emphasizes principles like accuracy, calibration, and chain of custody for reliable forensic evidence processing.

Course Objectives

1. To understand instrument classification, validation, and quality control in forensic labs.
2. To study microscopy, imaging, spectroscopic, and chromatographic techniques for trace evidence.
3. To learn DNA instrumentation, mass spectrometry, and portable/emerging forensic tools.

Course Outcomes

1. After completing the course, students will calibrate instruments and apply microscopy/spectroscopy for GSR, drugs, and Fibers.
2. Perform chromatographic separations and DNA analysis using PCR, STR typing, and LC-MS/MS.
3. Utilize specialized tools like VSC, IBIS, and portable analysers for field and lab investigations.
4. Ensure data integrity through chain of custody and AI-enhanced image processing.

Unit 1: Introduction to Forensic Instrumentation (7L)

Role of instruments in forensic investigations; Classification: physical, chemical, biological, imaging instruments; Basic principles: accuracy, precision, sensitivity, LOD, LOQ; Calibration, validation, and quality control in forensic labs; Chain of custody for instrument data and reports

Unit 2: Microscopy and Imaging Techniques (7L)

Light microscopy: compound, comparison, polarized, fluorescence; Stereomicroscope for trace evidence: hair, Fiber, paint; Electron microscopy: SEM-EDX for GSR, tool marks, diatoms; Forensic photography, alternate light sources, UV/IR imaging ; Basics of Virtopsy: CT, MRI in post-mortem examination

Unit 3: Spectroscopic Techniques (7L)

UV-Visible spectroscopy: drug analysis, blood detection; FTIR spectroscopy: polymers, Fibers, explosives, paint; Raman spectroscopy: inks, drugs, questioned documents; Atomic Absorption Spectroscopy AAS and ICP-MS for heavy metals; X-ray techniques: XRF, XRD for bullet lead, soil, glass

Unit 4: Chromatographic Techniques (7L)

Principle of separation and forensic applications; Thin Layer Chromatography TLC: inks, drugs, plant poisons; Gas Chromatography GC and GC-MS: alcohol, arson, drugs, pesticides, High Performance Liquid Chromatography HPLC: pharmaceuticals, explosives; LC-MS/MS for toxicology and doping analysis

Unit 5: Biological and DNA Instrumentation (7L)

PCR and Real-Time PCR: DNA amplification principles; Genetic analysers and capillary electrophoresis for STR typing; Automated DNA extraction systems; ELISA and immunoassay instruments for drug screening; Biosensors and microfluidic devices in forensic biology

Unit 6: Specialized and Emerging Instruments (7L)

Mass Spectrometry: MALDI-TOF, HRMS in toxicology and proteomics; Neutron Activation Analysis NAA for trace elements; Document examination tools: VSC, ESDA, stereo zoom; Ballistics: comparison microscope, automated IBIS/BAS ; Portable instruments: handheld Raman, FTIR, drug analysers for field use; Recent advances: AI in image analysis, portable DNA sequencers

Suggested Readings

1. Forensic Analytical Chemistry by William J. Higgs – Covers spectroscopy, chromatography, and validation principles.
2. Electron Microscopy in Forensic Science by Thomas Kubic – Details SEM-EDX for GSR and tool marks.
3. Forensic Applications of Gas Chromatography/Mass Spectrometry by John J. Manura – Arson, drugs, and explosives analysis.
4. DNA Fingerprinting: Advanced Methods by J. T. Robertson – PCR, STR profiling, and genetic analysers.
5. Handheld Forensic Instruments by David Jadlocki – Portable Raman, FTIR, and field drug testing.
6. Emerging Technologies in Forensic Science by Sarah S. Phinn – AI, Virtopsy, and portable sequencers.

M. Sc. (Forensic Science) Second Year Semester III

Code of the course /Subject	Title of the course /Subject	Total Number of Periods
FRS 304(ii) DSE-III (ii)	Legal Aspects in Forensic Science-I	45 hrs (3 hrs/week)

Course Overview

This course examines legal aspects of forensic science, covering fundamentals, crime scene protocols, evidence admissibility, criminal procedures, expert testimony, and comparative jurisdictions. It emphasizes chain of custody, court standards, and ethical practices for forensic evidence in Indian and international legal systems.

Course Objectives

1. To understand forensic science history, ethics, chain of custody, and crime scene management under legal protocols.
2. To study evidence admissibility rules, CrPC, Evidence Act, and special laws like NDPS and POCSO.
3. To learn expert testimony, criminal profiling, and comparative forensic practices across jurisdictions.

Course Outcomes

1. After completing the course, students will secure crime scenes, document evidence, and maintain chain of custody per ISO 17025.
2. Prepare forensic reports and provide admissible testimony under Daubert/Frye standards and Indian laws.
3. Analyse criminal procedures, evaluate evidence in special acts, and compare international forensic admissibility rules.

