



Two-Year Postgraduate Programme

**Master of Science
Forensic Science**

Faculty of Applied Sciences

**Parul University
Vadodara, Gujarat, India**

Master of Forensic Science

1. Vision of the Department

To seamlessly integrate traditional and modern sciences, fostering a conducive environment for contemporary innovations in forensic science, aligning with the overarching vision of the Institute.

2. Mission of the Department

M1: To provide graduates with a comprehensive foundation of knowledge and hands-on skills in Forensic Science, harmonizing with the Institute's mission of training students in a blend of traditional subjects and emerging specializations for skill development through rigorous laboratory work.

M2: To contribute to the advancement of forensic knowledge through faculty-led research, in consonance with the Institute's mission of developing programs that focus on specialization and environmental protection.

M3: To cultivate a culture of integrity, ethics, and collaboration, aligning with the Institute's mission of fostering a holistic learning environment that prepares students for the challenges of the future and instills a sense of responsibility towards the environment. This, in turn, aims to shape the next generation of skilled and ethical forensic professionals.

3. Program Educational Objectives

The statements below indicate the career and professional achievements that the M.Sc. Forensic Science curriculum enables graduates to attain.

PEO1	To develop technical skills such as critical investigation, communication, analysis, and computer proficiency, as well as human relations skills encompassing group dynamics, team building, organization, and delegation, enabling students to effectively apply acquired knowledge into action.
PEO 2	To instil critical analysis and communication skills in students, fostering their ability to articulate views both in writing and through oral presentations, aligning with the varied cognitive levels of Bloom's Taxonomy.
PEO 3	To create an environment conducive to cultivating a Research & Development attitude among students, facilitating their excellence in the domain of Research and Development

4. Program Learning Outcomes

Program Learning outcomes are statements conveying the intent of a program of study.

PLO 1	Disciplinary Knowledge	Demonstrate comprehensive knowledge of the discipline that form a part of a postgraduate programme. Execute strong theoretical and practical understanding generated from the specific programme in the area of work.
PLO 2	Critical Thinking and Problem Solving	Exhibit the skill of critical thinking and understand scientific texts and place scientific statements and themes in contexts and also evaluate them in terms of generic conventions. Identify the problem by observing the situation

		closely, take actions and apply lateral thinking and analytical skills to design the solutions.
PLO 3	Social Competence	Exhibit thoughts and ideas effectively in writing and orally; communicate with others using appropriate media, build effective interactive and presenting skills to meet global competencies. Elicit views of others, present complex information in a clear and concise and help reach conclusion in group settings.
PLO 4	Research-related Skills and Scientific Temper	Infer scientific literature, build sense of enquiry and able to formulate, test, analyse, interpret and establish hypothesis and research questions; and to identify and consult relevant sources to find answers. Plan and write a research paper / project while emphasizing on academics and research ethics, scientific conduct and creating awareness about intellectual property rights and issues of plagiarism.
PLO 5	Trans-disciplinary Knowledge	Create new conceptual, theoretical and methodological understanding that integrates and transcends beyond discipline-specific approaches to address a common problem.
PLO 6	Personal and Professional Competence	Perform independently and also collaboratively as a part of team to meet defined objectives and carry out work across interdisciplinary fields. Execute interpersonal relationships, self-motivation and adaptability skills and commit to professional ethics.
PLO 7	Effective Citizenship and Ethics	Demonstrate empathetic social concern and equity centred national development, and ability to act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.
PLO 8	Environment and Sustainability	Understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.
PLO 9	Self-directed and Life-long learning	Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

5. Program Specific Learning Outcomes

PSO 1	Scientific Problem Solving	To apply scientific problem-solving skills effectively, design solutions aligned with current investigatory and industrial demands and objectives.
PSO 2	Ethical Decision Making	To practice ethical and effective forensic methods, utilizing modern tools and methodologies to contribute to the advancement of science and the well-being of the community.
PSO 3	Proficiency in Investigatory Process	To demonstrate advanced proficiency in forensic science, integrating specialized knowledge and skills to address complex challenges in the investigatory process.

6. Credit Framework

Semester wise Credit distribution of the programme	
Semester 1	24
Semester 2	24
Semester 3	24
Semester 4	24
Total	96

Category wise Credit distribution of the programme	
Category	Credit
Major Core	84
Minor Stream	0
Research Project/Dissertation	12
Total Credits	96

7. Program Curriculum

Semester 1						
Sr. No.	Subject Code	Subject Name	Credit	Lect.	Lab.	Tut.
1	11207114	Crime Scene Management & Police Organization	3	3	-	-
2	11207115	Psychology, Criminology & Criminal law	3	3	-	-
3	11207116	Forensic Physics & Multimedia	3	3	-	-
4	11207117	Fingerprint & other impression evidences	3	3	-	-
5	11207118	Research Methodology	3	3	-	-
6	11207119	Crime scene management Lab	3	-	6	-
7	11207120	Forensic Physics & Multimedia Lab	3	-	6	-
8	11207121	Fingerprint & other impression evidences Lab	3	-	6	-
Total			24	15	18	-
Semester 2						
Sr. No.	Subject Code	Subject Name	Credit	Lect.	Lab.	Tut.
9	11207122	Forensic Chemistry & NDPS	4	4	-	-
10	11207123	Questioned Document	4	4	-	-
11	11207124	Digital & Cyber Forensics	4	4	-	-
12	11207125	Forensics Science Instrumentation	4	4	-	-
13	11207126	Basics of Statistics	2	2	-	-
14	11207127	LAB 1 Forensic Chemistry & NDPS	2	-	4	-
15	11207128	LAB 2 Questioned Document	2	-	4	-
16	11207129	LAB 3 Digital & Cyber Forensics	2	-	4	-
Total			24	18	12	-
Semester 3						
Sr. No.	Subject Code	Subject Name	Credit	Lect.	Lab.	Tut.
17	11207130	Forensic Toxicology & Pharmacology	4	4	-	-
18	11207131	Forensic Biology & Serology	4	4	-	-
19	11207132	Forensic Ballistics & Ammunition	4	4	-	-
20	11207133	Forensic Medicine & Anthropology	4	4	-	-
21	11207134	Research Writing	2	2	-	-
22	11207135	LAB 1 Forensic Toxicology & Pharmacology	2	-	4	-
23	11207136	LAB 2 Forensic Biology & Serology	2	-	4	-
24	11207137	LAB 3 Forensic Ballistics & Anthropology	2	-	4	-
Total			24	18	12	-
Semester 4						
Specialization in Forensic Physics, Multimedia & Ballistics						
Sr. No.	Subject Code	Subject Name	Credit	Lect.	Lab.	Tut.
25	11207138	Dissertation	12	12	-	-
26	11207139	Advanced Instrumentation in Physical Science	4	4	-	-
27	11207140	Advanced Concepts of Forensic Ballistics	4	4	-	-
28	11207141	Advanced Concepts of Multimedia Forensics	4	4	-	-
Total			24	24	-	-
Semester 4						
Specialization in Forensic Chemistry & Toxicology						
Sr. No.	Subject Code	Subject Name	Credit	Lect.	Lab.	Tut.

25	11207138	Dissertation	12	12	-	-
26	11207142	Advanced Instrumentation in Forensic Chemical Sciences	4	4	-	-
27	11207143	Advanced Concepts of Forensic Toxicology & Pharmacology	4	4	-	-
28	11207144	Advanced Concepts of Forensic Chemistry & Narcotics	4	4	-	-
Total			24	24		

Semester 4
Specialization in Forensic Biology, Serology & DNA

Sr. No.	Subject Code	Subject Name	Credit	Lect.	Lab.	Tut.
25	11207138	Dissertation	12	12	-	-
26	11207145	Advanced Concepts of Biology & Instrumentation in Biological Science	4	4	-	-
27	11207146	Advanced Concepts of Forensic Biology, Serology & Wild Life Forensics	4	4	-	-
28	11207147	Advanced Concepts of Forensic DNA Profiling	4	4	-	-
Total			24	24	-	-

Semester 4
Specialization in Digital Forensics

Sr. No.	Subject Code	Subject Name	Credit	Lect.	Lab.	Tut.
25	11207138	Dissertation	12	12	-	-
26	11207148	Advanced Instrumentation in Digital Forensics	4	4	-	-
27	11207149	Advanced Concepts of Digital Forensics	4	4	-	-
28	11207150	Reverse Engineering & Malware Analysis	4	4	-	-
Total			24	24		