Unit I: Fundamentals (7L)

History definition, scope, and ethics of forensic science in legal contexts, including fundamental rights and the role of forensic labs. Introduces chain of custody as a core legal principle to prevent evidence tampering. crime scene management basics and court procedures for expert testimony.

Unit II: Crime Scene Investigation (7L)

Focuses on legal protocols for securing scenes, documentation, search patterns, and evidence collection/packaging. Discusses roles of first responders and preservation techniques to maintain evidentiary integrity. Includes health/safety protocols and initial reporting under criminal procedure codes.

Unit III: Evidence Admissibility (7L)

Examines rules for admitting forensic evidence in court, such as relevance, reliability, and expert qualifications (e.g., Daubert/Frye standards). Covers report writing per ISO/IEC 17025:2017 and presentation of findings. Analyses challenges like contamination or bias in forensic testimony.

Unit IV: Criminal Procedure and Acts (7L)

Details elements of CrPC (e.g., FIR, arrest, bail), Indian Evidence Act, and constitutional provisions relevant to forensics. Includes socio-economic and environmental crime laws, plus special acts like POCSO, POCA, and NDPS. Explores integration of forensics in investigations and prosecutions.

Unit V: (7L)

Expert Testimony and Profiling, forensic expert's role in civil/criminal cases, criminal profiling, and medico-legal aspects like cause/time of death. Interrogation techniques and their legal limits. evaluate evidentiary value and cross-examination strategies.

Unit VI: Comparative Jurisdictions (7L)

Compares forensic evidence rules in India, UK, and US, including differences in lab organization and judicial powers. Reviews international standards for digital/trace evidence and emerging issues like digital forensics admissibility. case studies on miscarriages of justice due to forensic mishandling.

Suggested Readings

1. Forensic Science in Criminal Investigation by B.R. Sharma – Covers CrPC, Evidence Act, and chain of custody.
2. Criminal Procedure Code by R.V. Kelkar – Details FIR, arrest, bail, and forensic integration.
3. Forensic Evidence in Court by David E. Shelton – Explains Daubert standards and expert testimony.
4. Indian Evidence Act by V.P. Sarathi – Rules for admissibility and cross-examination strategies.
5. Ethics in Forensic Science by Peter C. Giannelli – Bias prevention and lab accreditation.
6. Criminal Profiling: An Introduction by Brent E. Turvey – Medico-legal aspects and interrogation limits.

M.Sc. (Forensic Science) Second Year Semester -III

Code of the course /Subject	Title of the course /Subject	Total Number of Periods
FRS 305	DSC I.3 Lab 5 (Forensic Science Practical V)	30 Hrs. (4 hrs./ week)

Practical Outcomes

1. Analytical Profiling: You will be able to identify functional groups in unknown solid samples (e.g., suspected narcotics or explosives) using qualitative chemical tests.
2. Toxicological Extraction: You will master Liquid-Liquid Extraction (LLE) to isolate drugs from biological matrices based on their pKa values (Acid-Base Drug Extraction).
3. Toxidrome Recognition: You will be able to identify clinical "toxidromes" (patterns of symptoms) to predict the class of poison involved and select the appropriate chemical antidote.

Practical List

1. Functional Group Analysis of Unknown Solids
2. Acid-Base Titration with Forensic Indicators
3. Gravimetric Analysis of Inorganic Evidence
4. Solvent Extraction of Organic Compounds
5. Phenolphthalein Detection in Trap Cases
6. Fire Triangle & Combustion Reaction Demo
7. Accelerant Identification by Flash Point
8. Arson Debris Extraction (Headspace Method)
9. GC-MS Simulation for Flammable Liquids
10. Petroleum Product Adulteration Testing

Recommended Readings

1. Bell, S. (2012). *Forensic Chemistry*. Pearson. (Comprehensive for functional groups and trap cases).
2. DeHaan, J. D., & Icove, D. J. (2011). *Kirk's Fire Investigation*. Brady/Pearson. (The definitive text for Arson and the Fire Triangle).
3. Bureau of Indian Standards (BIS). *Methods of Test for Petroleum and its Products*. (Specific to adulteration testing).
4. Klaassen, C. D. (2018). *Casarett & Doull's Toxicology: The Basic Science of Poisons*. McGraw-Hill. (Essential for Toxicokinetics and Biotransformation).
5. Flanagan, R. J., et al. (2007). *Fundamentals of Analytical Toxicology*. Wiley. (Excellent for extraction methods and GC simulation).
6. Moffat, A. C., et al. (2011). *Clarke's Analysis of Drugs and Poisons*. Pharmaceutical Press. (The "bible" for drug identification and chemical tests).