Semester 4
Specialization in Criminology & Forensic Psychology

Sr. No.	Subject Code	Subject Name	Credit	Lect.	Lab.	Tut.
25	11207138	Dissertation	12	12	-	-
26	11207151	Advanced concepts of Criminology	4	4	-	-
27	11207152	Legal & Investigative Psychology	4	4	-	-
28	11207153	Advanced Concepts of Psychology Assessment & Testing	4	4	-	-
Total			24	24		

Semester 4
Specialization in Questioned Documents, Fingerprint & Photography

Sr. No.	Subject Code	Subject Name	Credit	Lect.	Lab.	Tut.
25	11207138	Dissertation	12	12	-	-
26	11207154	Advanced Instrumentation in Forensic Physical Sciences	4	4	-	-
27	11207155	Advanced Concepts of Questioned Document Examination	4	4	-	-
28	11207156	Advanced Concept of Fingerprint Examination and Photography	4	4	-	-
Total			24	24	-	

8. Detailed Syllabus

Semester 1

- A. **Course Name:** Crime Scene Management and Police Organization
- B. **Course Code:** 11207114
- C. **Prerequisite:** Proficient in Crime Scene Management and Police Organization. Understanding scientific principles and methods. Strong critical thinking and problem-solving skills.
- D. **Rationale:** The "Crime Scene Management and Police Organization" course in MSc Semester One provides a comprehensive foundation, covering historical, legal, and scientific aspects. Students learn how to ensure the effective functioning of law enforcement agencies in maintaining public safety, preventing crime, and upholding justice.. The curriculum also includes preservation of evidences, chain of custody, investigative integrity, victim and witness protection along with resources allocation and accountability.
- E. **Course Learning Objective:**

CLOBJ 1	Understand the principles and importance of securing and preserving a crime scene.
CLOBJ 2	Learn the techniques for documenting and collecting physical evidence, including photography, sketching, evidence collection and reconstruction of crime scene
CLOBJ 3	Identify different types of evidence and their significance in criminal investigations.
CLOBJ 4	Understand the organizational structure of a police department, including ranks, divisions, and chains of command.
CLOBJ 5	Learn about the legal and ethical responsibilities of police officers and the importance of accountability and transparency.

F. Course Learning Outcomes:

CLO 1	Demonstrate an understanding of the principles and importance of securing and preserving a crime scene
CLO 2	Apply Techniques for documenting and collecting physical evidences including photography, sketching and evidence collection.
CLO 3	Explain the chain of custody and its importance in maintaining the integrity of evidence for admissibility in court.
CLO 4	Describe the organizational structure of a police department, including ranks, divisions, and chains of command.
CLO 5	Evaluate the legal and ethical responsibilities of police officers and the importance of accountability and transparency

G. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
Lect. Hrs./week	Tut Hrs.	Lab Hrs.	Credit	External		Internal			
				T	P	T	CE	P	
3	-	-	3	60	-	20	20	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

H. Course Content:

Sr. No	Content	Weightage	Teaching Hours
1.	Unit 1: Introduction: Forensic science definition, Need, Scope, Concepts and Significance. History and Development of Forensic Science, Laws and Basic principles of Forensic Science, Branches of forensic science, Investigative strategies. Expert testimony and eye-witness report	25%	5
2.	Unit 2: Crime scene Investigation: Scene of crime: Types, protection of scene of crime, searching, preservation (recording) of scene of crime-sketching, photography, videography and notetaking. Physical evidence: Meaning, Types, search methods, collection and preservation, Forwarding. Chain of custody. Collection, preservation, packing and forwarding of blood, semen and other biological stains, firearm exhibits, documents, fingerprint, viscera, hair & fibre, glass, soil and dust, petroleum products, drugs and poisons, etc. duties of various experts, chain of custody. Crime scene reconstruction: Steps involved (Recognition of evidence, Documentation of evidence, Collection of evidence, Evaluation of evidence, Hypothesis, Testing, Reconstruction), various crime scenes and scenarios (like Hit and Run, Accidents, Hanging, Shooting, Burglary, etc.). Digital Aids in Reconstruction (3-D Photography/Videography, Computer aided Reconstruction), Forensic science laboratories and facilities: Organizational set-up of a Forensic Science Laboratory and institutions in India, various service provided by labs, various branches and their role.	25%	15
3.	Unit 3: Forensic Photography: Basic principles of Photography, Techniques of black & white and color photography, cameras, lenses, shutters,	25%	12

	depth of field, film; exposing, development and printing techniques; Different kinds of developers and fixers; UV, IR, fluorescence illumination guided photography; Modern development in photography- digital photography, working and basic principles of digital photography; Surveillance photography. Videography and Crime Scene & laboratory photography.		
4.	Unit 4: Police Administration History and development of police administration; Police duties, responsibilities and powers. Organization and structure of police station; maintenance of crime records and accountability of police to law. Custodial deaths, Police and Human Rights. CBI, FBI, BSF and other.	25%	13
TOTAL		100%	45 Hrs

I. Text Book and Reference Book:

1. Houck, M.M& Siegel, J.A; Fundamentals of Forensic Science, Academic Press, London, 2006.
2. Sharma, B.R; Forensic Science in Criminal Investigation & Trials, Universal Publishing Co.,New Delhi, 2003
3. Nanda B.B and Tewari, R.K; Forensic Science in India- A vision for the Twenty First Century,Select Publisher, New Delhi, 2001.
4. James, S.H and Nordby, J.J; Forensic Science- An Introduction to Scientific and
5. Investigative Techniques, CRC Press, USA, 2003.
6. Saferstein; Criminalistics- An Introduction of Forensic Science, Prentice Hall Inc, USA,2007.
7. Barry, A.J. Fisher; Techniques of Crime Scene Investigation, 7th Ed, CRC Press, New York,2003.
8. Mordby, J. & Reckoning, D; The Art of Forensic Detection, CRC Press NewYork,2003.
9. Robertson and Vignaux; Interpreting Evidence, John Wiley, New York, 1995.
10. H.L. Blitzer and J. Jacobia; Forensic Digital Imaging and Photography, Academic Press,London, 2002.
11. David R. Redsicker; The Practical Methodology of Forensic Photography- 2nd Ed. CRC Press,New York, 2001.
12. R.E. Jacobson, S.F. Ray, G.G. Attridge; The Manual of Photography- Photographic and DigitalImaging, N.R. Oxford.

Semester 1

- A. Course Name:** Psychology, Criminology & Criminal law
- B. Course Code:** 11207115
- C. Prerequisite:** Familiarity with concepts such as behaviour, cognition, emotions, personality theories, and psychological disorders. Understanding of crime theories, criminal behaviour patterns, victimology, and the criminal justice system.
- D. Rationale:** The rationale for studying 'Psychology, Criminology & Criminal Law' is grounded in the fundamental understanding of human behavior, the causes of criminal activities, and the legal framework governing criminal justice.
- E. Course Learning Objective:**

CLOBJ 1	Understand the foundational principles of psychology and their application in criminal behavior analysis.
CLOBJ 2	Analyze criminological theories and their relevance to the understanding of crime causation and prevention.
CLOBJ 3	Examine the legal frameworks and procedures involved in criminal investigations, trials, and sentencing.
CLOBJ 4	Apply psychological theories and criminological concepts to assess and mitigate criminal risks in various contexts.
CLOBJ 5	Evaluate ethical dilemmas and legal considerations in the criminal justice system, fostering a comprehensive understanding of justice and fairness.

F. Course Learning Outcomes:

CLO 1	Students will gain a comprehensive understanding of the psychological theories and factors that contribute to criminal behavior, including motivations, cognitive processes, and environmental influences.
CLO 2	Participants will develop a solid grasp of the legal principles, procedures, and regulations governing criminal law and the criminal justice system, including aspects of investigation, trial processes, and sentencing.
CLO 3	Graduates will acquire practical skills in forensic analysis, including crime scene investigation techniques, evidence collection and preservation, and the use of forensic technologies for examining physical and digital evidence.
CLO 4	Graduates will develop critical thinking skills to analyze and evaluate criminological theories, legal cases, and psychological assessments, enabling informed decision-making in legal and investigative contexts.
CLO 5	Graduates will understand and apply ethical principles and professional standards in psychology, criminology, and criminal law practices, emphasizing integrity, fairness, and respect for diversity in dealing with clients, victims, and the legal system.

G. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
Lect. Hrs./week	Tut Hrs.	Lab Hrs.	Credit	External		Internal			
				T	P	T	CE	P	
3	-	-	3	60	-	20	20	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

H. Course Content:

Sr.	Topic	Weightage	Teaching Hours
1	Unit 1: Crime Definition, concept and scope of crime. Types of crime. Offences: nature and type. Juvenile Delinquency-factors, Juvenile Justice Act, Role of Correctional Institutions, Child Abuse- Physical Abuse, Emotional Abuse, Sexual Abuse, Child Neglect, Crime against Women, Crime against Elderly, Youth and Crime. Alcoholism and Drug Addiction. Offenders- Occasional Offenders, Professional Offenders, Habitual Offenders, Violent Offenders.	25%	10
2	Unit 2: Criminology, sociology and victimology Criminal, criminal behaviour, theories of criminology, theory of punishments, Sociology: cause of crime related to sociological factors: culture, economic, psychological, geographical, immigration etc. theories of social and environmental determinism. Victimology: victim, role of victim in crime, victim-offender relationship, justice system to aid the victim, relief and compensatory aids, therapies.	25%	10
3	Unit 3: Criminal Law Indian Penal Code: sections-23, 24, 25,39,44,52,76-79,84-86. Criminal Procedure Code: sections 2, 6-35, 41-60, 61-90,154-176, 293, 294. Charges: bailable/non-bailable offences, cognizable/ non-cognizable, summon case and warrant cases. Indian Evidence Act: sections- 3, 24-30, 45, 135-138, 141. Expert testimony. NDPS Act, Food and Adulteration Act, Drugs and Cosmetic Act, Arms Act, Explosives Act. probation & Parole.	25%	12
4	Unit 4: Forensic Psychology Forensic Psychology: Definition, scope, principle, practice and training, Historical perspective; Psychological approaches / Theories; Psychodynamic, Behavioural, Cognitive,	25%	13

	Interpersonal, Psychosocial, Gestalt, Transactional and Humanistic. Psychology of personality Definition, type, trait theories, psychoanalytical theories, learning and behavioral theories, and humanistic theories of personality, Psychological Assessments Case history; mental status examination; rationale of psychological assessment; lie detection techniques; Polygraph, Brain Mapping, LVA & Narco.		
TOTAL		100%	45 Hrs

I. Text Book and Reference Book:

1. Swanson, C.R, Terrbles, L & Taylor, R.W; Police Administration, Prentice Hall, USA, 1998.
2. Gross, H; Criminal Investigation- A Practical Textbook for Magistrates, Police Officers, and Lawyers; Universal Law Publishing Co., New Delhi, 2000.
3. Lyman, M.D; Criminal Investigation – The Art & the Science, Prentice Hall, New Jersey, 2002.
4. O'Hara CE & Osterburg, JW; An Introduction to Criminalistics., Indiana University. Press, London, 1972.
5. Swanson, C.R, Chamelin, N.C, & Territ, L; Criminal Investigator, McGrawhill, New York, 2000.
6. The Indian Evidence Act, (1872), Amendment Act (2002); Universal Law Publishing Co., 2003.
7. The Code of Criminal Procedure (1973) Amendment Act, (2001); Universal Law Publishing Co., 2002.
8. Rattan Lal & Dhiraj Lal; The Indian Penal Code, 28th Ed. Wadhwa & Co. Nagpur, 2002.

Semester 1

- A. **Course Name:** Fingerprint & other impression evidences
- B. **Course Code:** 110207117
- C. **Prerequisite:** Understand the proper techniques for collecting impression evidence to preserve its integrity and ensure accurate analysis. Learn about the appropriate methods for preserving impression evidence, including photography, casting, and lifting.
- D. **Rationale:** Fingerprint and impression evidence is generally admissible in court due to its scientific basis and widespread acceptance within the forensic community. Its use has been validated through numerous legal precedents, ensuring its relevance and reliability in the criminal justice system.
- E. **Course Learning Objective:**

CLOBJ 1	Students will explore various types of impression evidence beyond fingerprints, such as footprints, tire treads, tool marks, and bite marks, and learn how to collect, preserve, and analyze these impressions to contribute to criminal investigations.
CLOBJ 2	Participants will gain hands-on experience with cutting-edge forensic technologies, including Automated Fingerprint Identification Systems (AFIS), digital imaging techniques, and 3D scanning technologies, to enhance their ability to process and analyze impression evidence effectively.
CLOBJ 3	Students will understand the legal and ethical considerations surrounding the collection, preservation, and presentation of fingerprint and other impression evidence in court, including chain of custody protocols, admissibility criteria, and expert testimony requirements.
CLOBJ 4	Learners will develop proficiency in fingerprint identification techniques, including the analysis of ridge patterns, minutiae points, and latent prints, enabling them to accurately match fingerprints to individuals in forensic investigations.
CLOBJ 5	Students will be able to differentiate between various fingerprint classification systems, such as the Henry Classification System or the NCIC classification system, and apply them to analyze and categorize fingerprints accurately.

F. Course Learning Outcomes:

CLO 1	Students will be able to accurately analyze and compare fingerprint patterns using appropriate techniques and technology, leading to the identification of individuals with a high degree of accuracy.
CLO 2	Learners will develop the skills to examine and interpret various types of impression evidence, such as footwear impressions, tire tracks, and tool marks, to determine their relevance to criminal investigations.
CLO 3	Students will gain knowledge of proper collection methods for impression evidence, including preserving and documenting crime scenes, lifting prints, casting impressions, and maintaining chain of custody protocols.

CLO 4	Participants will critically assess the strengths and weaknesses of impression evidence in forensic investigations, considering factors such as distortion, contamination, and the potential for false positives or negatives.
CLO 5	Students will be able to present their findings and analysis of impression evidence in a clear, concise manner, both orally and in written reports, suitable for use in legal proceedings or investigative contexts.

H. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
Lect. Hrs./week	Tut Hrs.	Lab Hrs.	Credit	External		Internal			
				T	P	T	CE	P	
3	-		3	60		20	20		100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

I. Course Content:

Sr.	Topic	Weightage	Teaching Hours
1	Unit 1: Fingerprint history, formation and classification: History and development of Dermatoglyphics, formation of ridges. Plain print and rolled print, direct or inked print. Pattern types, pattern area, ridge characteristics, ridge tracing. Classification of fingerprints- Henry's system of classification, single-digit classification, filing, searching and fingerprint bureau. Taking of fingerprints and palm prints from living and dead person, post-mortem fingerprint, forgery and comparison of fingerprint. Edgeoscopy and Poroscopy.	25%	15
2	Unit 2: Fingerprint composition and enhancement methods: Composition of sweat, development of chance, latent, visible and plastic prints. Conventional methods of development of latent prints- fluorescent methods, magnetic powder method, fuming method, chemical method, Application of laser and other radiations to develop latent fingerprints, metal deposition method and development of latent prints on skin. Preserving and lifting of fingerprints, photography of fingerprints.	25%	10
3	Unit 3: Other impression evidences: Footprint and footwear: Importance, types of prints, gait pattern, casting of footprints according to the place, collection, tracing, lifting-electrostatic lifting of footwear impression, taking of control sample, comparison. Lip print & Ear print: Nature, location, collection and evaluation of lip print & Ear Print, photography, taking of control samples, photography and forensic significance.	25%	15

	Modern techniques of latent print enhancement.		
4	Unit 4: Tyre marks and biometric Tool and tyre marks: importance, types, collection of evidence from crime scene, collection of samples, casting, lifting and comparison. Biometric: Biometric evidences such as finger impressions, gait pattern, Recent developments, and biometric databases.	25%	5
TOTAL		100%	45 Hrs

J. Text Book and Reference Book:

1. Forensic Biology – Richard Li
2. Richard Saferstein, An Introduction to Forensic science.
3. Ashraf Mozayani, The forensic Laboratory handbook: Procedures and Practices.
4. Fundamentals of Forensic DNA Typing – John M. Butler
5. Dr. Archana Tripathi, Forensic serology and blood examination.
6. M.KBhasin, A laboratory manual for human blood analysis.
7. V. S Verma, V.KAgrawal, S.Chand and company, Cell biology, genetics, molecular biology, evolution and ecology.
8. Avinash Upadhyay, Fundamentals of Molecular Biology.