M.Sc. (Forensic Science) Second Year Semester -III

Code of the course /Subject	Title of the course /Subject	Total Number of Periods
FRS 306 (i/ii)	DSE I.3 (i/ii) Lab 6 (Forensic Science Practical-VI)	30 Hrs. (4 hrs./ week)

Practical Outcomes

1. Spot Test Proficiency: You will gain the ability to perform presumptive colour tests (e.g., Marquis for opiates, Duquenois-Levine for cannabis) to narrow down drug classes.
2. Clinical Forensic Correlation: You will master the identification of Toxidromes (e.g., Anticholinergic, Opioid, Sympathomimetic) to provide life-saving antidote recommendations during emergency screenings.
3. Quantitative Accuracy: You will perform the Kozelka-Hine method, using steam distillation and redox titration to measure Blood Alcohol Concentration (BAC) with forensic precision.

Practical List

1. Classification and Extraction of Poisons
2. Drug Identification by Chemical Tests
3. Toxicokinetics Simulation (Absorption/Distribution)
4. Biotransformation of Codeine to Morphine
5. Toxidrome Recognition and Antidote Selection
6. Inorganic Poison Analysis (Cations/Anions)
7. Acid-Base Drug Extraction Methods
8. Volatile Poison Detection (GC Simulation)
9. Blood Alcohol Analysis (Kozelka-Hine Method)
10. Breath Alcohol Testing and Report Writing

Suggested Readings

1. Moffat, A. C., et al. (2011). *Clarke's Analysis of Drugs and Poisons*. Pharmaceutical Press. (This is the primary reference for all chemical tests and extraction pKa values).
2. Flanagan, R. J. (2007). *Fundamentals of Analytical Toxicology*. Wiley. (Excellent for Stas-Otto and Kozelka-Hine methodologies).
3. Klaassen, C. D. (2018). *Casarett & Doull's Toxicology: The Basic Science of Poisons*. McGraw-Hill. (Best for Toxicokinetics and Biotransformation mechanics).
4. Nelson, L. S., et al. *Goldfrank's Toxicologic Emergencies*. McGraw-Hill. (The gold standard for Toxidrome recognition and Antidotes).
5. Baselt, R. C. (2017). *Disposition of Toxic Drugs and Chemicals in Man*. Biomedical Publications. (Reference for half-lives and distribution rates).

M.Sc. (Forensic Science) Second Year Semester- III [Level 6.5]

Code of the Course / Subject	Title of the Course/Subject	(Total Number of Periods)
FRS 307	Lab 07 (Research Project Phase I)	90 hrs (2Tut. + 4 P = 6 hrs/week)

Course Outcomes: At the end of the course students will be able to..

1. Identify a research problem and carry out literature survey
2. Analyse the research gap and formulate the problem
3. Interpret the data and synthesize research findings.

Research Project Phase I: It should be based on rigorous literature survey, finding research gaps, preparation of research proposal to be executed in the next semester. There will be a presentation on the topic selected for the research project. Students need to submit the synopsis of the proposed research work.

Modalities:

1. Individual or group projects can be taken up
2. Involve in literature survey in the chosen field.
3. Use Science/Engineering principles to solve identified issues.
4. Adopt relevant and well-defined / innovative methodologies to fulfil the specified objective
5. Submission of scientific report in a specified format.

Examination: FRS 307	Lab 7 Research project Phase I	Max Marks 50 (Internal)
A.	Submission of Research proposal synopsis	25
B.	Presentation on the research proposal synopsis	25
	Total	50

M.Sc. (Forensic Science) Second Year Semester -IV

Code of the course /Subject	Title of the course /Subject	Total Number of Periods
FRS401 DSC I.4	Forensic Biology	60 hrs (4 hrs/week)

Course Overview (Theory Paper)

This course provides a comprehensive understanding of biological evidence in forensic science, including its identification, collection, and analysis. It integrates concepts of cell biology, plant biology, forensic botany, diatomology, palynology, and human physiology to explain their role in crime investigation and evidence interpretation.