Semester 1

- A. **Course Name:** Forensic Physics & Multimedia
- B. **Course Code:** 11207116
- C. **Prerequisite:** Proficient in fundamental Forensic Physics & Multimedia Understanding scientific principles and methods. Strong critical thinking and problem-solving skills.
- D. **Rationale:** The rationale behind forensic physics and multimedia lies in the need for precise scientific methods to analyse digital evidence in legal investigations. By applying principles of physics to multimedia materials like videos and images, forensic experts can determine authenticity, detect tampering, and reconstruct events accurately.

E. Course Learning Objective:

CLOBJ 1	Analyze multimedia evidence using principles of forensic physics to determine authenticity and detect manipulation.
CLOBJ 2	Apply optical and digital signal processing techniques to enhance visual and auditory details in multimedia materials.
CLOBJ 3	Evaluate gunshot residue patterns and projectile trajectories to reconstruct events accurately in legal investigations.
CLOBJ 4	Utilize thermodynamics principles to assess the integrity of digital files and detect alterations or tampering.
CLOBJ 5	Employ forensic physics methodologies to provide scientifically rigorous support for legal arguments involving multimedia evidence.

F. Course Learning Outcomes:

CLO 1	Students will demonstrate proficiency in analyzing and interpreting multimedia evidence using forensic physics principles.
CLO 2	Graduates will possess advanced skills in enhancing and authenticating multimedia materials through optical and digital signal processing techniques.
CLO 3	Participants will be capable of reconstructing events accurately in legal investigations by evaluating gunshot residue patterns and projectile trajectories.
CLO 4	Graduates will be adept at applying thermodynamics principles to assess digital file integrity and detect tampering.
CLO 5	Students will showcase the ability to provide scientifically rigorous support for legal arguments involving multimedia evidence through forensic physics methodologies.

G. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
Lect. Hrs./week	Tut Hrs.	Lab Hrs.	Credit	External		Internal			
				T	P	T	CE	P	
3	-	-	3	60	-	20	20	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

H. Course Content:

Sr. No	Content	Weightage	Teaching Hours
1.	Unit-1 Types and composition of soil, sample preparation, removal of contaminants, colour, molecular particle size distribution, turbidity test, pH measurements, microscopic examination, density gradient analysis, ignition-loss test, elemental analysis, interpretation of soil evidence. Examination and analysis of the construction materials, Sampling, collection & preservation of the materials with relevant information required for the investigation, determination of adulterants by physical, chemical and instrumental methods, investigation and observation of collapsed structures & causes of failure, crash investigations. Paint: Types of paint and their composition, Difference between dye and pigment, chemical and instrumental analysis of paint pigments, forensic significance	25%	12
2.	Unit-2 Glass, Tool Marks & Restoration Marks: Glass: Types, composition, chemical and physical properties of glass, types of glass fractures, examination and elemental analysis of evidence. Tool Marks: Types of tool marks- compression marks, striated marks, combination of compression and striated marks, repeated marks, class characteristics and individual characteristics, tracing and lifting of marks, Photographic examination of tool marks and cut marks on clothes and walls etc. Restoration of erased / obliterated marks- Method of making-cast, punch, engrave; methods of obliteration, Restoration of erased/obliterated marks: Importance of individual markings, Methods of marking-cast, methods to obliterate numbers – Fundamental principle of restoration of marks, Restoration methods and its principles (Destructive and non-destructive), Preparation of etching reagents, Photography and assessment of the methods for restoration of obliterated marks.	25%	13
3.	Unit-3 Speech recognition Voice production theory-vocal anatomy, speech signal processing and pattern recognition, basic factors of sound in speech acoustic characteristics of speech signal, fourier analysis, frequency and time domain representation of speech signal, analogue to digital signal and conversion, quantization and speech enhancement, analysis of audio signal for authenticity, introduction to the techniques of pattern recognition and comparison of audios	25%	10
4.	UNIT 4	25%	10

	Image analysis, Image perception, Colour space & representation, Storage, Image processing application, Introduction to image enhancement, Image restoration, Concept of digital water marking, Image compression, Retrieval of video files, Integrity of images, Facial image recognition, Related Case Studies and its admissibility in court proceedings.		
TOTAL		100%	45 Hrs

I. Text Book and Reference Book:

9. "Forensic Physics: Principles and Applications" by T. Gray, J. Jackson, and N. Purkis
10. "Digital Multimedia Evidence Processing: Forensic Analysis and Examination" by Shyu, Meiya, and Liu
11. "Forensic Science: An Introduction to Scientific and Investigative Techniques" by Stuart H. James, Jon J. Nordby, and Suzanne Bell
12. "Forensic Physics: A Comprehensive Reference Guide to Scientific Principles and Techniques" edited by J. Almirall and K. Furton
13. "Handbook of Forensic Science" by Jim Fraser
14. "Forensic Digital Imaging and Photography" by Herbert L. Blitzer and Jack Jacobia"

Semester 1

- A. **Course Name:** Crime Scene Management Lab
- B. **Course Code:** 11207119
- C. **Prerequisite:** Proficient in Crime Scene Management and Police Organization. Understanding scientific principles and methods. Strong critical thinking and problem-solving skills.
- D. **Rationale:** The "Crime Scene Management and Police Organization" course in MSc Semester One provides a comprehensive foundation, covering historical, legal, and scientific aspects.

E. Course Learning Objective:

CLOBJ 1	Understand the principles and importance of securing and preserving a crime scene.
CLOBJ 2	Learn the techniques for documenting and collecting physical evidence, including photography, sketching, evidence collection and reconstruction of crime scene
CLOBJ 3	Identify different types of evidence and their significance in criminal investigations.
CLOBJ 4	Understand the organizational structure of a police department, including ranks, divisions, and chains of command.
CLOBJ 5	Learn about the legal and ethical responsibilities of police officers and the importance of accountability and transparency.

F. Course Learning Outcomes:

CLO 1	Demonstrate an understanding of the principles and importance of securing and preserving a crime scene.
CLO 2	Apply Techniques for documenting and collecting physical evidences including photography, sketching and evidence collection.
CLO 3	Explain the chain of custody and its importance in maintaining the integrity of evidence for admissibility in court.
CLO 4	Describe the organizational structure of a police department, including ranks, divisions, and chains of command.
CLO 5	Evaluate the legal and ethical responsibilities of police officers and the importance of accountability and transparency

G. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
Lect. Hrs./week	Tut Hrs.	Lab Hrs.	Credit	External		Internal			
				T	P	T	CE	P	
0	-	6	3	0	30	-	10	10	50

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

H. Course Content:

Sr.	List of Practical
1	To carry out photography of indoor and outdoor crime scenes.
2	Crime scene photographic processing and development in different light sources and using different filters.
3	To carry out digital photography of various forensic evidences.
4	Mock crime scene investigation and writing a report on evaluation of crime scene.
5	Interpretation of crime scene notes, photos, sketches and reconstruction of crime scene.
6	Microscopy of various physical evidences.
7	Expert testimony in a mock court case scenario.

I. Text Book and Reference Book:

1. Houck, M.M& Siegel, J.A; Fundamentals of Forensic Science, Academic Press, London, 2006.
2. Sharma, B.R; Forensic Science in Criminal Investigation & Trials, Universal Publishing Co., New Delhi, 2003
3. Nanda B.B and Tewari, R.K; Forensic Science in India- A vision for the Twenty First Century, Select Publisher, New Delhi, 2001.
4. James, S.H and Nordby, J.J; Forensic Science- An Introduction to Scientific and
5. Investigative Techniques, CRC Press, USA, 2003.
6. Saferstein; Criminalistics- An Introduction of Forensic Science, Prentice Hall Inc, USA,2007.
7. Barry, A.J. Fisher; Techniques of Crime Scene Investigation, 7th Ed, CRC Press, New York, 2003.
8. Mordby, J. & Reckoning, D; The Art of Forensic Detection, CRC Press NewYork,2003.
9. Robertson and Vignaux; Interpreting Evidence, John Wiley, New York, 1995.
10. H.L. Blitzer and J. Jacobia; Forensic Digital Imaging and Photography, Academic Press, London, 2002.
11. David R. Redsicker; The Practical Methodology of Forensic Photography- 2nd Ed. CRC Press, New York, 2001.
12. R.E. Jacobson, S.F. Ray, G.G. Attridge; The Manual of Photography- Photographic and Digital Imaging, N.R. Oxford.

Semester 1

A. Course Name: Forensic Physics & Multimedia Lab

B. Course Code: 11207120

C. Prerequisite: Proficient in fundamental Forensic Physics & Multimedia Understanding scientific principles and methods. Strong critical thinking and problem-solving skills.