Course Objectives

- To understand the nature and significance of biological evidence
- To develop knowledge of cellular and biomolecular concepts in forensics
- To study plant biology and its forensic applications
- To understand specialized fields like forensic botany, diatomology, and palynology
- To analyse human biological traces such as hair, Fibers, and tissues

Course Outcomes

- After completing the course, students will be able to:
- Identify and interpret different types of biological evidence
- Apply cell biology and biomolecular concepts in forensic analysis
- Examine and analyse plant-based evidence in criminal cases
- Understand the role of diatoms and pollen in forensic investigations
- Perform basic examination of hair, Fibers, and biological traces
- Relate human physiology and anatomy to forensic casework

UNIT I: BIOLOGICAL EVIDENCE AND CRIME SCENE INVESTIGATION

Definition, scope and significance of biological evidence in forensic science, types of biological evidence, recognition and location of biological evidence at crime, crime scene search and documentation, collection and preservation of evidence, contamination control, transfer and persistence of evidence, chain of custody, role in crime scene reconstruction

UNIT II: CELL BIOLOGY AND BIOMOLECULES

Cell structure and organization, cell organelles and functions, basics of biomolecules, carbohydrates, proteins, lipids and nucleic acids, enzymes and their functions, forensic significance of cells and biomolecules.

UNIT III: FORENSIC BOTANY

Definition, types of plant-based evidence, collection and preservation, identification of plant fragments, basic age estimation techniques (dendrochronology, transfer and persistence, evidentiary value, Scope and significance.

Diatoms in drowning cases, ante-mortem and post-mortem drowning identification and comparison, forensic significance of diatoms.

Forensic palynology – morphology and classification of pollen grains, collection, preservation and identification techniques, transfer and persistence of pollen evidence, forensic applications and evidentiary value

UNIT VI: FORENSIC ENTOMOLOGY

Definition, scope and importance of forensic entomology, types of forensic entomology, forensic insects and their life cycle, stages of insect development, collection and preservation of insect evidence, estimation of post-mortem interval, insect succession on dead bodies, factors affecting insect growth, forensic applications of entomology.

UNIT IV: EXAMINATION OF HAIR, FIBERS AND OTHER BIOLOGICAL TRACES

Structure and types of human hair, microscopic examination of hair (human vs animal), hair growth cycle and forensic relevance, basics of Fiber evidence (natural and synthetic), nails and epithelial cells as evidence.

UNIT VI: HUMAN PHYSIOLOGY AND ANATOMY

Skeletal muscle physiology, nervous system and coordination, digestive system and its functions, brain functions and receptor organs, respiratory system physiology – exchange of gases and process of respiration, mechanism of blood circulation and cardiac cycle, morphological study of human body parts and regions, microbe–human interactions.

Suggested readings

1. Li, R. Forensic Biology, 2nd Ed. CRC Press, 2015- Best single book covering all sub-disciplines.
2. Saferstein, R. Criminalistics, 13th Ed Pearson. 2021. Ch. 10-13 - Blood semen. saliva. botanical evidence
3. James, S.H., & Nordby, J.J. Forensic Science: An Introduction, 5th Ed. CRC
4. Byrd, J.H. & Castner, J.L. Forensic Entomology, 3rd Ed. CRC Press. 2019 -PM estimation.
5. Haglund, W.D., & Sora, M.H. Forensic Taphonomy. CRC Press, 1996 - Decomposition studies
6. Linacre, A. Forensic Science in Wildlife Investigations. CRC Press, 2009 - Species ID. DNA from animals.
7. Houck, M.M. Trace Evidence Analysis

M.Sc. (Forensic Science) Second Year Semester -IV

Code of the course /Subject	Title of the course /Subject	Total Number of Periods
FRS 402 DSC II.4	Forensic Serology	45 hrs (3 hrs/week)

Course Overview

This course provides an in-depth understanding of forensic serology, focusing on the identification, analysis and interpretation of biological fluids such as blood, semen and saliva. It covers fundamental principles, serological and immunological techniques, and their application in forensic investigations. The course also introduces the immunological basis of antigen–antibody reactions and highlights the role of serology in personal identification and legal proceedings.

Course Objectives

- To understand the principles and scope of forensic serology
- To study the identification and examination of blood and other body fluids
- To learn various serological and immunological techniques used in forensic analysis
- To understand antigen–antibody interactions and their forensic applications
- To develop the ability to interpret serological evidence in forensic investigations

Course Outcomes (COs)

- CO1: Explain the principles, scope and significance of forensic serology
- CO2: Describe the composition and forensic examination of blood and bloodstains
- CO3: Identify and differentiate various body fluids using standard serological methods
- CO4: Apply serological and immunological techniques in the analysis of biological evidence
- CO5: Interpret antigen–antibody reactions in the context of forensic identification
- CO6: Evaluate the role and limitations of serological evidence in forensic casework

Unit I: Fundamentals of Forensic Serology

Definition, scope and history of forensic serology, Nature and types of biological evidence (blood, semen, saliva, etc.), Collection, preservation, packaging and chain of custody, Degradation and contamination of biological samples, Medico-legal significance of serological evidence

Unit II: Blood and Bloodstain Examination

Composition and functions of blood, Identification of blood (presumptive & confirmatory tests), Species determination (precipitin test), Blood grouping systems (ABO, Rh, MN), Basics of bloodstain pattern interpretation.