D. Rationale: The rationale behind forensic physics and multimedia lies in the need for precise scientific methods to analyse digital evidence in legal investigations. By applying principles of physics to multimedia materials like videos and images, forensic experts can determine authenticity, detect tampering, and reconstruct events accurately.

E. Course Learning Objective:

CLOBJ 1	Analyze multimedia evidence using principles of forensic physics to determine authenticity and detect manipulation.
CLOBJ 2	Apply optical and digital signal processing techniques to enhance visual and auditory details in multimedia materials.
CLOBJ 3	Evaluate gunshot residue patterns and projectile trajectories to reconstruct events accurately in legal investigations.
CLOBJ 4	Utilize thermodynamics principles to assess the integrity of digital files and detect alterations or tampering.
CLOBJ 5	Employ forensic physics methodologies to provide scientifically rigorous support for legal arguments involving multimedia evidence.

G. Course Learning Outcomes:

CLO 1	Demonstrate proficiency in analyzing and interpreting multimedia evidence using forensic physics principles.
CLO 2	Possess advanced skills in enhancing and authenticating multimedia materials through optical and digital signal processing techniques.
CLO 3	Reconstructing events accurately in legal investigations by evaluating gunshot residue patterns and projectile trajectories.
CLO 4	Applying thermodynamics principles to assess digital file integrity and detect tampering.
CLO 5	Provide scientifically rigorous support for legal arguments involving multimedia evidence through forensic physics methodologies.

K. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
Lect. Hrs./week	Tut Hrs.	Lab Hrs.	Credit	External		Internal			
				T	P	T	CE	P	
-	-	6	3	-	30	-	10	10	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

L. Course content

Sr.	List of Practical
1	Density gradient technique for soil analysis.
2	Study microscopic examination of different plant and animal fibre
3	Study chemical properties and burn test for fibre.
4	Study of glass fractures and physical matching of broken glass.
5	Examination of physical properties of glass, soil, fiber and paint evidences.
6	Recording of speech samples using tape recorder & digital recorders, their handling and preservation
7	Editing, processing, and conversion of audio files using Goldwave software.
8	Speech acquisition and analysis of speech samples using Audio Software
9	Detection of tampering in audio files, audio restoration and speech enhancement

J. Text Book and Reference Book:

1. Hatcher, Jury and Weller: Firearms Investigation, Identification and Evidence;
a. Stackpole Books, Harrisburg, PA; (1977).
2. M. Johari, Identification of Firearms, Ammunition and Firearms Injuries; BPR&
a. D, New Delhi; (1980)
3. Working Procedures Manual: Ballistics, BPR& D pub. (2000).
4. Working Procedure Manual; Chemistry, Explosives and Narcotics, BPR& D Pub.
(2000).
5. Saferstein, R., (1995) Criminalistics – An Introduction to Forensic Science,
a. Prentice Hall, Englewood Cliffs, NJ 07632, USA.
6. Kumar, K., (1987) Forensic Ballistics in Criminal Justice, Eastern Book Co.,
a. Lucknow, India.
7. B. R Sharma, Firearm in criminal investigations and trials (Reprint 2011).

Semester 1

- A. Course Name:** Fingerprint & other impression evidences
- B. Course Code:** 110207117
- C. Prerequisite:** Understand the proper techniques for collecting impression evidence to preserve its integrity and ensure accurate analysis. Learn about the appropriate methods for preserving impression evidence, including photography, casting, and lifting.
- D. Rationale:** Fingerprint and impression evidence is generally admissible in court due to its scientific basis and widespread acceptance within the forensic community. Its use has been validated through numerous legal precedents, ensuring its relevance and reliability in the criminal justice system.
- E. Course Learning Objective:**

CLOBJ 1	Students will explore various types of impression evidence beyond fingerprints, such as footprints, tire treads, tool marks, and bite marks, and learn how to collect, preserve, and analyze these impressions to contribute to criminal investigations.
CLOBJ 2	Participants will gain hands-on experience with cutting-edge forensic technologies, including Automated Fingerprint Identification Systems (AFIS), digital imaging techniques, and 3D scanning technologies, to enhance their ability to process and analyze impression evidence effectively.
CLOBJ 3	Students will understand the legal and ethical considerations surrounding the collection, preservation, and presentation of fingerprint and other impression evidence in court, including chain of custody protocols, admissibility criteria, and expert testimony requirements.
CLOBJ 4	Learners will develop proficiency in fingerprint identification techniques, including the analysis of ridge patterns, minutiae points, and latent prints, enabling them to accurately match fingerprints to individuals in forensic investigations.
CLOBJ 5	Students will be able to differentiate between various fingerprint classification systems, such as the Henry Classification System or the NCIC classification system, and apply them to analyze and categorize fingerprints accurately.

F. Course Learning Outcomes:

CLO 1	Analyze and compare fingerprint patterns using appropriate techniques and technology, leading to the identification of individuals with a high degree of accuracy.
CLO 2	Develop the skills to examine and interpret various types of impression evidence, such as footwear impressions, tire tracks, and tool marks, to determine their relevance to criminal investigations.
CLO 3	Collection methods for impression evidence, including preserving and documenting crime scenes, lifting prints, casting impressions, and maintaining chain of custody protocols.
CLO 4	Assess the strengths and weaknesses of impression evidence in forensic investigations, considering factors such as distortion, contamination, and the potential for false positives or negatives.

CLO 5	Students will be able to present their findings and analysis of impression evidence in a clear, concise manner, both orally and in written reports, suitable for use in legal proceedings or investigative contexts.
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G. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
Lect. Hrs./week	Tut Hrs.	Lab Hrs.	Credit	External		Internal			
				T	P	T	CE	P	
3	-		3	60		20	20		100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

H. Course Content:

Sr.	Topic	Weightage	Teaching Hours
1	Unit 1: Fingerprint history, formation and classification: History and development of Dermatoglyphics, formation of ridges. Plain print and rolled print, direct or inked print. Pattern types, pattern area, ridge characteristics, ridge tracing. Classification of fingerprints- Henry's system of classification, single-digit classification, filing, searching and fingerprint bureau. Taking of fingerprints and palm prints from living and dead person, post-mortem fingerprint, forgery and comparison of fingerprint. Edgeoscopy and Poroscopy.	25%	13
2	Unit 2: Fingerprint composition and enhancement methods: Composition of sweat, development of chance, latent, visible and plastic prints. Conventional methods of development of latent prints- fluorescent methods, magnetic powder method, fuming method, chemical method, Application of laser and other radiations to develop latent fingerprints, metal deposition method and development of latent prints on skin. Preserving and lifting of fingerprints, photography of fingerprints.	25%	12
3	Unit 3: Other impression evidences: Footprint and footwear: Importance, types of prints, gait pattern, casting of footprints according to the place, collection, tracing, lifting-electrostatic lifting of footwear impression, taking of control sample, comparison. Lip print & Ear print: Nature, location, collection and evaluation of lip print & Ear Print, photography, taking of control samples, photography and forensic significance. Modern techniques of latent print enhancement.	25%	10
4	Unit 4: Tyre marks and biometric	25%	10

	Tool and tyre marks: importance, types, collection of evidence from crime scene, collection of samples, casting, lifting and comparison. Biometric: Biometric evidences such as finger impressions, gait pattern, Recent developments, and biometric databases.		
TOTAL		100%	45 Hrs

I. Text Book and Reference Book:

15. Forensic Biology – Richard Li
16. Richard Saferstein, An Introduction to Forensic science.
17. Ashraf Mozayani, The forensic Laboratory handbook: Procedures and Practices.
18. Fundamentals of Forensic DNA Typing – John M. Butler
19. Dr. Archana Tripathi, Forensic serology and blood examination.
20. M.KBhasin, A laboratory manual for human blood analysis.
21. V. S Verma, V.KAgrawal, S.Chand and company, Cell biology, genetics, molecular biology, evolution and ecology.
22. Avinash Upadhyay, Fundamentals of Molecular Biology.

Semester 1

A. Course Name: Fingerprint & other impression evidences lab

B. Course Code: 110207121

C. Prerequisite: Understand the proper techniques for collecting impression evidence to preserve its integrity and ensure accurate analysis. Learn about the appropriate methods for preserving impression evidence, including photography, casting, and lifting.