Unit III: Examination of Other Body Fluids

Semen identification (acid phosphatase test, spermatozoa detection), Saliva detection (amylase activity), Vaginal fluid identification, Urine, sweat and other biological fluids, Mixed stains and their forensic interpretation.

Unit IV: Immunological Basis of Forensic Serology

Basics of immune system (innate & acquired immunity), Antigens and antibodies: structure and functions, Immunoglobulin classes and their forensic importance, Antigen-antibody specificity in forensic identification, Major Histocompatibility Complex (MHC) and its relevance, Hypersensitivity and autoimmune aspects (brief forensic relevance).

Unit V: Serological Techniques and Immunoassays

Principles of antigen–antibody reactions, Precipitation and agglutination techniques, Gel diffusion and immunodiffusion methods, ELISA (Enzyme-Linked Immunosorbent Assay), Radioimmunoassay (RIA), Immunofluorescence and immunoelectrophoresis.

Unit VI: Applications of Forensic Serology

Role of serology in crime investigation, Personal identification using blood groups and body fluids, Basic concept of paternity testing, Use of serology in sexual assault cases, Advantages and limitations of serological methods, Evidentiary value in court.

Suggested Readings

1. Gaensslen, R.E. Sourcebook in Forensic Serology, Immunology, and Biochemistry. NIJ, 1983 - Classic, free PDF online. Covers ABO, PGM, EAP Hp
2. Lee, H.C., & Ladd, C. Preservation and Collection of Biological Evidence. CRC Press. 2001- Crime scene to lab
3. Kobilinsky, L. Forensic Chemistry Handbook. Wiley, 2012. Ch. 4 -Serological methods.
4. Eckert, W.G. Introduction to Forensic
5. Kirk, P.L. Crime Investigation, 2nd Ed Wiley, 1974 - Original methods for blood semen, saliva ID
6. Sharma, B.R. Forensic Science in Criminal Investigation & Trials, 6th Ed. LexisNexis, 2020. Ch. 8 - Serological evidence in

M.Sc. (Forensic Science) Second Year Semester -IV

Code of the course /Subject	Title of the course /Subject	Total Number of Periods
FRS403 DSC III.4	DNA Fingerprinting	60 hrs (4 hrs/week)

Course Overview

This course introduces the principles and applications of DNA fingerprinting in forensic science. It covers biological evidence, DNA extraction, PCR, STR analysis, DNA profile interpretation, population genetics, and legal aspects of forensic DNA profiling.

Course Objectives

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

1. Understand the basics and significance of DNA fingerprinting.
2. Learn methods of biological evidence handling and DNA analysis.
3. Study PCR, STR typing, and DNA profile interpretation.
4. Apply DNA profiling in forensic investigations.
5. Understand legal and ethical aspects of forensic DNA analysis.

Course Outcomes

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

- **CO1:** Explain the principles of DNA fingerprinting.
- **CO2:** Perform DNA extraction, quantification, and amplification.
- **CO3:** Interpret STR profiles and forensic DNA evidence.
- **CO4:** Apply DNA profiling in forensic casework.
- **CO5:** Understand legal and quality control aspects of forensic DNA analysis.

Unit I: Introduction to DNA Fingerprinting and Biological Evidence

History, development and scope of DNA fingerprinting, structure and organization of DNA, types of genetic markers used in forensic science, sources of biological evidence at crime scenes, collection, preservation, packaging and transportation of biological samples, chain of custody and contamination control, reference sample collection and documentation, quality assurance and quality control in forensic laboratories

Unit II: DNA Extraction and Quantification Methods

Principles of DNA extraction, organic extraction (Phenol-Chloroform method), Chelex extraction method, silica-based and magnetic bead extraction methods, differential extraction techniques, DNA extraction from blood, saliva, hair root, semen, bone, teeth and nail samples, DNA quantification methods, spectrophotometry and fluorometry, real-time quantitative PCR (qPCR), DNA degradation and inhibition studies.

Unit III: PCR and STR Typing

Principle and components of Polymerase Chain Reaction (PCR), types of PCR techniques, Short Tandem Repeats (STRs) and their forensic significance, CODIS and commonly used STR loci, multiplex PCR systems, Y-STR and X-STR markers, mitochondrial DNA analysis, capillary electrophoresis, allele calling and profile generation, artifacts in STR profiling including stutter peaks, pull-up peaks, split peaks and allele dropout.

Unit IV: DNA Profile Interpretation and Population Genetics

Interpretation of DNA profiles, mixture interpretation and low template DNA analysis, statistical evaluation of DNA evidence, match probability and random match probability, Hardy-Weinberg equilibrium, population databases and allele frequencies, likelihood ratio and paternity index, kinship analysis and missing person identification, validation and reliability of DNA evidence.

Unit V: Applications of DNA Fingerprinting

DNA profiling in criminal investigations, sexual assault and homicide investigations, paternity and maternity disputes, child swapping and immigration disputes, disaster victim identification (DVI), wildlife forensic applications, non-human DNA analysis, agricultural and veterinary applications, ancient DNA and archaeological applications, emerging trends in forensic genomics.

Unit VI: Legal and Ethical Aspects of DNA Fingerprinting

Legal admissibility of DNA evidence, expert testimony and report writing, ethical issues in DNA profiling, privacy concerns and DNA databases, national and international DNA databases, DNA Technology Regulation Bill and forensic policies in India, accreditation standards for forensic laboratories, ISO/IEC guidelines and laboratory audits, limitations and challenges of forensic DNA analysis.

Suggested Readings

1. Technology, and Genetics of STR Markers, 2nd Ed. Academic Press. 2005 -Foundation text
2. Butler. J.M. Advanced Topics in Forensic DNA Typing: Methodology. Academic Press, 2011 - Capillary electrophoresis, kits, artifacts.
3. DNA Typing: Interpretation. Academic Press. 2014 - Mixtures. stats. LR calculations. Practical & Standards
6. SWGDAM Interpretation Guidelines for Autosomal STR Typing by Forensic DNA Testing Laboratories. FBI,
7. Buckleton, J., Triggs, C.M., & Walsh, S.J. Forensic DNA Evidence Interpretation, 2r Ed. CRC Press, 2016- Statistics, Bavesia

M.Sc. (Forensic Science) Second Year Semester -IV

Code of the course /Subject	Title of the course /Subject	Total Number of Periods
FRS 404 DSE IV(i)	Forensic Anthropology and Wildlife Forensic	45 hrs (3 hrs/week)

Course Overview

This course provides an advanced understanding of forensic anthropology and wildlife forensics, focusing on identification and analysis of human and animal remains. It integrates skeletal biology, taphonomy, and molecular techniques with wildlife crime investigation and legal frameworks.

Course Objectives

- To develop expertise in human skeletal analysis for forensic identification
- To understand taphonomic processes and trauma interpretation
- To apply anthropological methods in medico-legal and disaster contexts
- To gain knowledge of wildlife crime investigation and species identification
- To understand national and international wildlife protection laws
- To integrate morphological and molecular techniques in forensic casework

Course Outcomes (COs)

- CO1: Differentiate human and non-human remains using osteological and morphological features
- CO2: Reconstruct biological profile (age, sex, stature, ancestry) from skeletal remains
- CO3: Analyse trauma and taphonomic changes in forensic contexts
- CO4: Identify wildlife species and illegal animal products using forensic techniques
- CO5: Apply molecular tools (DNA barcoding) in species identification
- CO6: Interpret forensic findings within legal and conservation framework

Unit: I Fundamentals of Forensic Anthropology

Scope of forensic anthropology, role in medico-legal investigations, human osteology, skeletal system, bone growth, bone remodelling, human vs non-human remains, sex estimation, age estimation, stature estimation, ancestry estimation.

Unit II: Taphonomy and Trauma Analysis

Decomposition, environmental effects on remains, taphonomy, antemortem changes, perimortem changes, postmortem changes, blunt force injuries, sharp force injuries, ballistic injuries, forensic odontology basics, frontal sinus identification, implants, superimposition techniques.

Unit III: Recovery and Identification Techniques

Forensic archaeology, excavation methods, recovery methods, mass disaster victim identification (DVI), facial reconstruction, 2D reconstruction, 3D reconstruction, DNA in forensic anthropology.

Unit IV: Wildlife Conservation and Management

Wildlife conservation, biodiversity, endangered species, national parks and sanctuaries,

human-wildlife conflict, wildlife census techniques, habitat management, captive breeding, wildlife rehabilitation, conservation awareness programs.

Unit V: Wildlife Forensics and Legal Framework

Wildlife forensics, wildlife crimes, illegal wildlife trade, Wildlife Protection Act 1972, Forest Conservation Act 1981, Environment Protection Act 1986, CITES regulations, Wildlife Crime Control Bureau (WCCB).

Unit VI: Wildlife Evidence Analysis

Hair identification, fur identification, feather identification, skin identification, forensic ornithology, forensic botany, ivory identification, horn identification, bone identification, reptile skin identification, microscopic techniques, wildlife crime scene investigation, evidence handling.