D. Rationale: Fingerprint and impression evidence is generally admissible in court due to its scientific basis and widespread acceptance within the forensic community. Its use has been validated through numerous legal precedents, ensuring its relevance and reliability in the criminal justice system.

E. Course Learning Objective:

CLOBJ 1	Explore various types of impression evidence beyond fingerprints, such as footprints, tire treads, tool marks, and bite marks, and learn how to collect, preserve, and analyze these impressions to contribute to criminal investigations.
CLOBJ 2	Gain hands-on experience with cutting-edge forensic technologies, including Automated Fingerprint Identification Systems (AFIS), digital imaging techniques, and 3D scanning technologies, to enhance their ability to process and analyze impression evidence effectively.
CLOBJ 3	Understand the legal and ethical considerations surrounding the collection, preservation, and presentation of fingerprint and other impression evidence in court, including chain of custody protocols, admissibility criteria, and expert testimony requirements.
CLOBJ 4	Develop proficiency in fingerprint identification techniques, including the analysis of ridge patterns, minutiae points, and latent prints, enabling them to accurately match fingerprints to individuals in forensic investigations.
CLOBJ 5	Differentiate between various fingerprint classification systems, such as the Henry Classification System or the NCIC classification system, and apply them to analyze and categorize fingerprints accurately.

F. Course Learning Outcomes:

CLO 1	Analyze and compare fingerprint patterns using appropriate techniques and technology, leading to the identification of individuals with a high degree of accuracy.
CLO 2	Develop the skills to examine and interpret various types of impression evidence, such as footwear impressions, tire tracks, and tool marks, to determine their relevance to criminal investigations.
CLO 3	Gain knowledge of proper collection methods for impression evidence, including preserving and documenting crime scenes, lifting prints, casting impressions, and maintaining chain of custody protocols.

CLO 4	Critically assess the strengths and weaknesses of impression evidence in forensic investigations, considering factors such as distortion, contamination, and the potential for false positives or negatives.
CLO 5	Present findings and analysis of impression evidence in a clear, concise manner, both orally and in written reports, suitable for use in legal proceedings or investigative contexts.

H. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
Lect. Hrs./week	Tut Hrs.	Lab Hrs.	Credit	External		Internal			
				T	P	T	CE	P	
-	-	6	3	-	30	-	10	10	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

I. Course Content:

Sr.	List of Practical
1	Taking of plain and rolled fingerprint.
2	Pattern recognition of given fingerprint slip.
3	Ridge counting and Ridge tracing of the given fingerprint slip
4	Development of latent fingerprints using different powder and chemical methods on porous Surface
5	Development of latent fingerprints using different powder and chemical methods on non-porous Surface
6	Comparison of fingerprints and palm prints by individual and class characteristics.
7	10-digit Henry's Classification
8	Restoration techniques of tool mark impressions and casting footprints.
9	Comparison and identification of individuals from lip print evidence.
10	Gait pattern recognition.

J. Text Book and Reference Book:

1. Forensic Biology – Richard Li
2. Richard Saferstein, An Introduction to Forensic science.
3. Ashraf Mozayani, The forensic Laboratory handbook: Procedures and Practices.
4. Fundamentals of Forensic DNA Typing – John M. Butler
5. Dr. Archana Tripathi, Forensic serology and blood examination.
6. M.KBhasin, A laboratory manual for human blood analysis.
7. V. S Verma, V.KAgrawal, S.Chand and company, Cell biology, genetics, molecular biology, evolution and ecology.
8. Avinash Upadhyay, Fundamentals of Molecular Biology.

Semester 1

- A. **Course Name:** Research Methodology
- B. **Course Code:** 11207118
- C. **Prerequisite:** A foundation in critical thinking, basic statistics, and a curious mindset are essential for understanding research methodology.
- D. **Rationale:** Research methodology provides a systematic framework for effective inquiry, enabling scholars to navigate complexity, evaluate evidence, and contribute to knowledge advancement.

E. Course Learning Objective:

CLOBJ 1	Understand the key principles and concepts of research methodology.
CLOBJ 2	Develop proficiency in selecting appropriate research designs and methods for various research questions.
CLOBJ 3	Apply statistical techniques to analyze and interpret research data accurately.
CLOBJ 4	Critically evaluate the strengths and limitations of different research methodologies.
CLOBJ 5	Demonstrate ethical awareness and adherence to research standards throughout the research process.

F. Course Learning Outcomes:

CLO 1	Ability to articulate the fundamental principles and terminology of research methodology.
CLO 2	Competence in designing research studies, including formulating research questions and hypotheses.
CLO 3	Proficiency in conducting statistical analyses and interpreting results to draw meaningful conclusions.
CLO 4	Capacity to critically assess the validity, reliability, and generalizability of research findings.
CLO 5	Ethical conduct in research practice, including the protection of human subjects and integrity in data collection and reporting.

G. Teaching and Examination Scheme:

Lect. Hrs./week	Teaching Scheme			Examination Scheme					Total
	Tut Hrs	Lab Hrs	Credit	T	P	T	CE	P	
2	-	-	2	30	-	10	10	-	50

Lect- Lecture, **Tut** - Tutorial, **Lab** - Lab, **T** - Theory, **P** - Practical, **CE** - CE, **T** - Theory, **P** – Practical

Sr. No.	Topic	Weightage	Teaching Hours
1	Unit 1: Fundamentals of Research	50%	15

	Definition and basic concepts; objectives of research; research approaches, types and techniques of research; hypothesis; literature survey; selection of topic, compiling records; different types of scientific documents; review papers; book reviews; research paper; thesis; project reports (for the scientific community and funding agencies) and conference report. A brief idea about government research agencies.		
2	Unit 2: Probability and Test of hypothesis Introduction to probability theory, various definitions of probability, Basic terms: random experiments, event, trial, sample space, independent and mutually exclusive events; conditional probability, Addition and multiplication theorem, Baye's theorem, likelihood ratio and discriminating power. Distribution of data: normal, binomial and Poisson distribution.	50%	15
	Total	100%	30

Reference Books:

1. Research Methodology Tools and Techniques: H.C Purohit
2. Research Methodology: An Introduction: Wayne Dean Goddard, Stuart Melville
3. Research Methodology in the Medical and Biological Sciences: PetterLaake (Author) Haakon Breien Benestad (Author) Bjorn Reino Olsen (Editor)
4. Research Methodology for Biological Science: Gurumani N Gurumani
5. Research Methodology- G.R. Basotia and K.K. Sharma.
6. Research Methodology- C.H. Chaudhary, RBSA Publication
7. Research Methodology: An Introduction - Wayne Goddard & Stuart Melville
8. Research Methodology - Ranjit Kumar
9. Research Methodology: Methods & Techniques - Kothari, C.R.
10. ASTM Standards with respect to the usage of terminology, wording & phraseology while writing reports and research articles/thesis.

Semester 2

A. Course Name: Forensic Chemistry and NDPS

B. Course Code: 11207122

C. Prerequisite: Proficient in fundamental Forensic Chemistry and NDPS. Understanding scientific principles and methods. Strong critical thinking and problem-solving skills.

D. Rationale: Chemistry forms the backbone of forensic science, providing the analytical tools necessary for identifying, characterizing, and interpreting evidence crucial to criminal investigations.

E. Course Learning Objective:

CLOBJ 1	Understand the role of Forensic Chemistry in criminal investigations and the criminal justice system.
CLOBJ 2	Analyze post-mortem changes affecting the analysis of narcotics in cases of drug poisoning.
CLOBJ 3	Evaluate the significance of qualitative and quantitative chemical tests such as color tests, volumetric tests etc.
CLOBJ 4	Classify the different types of exhibits in cases of arson, explosives etc.
CLOBJ 5	Utilize Forensic Chemistry procedures to cater to examination of chemical evidences and draw its conclusions.

a. Course Learning Outcomes:

CLO 1	Students will understand the fundamental principles of Chemistry and their application to forensic analysis.
CLO 2	Students will be able to demonstrate proficiency in the use of microcrystalline tests for drugs of abuse.
CLO 3	Students will be able to communicate scientific findings effectively for cases of adulteration of food and beverages.
CLO 4	Students will acquire proficiency in crime scene investigation methods, including collection, preservation, and documentation of chemical evidences.
CLO 5	Students will be able to identify and interpret various causes and stages of arson through scientific investigations.

G. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
Lect. Hrs./week	Tut Hrs.	Lab Hrs.	Credit	External		Internal			
				T	P	T	CE	P	
4	-	-	4	60	-	20	20	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

H. Course Content:

Sr.	Topic	Weightage	Teaching Hours
1	Unit 1: Introduction to Forensic Chemistry Basics concepts of Chemistry: Periodic trends, bonding & hybridization, electronic transitions, polarity, pH, Buffer, solutions, basics of Mole Concept, Types of cases/exhibits received for analysis, Overview of forensic chemical analysis, Qualitative and Quantitative Analysis, Bribe Trap Cases: Examination of Chemicals (Phenolphthalein) used in Bribe trap cases. Petroleum and Petroleum Products Distillation and fractionation of petroleum products Commercial uses of different petroleum fractions. Analysis of petroleum products.	25%	15
2	Unit 2: Narcotic Drugs & Psychotropic Substances Definition of narcotics, drugs and psychotropic substances. classification – Narcotics, stimulants, depressants and hallucinogens. on. Natural, synthetic and semi-synthetic n narcotics, drugs and psychotropic substances. Designer drugs. Collection and preservation of drug evidence. Testing of narcotics, drugs and psychotropic substances. Microcrystalline testing of drugs of abuse. Drugs and driving. Dope tests. Post-mortem changes affecting the analysis of narcotics.	25%	15
3	Unit 3: Fire and Arson Introduction to Fires, Types of Fires, and Causes of fire, Patterns of fire, Thermodynamics of fire, Accelerants and incendiary devices, Forensic Analysis of Fire Debris by Instrumental methods, Introduction, Forensic Analysis, and adulteration in petroleum products as per BIS Specifications. Explosives Introduction, classification and chemistry of explosives, Various types of IEDs and their reconstruction, Accidental Explosions, Mechanism of explosion and their effects, Post blast residue analysis (organic and inorganic) by chemical and instrumental techniques and interpretation of results, Explosives Act and Explosive Substance Act.	25%	15
4	Unit 4: Forensic Analysis of Food & Beverages Introduction to Alcoholic and non-alcoholic beverages, Analysis of alcoholic beverages, country made liquor, illicit liquor and medicinal preparations containing alcohol as constituents, Analysis of non-alcoholic beverages like tea, coffee.	25%	15

Adulterated Food Analysis: Common adulterants in food, Analysis of samples taken under Food Adulteration Act, and case studies.		
TOTAL	100%	60 Hrs

I. Reference Books:

1. Maudham Bassett etal; Voget's Textbook of Quantitative Chemical Analysis, 6th Ed. Longman Essex
2. I. I. Finar: Organic Chemistry vol. II Pearson Education (Singapore)
3. R. T. Morrison, Rn.N Boyd; Organic Chemistry, 6th Ed. Prentice Hall, New Delhi
4. Brean S. Furniss Etal; A.I.Vogel Textbook Of Practicals: Oraganic Chemistry, Addison Wesley Longman, Edinburg
5. A. Burger; Medicinal Chemistry, Vol. Ii, Wiley Interscience, Ny
6. D A Skoog, D.M. West, F.J. Holler; Analytical Chemistry – An Introduction, 7th Ed. Saunders College Pub, Philadelphia, USA
7. Boudreau JE, Etal; Arson & Arson Investigation, Survey & Assessment National Institutes Of Law Enforcement, U.S. Deptt Of Justice, U.S. Govt Printing Press
8. Dettean J D; Kirk's Fire Investigation, 5th Ed. Prentice Hall, Eaglewood Cliffs, N. J.
9. Yinon Jitrin; Modern Methods & Application In Analysis Of Explosives, John Wiley & Sons, England
10. Working Procedure Manual – Chemistry, Explosives And Narcotics, BPR&D Pub.
11. C.A. Watson; Official And Standardized Methods Of Analysis, Royal Society Of Chem-istry, UK
12. Feigl; Spot Test In Inorganic Analysis, Elsevier Pub. New Delhi
13. Feigl; Spot Test In Organic Analysis, Elsevier Pub. New Delhi
14. Silverman; Organic Chemistry Of Drug Design & Drug Action, Elserier Pub. New Delhi
15. Abraham Burger; Medicinal Chemistry & Drug Discovery, 6 Vol Set, 6th Ed John Wiley & Sons, NY.

Semester 2

- A. **Course Name:** Forensic Chemistry and NDPS Lab
B. **Course Code:** 11207127
C. **Prerequisite:** Proficient in fundamental Forensic Chemistry and NDPS. Understanding scientific principles and methods. Strong critical thinking and problem-solving skills.
D. **Rationale:** Chemistry forms the backbone of forensic science, providing the analytical tools necessary for identifying, characterizing, and interpreting evidence crucial to criminal investigations.
E. **Course Learning Objective:**

CLOBJ 1	Understand the role of Forensic Chemistry in criminal investigations and the criminal justice system.
CLOBJ 2	Analyze post-mortem changes affecting the analysis of narcotics in cases of drug poisoning.
CLOBJ 3	Evaluate the significance of qualitative and quantitative chemical tests such as color tests, volumetric tests etc.
CLOBJ 4	Classify the different types of exhibits in cases of arson, explosives etc.
CLOBJ 5	Utilize Forensic Chemistry procedures to cater to examination of chemical evidences and draw its conclusions.

F. Course Learning Outcomes:

CLO 1	Students will understand the fundamental principles of Chemistry and their application to forensic analysis.
CLO 2	Students will be able to demonstrate proficiency in the use of microcrystalline tests for drugs of abuse.
CLO 3	Students will be able to communicate scientific findings effectively for cases of adulteration of food and beverages.
CLO 4	Students will acquire proficiency in crime scene investigation methods, including collection, preservation, and documentation of chemical evidences.
CLO 5	Students will be able to identify and interpret various causes and stages of arson through scientific investigations.

G. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
Lect. Hrs./week	Tut Hrs.	Lab Hrs.	Credit	External		Internal			
				T	P	T	CE	P	
-	-	3	2		30	-	10	10	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation,

H. Course Content:

Sr.	List of Practical
1	To carry out analysis of gasoline.
2	To carry out analysis of diesel.
3	To carry out analysis of kerosene.
4	To prepare a case report on a case involving arson.
5	Analysis of phenolphthalein in bribe cases.
6	Analysis of food samples by chemical methods.
7	Qualitative analysis of Post blast residue by chemical test and Chromatography methods.

I. Reference Books:

1. Maudham Bassett et al; Voget's Textbook of Quantitative Chemical Analysis, 6th Ed. Longman Essex
2. I. I. Finar: Organic Chemistry vol. II Pearson Education (Singapore)
3. R. T. Morrison, Rn.N Boyd; Organic Chemistry, 6th Ed. Prentice Hall, New Delhi
4. Brean S. Furniss Etal; A.I.Vogel Textbook Of Practicals: Organic Chemistry, Addison Wesley Longman, Edinburg
5. A. Burger; Medicinal Chemistry, Vol. II, Wiley Interscience, Ny
6. D A Skoog, D.M. West, F.J. Holler; Analytical Chemistry – An Introduction, 7th Ed. Saunders College Pub, Philadelphia, USA
7. Boudreau JE, Etal; Arson & Arson Investigation, Survey & Assessment National Insti-tutes Of Law Enforcement, U.S. Deptt Of Justice, U.S. Govt Printing Press
8. Dettean J D; Kirk's Fire Investigation, 5th Ed. Prentice Hall, Eaglewood Cliffs, N. J.
9. Yinon Jitrin; Modern Methods & Application In Analysis Of Explosives, John Wiley & Sons, England
10. Working Procedure Manual – Chemistry, Explosives and Narcotics, BPR&D Pub.
11. C.A. Watson; Official and Standardized Methods Of Analysis, Royal Society Of Chemistry, UK
12. Feigl; Spot Test In Inorganic Analysis, Elsevier Pub. New Delhi
13. Feigl; Spot Test In Organic Analysis, Elsevier Pub. New Delhi
14. Silverman; Organic Chemistry Of Drug Design & Drug Action, Elsevier Pub. New Delhi
15. Abraham Burger; Medicinal Chemistry & Drug Discovery, 6 Vol Set, 6th Ed John Wiley & Sons, NY.

Semester 2

A. **Course Name:** Questioned Document

B. **Course Code:** 11207123

C. **Prerequisite:** Proficient in fundamentals of Questioned Document. Understanding scientific principles and methods. Strong critical thinking and problem-solving skills.

D. **Rationale:** A "Questioned Document" refers to any piece of documentation whose authenticity, origin, or content is under dispute or subject to scrutiny.