Suggested Readings

1. Christensen, A. M., Passalacqua, N. V., & Bartelink, E. J. (2019). *Forensic Anthropology: Current Methods and Practice*. Academic Press.
2. Ubelaker, D. H. (2014). *Human Skeletal Remains: Excavation, Analysis, Interpretation*. Aldine Transaction.
3. Haglund, W. D., & Sorg, M. H. (2001). *Advances in Forensic Taphonomy: Method, Theory, and Process*. CRC Press.
4. Kimmerle, E. H., & Baraybar, J. P. (2008). *Skeletal Trauma: Identification of Injuries Resulting from Human Rights Violations and Armed Conflict*. CRC Press.
5. Interpol. (2018). *Disaster Victim Identification (DVI) Guide*.
6. Units IV–VI: Wildlife Conservation & Forensics
7. Linacre, A. (2009). *Forensic Science in Wildlife Investigations*. CRC Press.
8. Cooper, J. E., & Cooper, M. E. (2013). *Wildlife Forensic Investigation: Principles and Practice*. CRC Press.
9. The Wildlife (Protection) Act, 1972 (with Amendments). Government of India.
10. Sinclair, A. R. E., Fryxell, J. M., & Caughley, G. (2006). *Wildlife Ecology, Conservation, and Management*. Wiley-Blackwell.

M.Sc. (Forensic Science) Second Year Semester -IV

Code of the course /Subject	Title of the course /Subject	Total Number of Periods
FRS 404 (ii) DSE-IV (ii)	Legal Aspects in Forensic Science II	45 hrs (3 hrs/week)

Course overview

This advanced-level course examines major theoretical frameworks in criminology, patterns and typologies of criminal behaviour, and the contemporary functioning of criminal-justice institutions. It integrates critical perspectives on policing, corrections, victimology, and emerging forms of crime such as cybercrime, white-collar crime, and green criminology. Students will also develop methodological and analytical skills to interpret crime data and assess evidence-based policies.

Course objectives

1. To provide students with an advanced understanding of classical, positivist, sociological, critical, and modern criminological theories and their application to real-world crime and justice issues.
2. To enable students to identify, classify, and analyse major patterns and typologies of criminal behaviour, including violent, economic, organized, cyber, corporate, and environmental crimes.
3. To sensitize students to the role of victims, victimization processes, and the impact of crime on individuals and communities, while exploring restorative justice and victim-oriented reforms.
4. To develop students' research and analytical competence in quantitative and qualitative criminological methods, crime mapping, and policy evaluation, grounded in ethical research practice.

Course outcomes

1. CO-1: Analyse and compare major criminological theories (classical, positivist, sociological, critical, and modern perspectives) and apply them to contemporary crime patterns and justice practices.
2. CO-2: Demonstrate the ability to identify and explain key typologies of crime (violent, economic, white-collar, organized, cyber, and green crime) and their socio-structural and cross-national dimensions.
3. CO-3: Critically evaluate the role of victims, victimology, and restorative justice in the criminal-justice process, including issues of secondary victimization and institutional responses.
4. CO-4: Design and interpret basic criminological research using quantitative and qualitative methods, including crime statistics, surveys, ethnography, and GIS-based crime mapping, and apply findings to policy evaluation.

Unit I Introduction to Criminology

This unit explores the fundamental nature and scope of criminology as a multidisciplinary field of study. It examines the historical evolution of criminological thought and the distinction between crime, deviance, and social harm. Students analyse the legal and social definitions of crime while exploring how various societies establish norms and boundaries for acceptable behaviour.

Unit II Schools of Criminological Thought

Focus is placed on the major theoretical frameworks that explain criminal behaviour from the 18th century to the present. This includes the Classical School's emphasis on free will and deterrence, the Positive School's focus on biological and psychological factors, and the Neoclassical revisions. The unit also covers the development of the Chicago School and its influence on environmental and social ecology theories.

Unit III Sociological Explanations of Crime

This section investigates the relationship between social structures and criminal activity through various lenses. It covers Structural Functionalism and Strain Theory, highlighting how social pressure leads to deviance. The unit further examines Social Control Theory, Labelling Theory, and Conflict Criminology to understand how power dynamics and social interactions shape criminal identity and law enforcement.

Unit IV Typologies of Crime and Victimology

Students examine specific categories of criminal activity including blue-collar crime, white-collar crime, organized crime, and cybercrime. A significant portion of this unit is dedicated to Victimology, which studies the role of the victim in the criminal justice process. It analyses victim precipitation, the psychological impact of victimization, and the rights of victims within modern legal systems.

Unit V Penology and Correctional Systems

This unit focuses on the philosophy and practice of punishment and rehabilitation. It examines the objectives of the penal system such as retribution, deterrence, incapacitation, and reformation. Discussions include the history of prison systems, the effectiveness of capital punishment, and the shift toward community-based corrections like probation, parole, and restorative justice practices.

Unit VI Criminal Justice System and Prevention

The final unit provides an overview of the structural components of the justice system, including the police, the judiciary, and the correctional administration. It analyses the process from investigation and arrest to trial and sentencing. Furthermore, it explores contemporary crime prevention strategies, including situational crime prevention and social programs designed to address the root causes of offending.

Suggested readings

1. E. P. Sykes & D. Matza – “Techniques of Neutralization” (article)
Classic piece on rationalizations of deviance, useful for Units 1 and 2 (rational choice, moral-entrepreneurship, and labelling).
2. Larry J. Siegel – *Criminology: Theories, Patterns, and Typologies** (latest ed.)
Comprehensive textbook that covers classical, biological, psychological, and sociological theories, plus typologies of crime and research methods (Units 1–6).
3. Francis T. Cullen & Pamela Wilcox – *Encyclopaedia of Criminological Theory**
(selected entries)
A strong reference for comparing classical, positivist, critical, and contemporary perspectives (Unit 1).
4. David Garland – *The Culture of Control: Crime and Social Order in Contemporary Society**
Critical, socio-political analysis of modern crime control; useful for Units 3–5 on policing, punitiveness, and penal trends.
5. Sandra Walklate – *Victimology: The Victim and the Criminal Justice System**
Foundational text for Unit 3 on victimology, secondary victimization, and victim-centered reforms.

M.Sc. (Forensic Science) Second Year Semester -IV

Code of the course /Subject	Title of the course /Subject	Total Number of Periods
FRS 405	DSC- Lab 8 (Forensic Science Practical VII)	30 Hrs. (4 hrs./ week)

Practical Outcomes

1. Handle, collect, and preserve biological evidence properly
2. Perform microscopic examination of plant, hair, and cells
3. Identify diatoms, pollen grains, and plant tissues
4. Differentiate between various biological traces (hair, Fibers, cells)
5. Conduct basic biochemical tests for biomolecules
6. Maintain proper documentation and chain of custody in lab work

Practical List

1. To identify different types of biological evidence.
2. To learn collection and preservation techniques of biological samples.
3. To study proper packaging and contamination control methods.
4. To observe the life cycle stages of blow flies and house flies.
5. To collect and preserve entomological evidence from simulated crime scenes
6. To study the effect of environmental factors on insect growth
7. To isolate and identify diatoms from given samples.
8. To study morphology and identification of pollen grains.
9. To identify and study human skeletal bones.
10. To differentiate between human and non-human bones.
11. To estimate sex, age, stature, and ancestry from skeletal remains.
12. To study bone growth and skeletal variations.
13. To observe stages of decomposition and taphonomic changes.
14. To identify antemortem, perimortem, and postmortem changes in bones.
15. To understand basics of forensic odontology and dental identification.

Suggested Readings

- Saferstein, R. – *Criminalistics: An Introduction to Forensic Science*
- James, S.H. & Nordby, J.J. – *Forensic Science: An Introduction to Scientific and Investigative Techniques*
- Souck, M.M. & Siegel, J.A. – *Fundamentals of Forensic Science*
- *Forensic Entomology: The Utility of Arthropods in Legal Investigations* — Jason H. Byrd & Jeffery K. Tomberlin
- *Forensic Entomology: An Introduction* — Dorothy E. Gennard
- Vashishta – *Botany for Degree Students*
- Biswas – *Forensic Medicine and Toxicology*
- Sharma, B.R. – *Forensic Science in Criminal Investigation*

M.Sc. (Forensic Science) Second Year Semester- IV [Level 6.5]

Code of the Course / Subject	Title of the Course/Subject	(Total Number of Periods)
FRS 406	Lab 09 (Research Project Phase II)	150 hrs (2Tut. + 8 P = 10 hrs/week)

Course Outcomes:

At the end of the course students will be able to

1. Identify a research problem and carry out literature survey
2. Analyse the research gap and formulate the problem
3. Interpret the data and synthesize research findings.

Research Project Phase II: The project/dissertation must be submitted in the hardbound copy to the University Department/College/Institute. For internal evaluation, the students shall have to give a presentation of the project/dissertation in a given Semester. Further, for external examination, Project/Dissertation shall be evaluated by the concerned teacher/supervisor/guide in the University Department/College / Institute as an Internal Examiner along with an External Examiner appointed by the University.

Modalities:

1. Individual or group projects can be taken up
2. Involve in literature survey in the chosen field.
3. Use Science/Engineering principles to solve identified issues.
4. Adopt relevant and well-defined / innovative methodologies to fulfil the specified objective
5. Submission of scientific report in a specified format

Examination: FRS 406	Lab 9 Research project Phase II	Max Marks 150
A.	Internal Assessment*	75
B.	Submission of Research project	25
C.	VIVA (Internal and External Examiner)	50
	Total	150