E. **Course Learning Objective:**

CLOBJ 1	Comprehensive understanding of the principles and methodologies involved in questioned document examination, including handwriting analysis, ink and paper analysis, and typewritten document examination.
CLOBJ 2	Learning scientific and forensic techniques to authenticate documents, such as spectroscopy, chromatography, microscopy, and digital analysis tools.
CLOBJ 3	Develop the ability to conduct detailed comparisons between questioned documents and known exemplars, identifying similarities, differences, and potential signs of forgery or alteration.
CLOBJ 4	Gaining expertise in analyzing the chemical composition of ink and paper, determining their age, origin, and authenticity through methods such as ink dating and paper fiber analysis.
CLOBJ 5	Understanding the unique characteristics of typewritten documents and learn techniques for identifying typewriter models, assessing typing irregularities, and detecting alterations.

F. **Course Learning Outcomes:**

CLO 1	Understand the fundamental principles of questioned document and their application to cases.
CLO 2	Demonstrate proficiency in the use of different test for ink, paper and variety of documents.
CLO 3	Communicate scientific findings effectively for cases of authenticity of documents.
CLO 4	Acquire proficiency in crime scene investigation methods, including collection, preservation, and documentation of documents.
CLO 5	Identify and interpret various causes and stages of burned documents through scientific investigations.

G. **Teaching & Examination Scheme:**

Teaching Scheme	Examination Scheme	Total
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Lect. Hrs./week	Tut Hrs.	Lab Hrs.	Credit	External		Internal			
				T	P	T	CE	P	
4	-	-	4	60	-	20	20	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation,
CE- Continuous Evaluation, ESE- End Semester Examination

H. Course Content:

Sr.	Topic	Weightage	Teaching Hours
1	Unit 1: Document and examination methods Questioned Documents nature, scope and definition. Types of documents: standard admitted/specimen writing. Preliminary examination of documents. Comparison of Documents. Basic tools needed for forensic documents' examination, Determining the age and relative age of documents. Collection, handling, preservation and forwarding of documents seized from scene of crime.	25%	12
2	Unit 2: Handwriting Identification Basics of handwriting identification, Comparison of handwriting, development of individuality. Natural variations and fundamental divergences in handwritings. Class and individual characteristics. Merits and demerits of exemplar and non-exemplar samples during comparison of handwriting. Standards for comparison of handwriting. Distinguished writing and anonymous letter: identification of writer, examination of signature.	25%	15
3	Unit 3: Examination of printing, photocopying and security documents Examination of black and white, colored Xeroxed copies, carbon fax copies: forgeries and their detection, detection of strokes, physical matching of documents. Typewriting- Class and individual characters & their comparison. Printed matter and their examination. Comparison of printing process, paper, ink, printed documents, typed documents, Xeroxed documents.	25%	18
4	Unit 4: Foraged Documents Forgeries Alterations in documents, including erasures, additions, over-writings and obliterations. Indented and Secret writings. Charred documents & their decipherment.	25%	15

	Examination of counterfeit Indian passports, visas, currency notes, coins and stamp. Sequence Of Stroke Analysis		
TOTAL		100%	60 Hrs

I. Reference Books:

1. Rev. ED.; Ordway Hilton; Scientific Examination. I of Questioned Documents, Elsevier, New York;
2. Albert S. Osborn; Questioned Documents, Second Ed.; Universal Law Publishing, Delhi;
3. Albert S. Osborn; The Problem of Proof~ Second Ed.; Universal Law Publishing, Delhi;
4. Charles C. Thomas, Typewriting Identification I.S.Q.D.; Billy Prior Bates; Springfield, Illinois, USA
5. Charles C. Thomas, I.S.Q.D. Identification System for Questioned Documents; Billy Prior Bates Springfield, Illinois, USA
6. Wilson R. Harrison; Suspect Documents -Their Scientific Examination; Universal Law Publishing, Delhi- please see publisher
7. Morris, Ron, N: Forensic handwriting identification, Acad Press, London
8. Kurtz Sheila: Graphotypes a new plant on handwriting, analysis, Crown Publishers Inc., USA.
9. Hard less, H.R: Disputed Documents, handwriting and thumbs -print identification: profusely illustrated, Low Book Co., Allahabad
10. Lerinson Jay; Questioned Documents, Academic Press, London
11. Wilson R Harrison: Detection of Forgery
12. V P Convey: Evidential Documents.
13. David Ellen: Scientific Examination of questioned documents
14. Jan Seaman Kelly: Scientific Examination of Questioned Documents
15. Heidi H Harralson: Huber and Headrick's Handwriting Identification
16. Jane Lewis: Forensic Document Examination

Semester 2

A. **Course Name:** LAB Questioned Document

B. **Course Code:** 11207123

C. **Prerequisite:** Proficient in fundamentals of Questioned Document. Understanding scientific principles and methods. Strong critical thinking and problem-solving skill.

D. **Rationale:** A "Questioned Document" refers to any piece of documentation whose authenticity, origin, or content is under dispute or subject to scrutiny.

E. **Course Learning Objective:**

CLOBJ 1	Comprehensive understanding of the principles and methodologies involved in questioned document examination, including handwriting analysis, ink and paper analysis, and typewritten document examination.
CLOBJ 2	Learning scientific and forensic techniques to authenticate documents, such as spectroscopy, chromatography, microscopy, and digital analysis tools.
CLOBJ 3	Develop the ability to conduct detailed comparisons between questioned documents and known exemplars, identifying similarities, differences, and potential signs of forgery or alteration.
CLOBJ 4	Gaining expertise in analyzing the chemical composition of ink and paper, determining their age, origin, and authenticity through methods such as ink dating and paper fiber analysis.
CLOBJ 5	Understanding the unique characteristics of typewritten documents and learn techniques for identifying typewriter models, assessing typing irregularities, and detecting alterations.

F. **Course Learning Outcomes:**

CLO 1	Understand the fundamental principles of questioned document and their application to cases.
CLO 2	Demonstrate proficiency in the use of different test for ink, paper and variety of documents.
CLO 3	Communicate scientific findings effectively for cases of authenticity of documents.
CLO 4	Acquire proficiency in crime scene investigation methods, including collection, preservation, and documentation of documents.

CLO 5	Identify and interpret various causes and stages of burned documents through scientific investigations.
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G. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
Lect. Hrs./week	Tut Hrs.	Lab Hrs.	Credit	External		Internal			
				T	P	T	CE	P	
-	-	3	2		30	-	10	10	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

H. Course Content:

Sr.	List of Practical
1	Identification of Handwriting-general characteristics, natural variations, fundamental divergences and individual characteristics.
2	To detect Simulated and traced forgeries.
3	To study the handwriting of person suffering from illness and handwriting written on usual surface.
4	Examination of additions, alterations, and obliterations in the documents.
5	Examination of mechanical and chemical use of erasers on the documents.
6	Examination of indented handwriting.
7	Examination of writing inks by TLC/ Paper chromatography.
8	Examination of sequence of intersecting strokes.
9	Examination of disguised writings.
10	Examination of counterfeit currency by using microscopy and UV light.
11	To examine the security features of passports.

I. Reference Books:

1. Rev. ED.; Ordway Hilton; Scientific Examination. I of Questioned Documents, Elsevier, New York;
2. Albert S. Osborn; Questioned Documents, Second Ed.; Universal Law Publishing, Delhi;
3. Albert S. Osborn; The Problem of Proof~ Second Ed.; Universal Law Publishing, Delhi;
4. Charles C. Thomas, Typewriting Identification I.S.Q.D.; Billy Prior Bates; Springfield, Illinois, USA
5. Charles C. Thomas, I.S.Q.D. Identification System for Questioned Documents; Billy Prior Bates Springfield, Illinois, USA
6. Wilson R. Harrison; Suspect Documents -Their Scientific Examination; Universal Law Publishing, Delhi- please see publisher
7. Morris, Ron, N: Forensic handwriting identification, Acad Press, London
8. Kurtz Sheila: Graphotypes a new plant on handwriting, analysis, Crown Publishers Inc., USA.

9. Hard less, H.R: Disputed Documents, handwriting and thumbs -print identification: profusely illustrated, Low Book Co., Allahabad
10. Lerinson Jay; Questioned Documents, Academic Press, London
11. Wilson R Harrison: Detection of Forgery
12. V P Convey: Evidential Documents.
13. David Ellen: Scientific Examination of questioned documents
14. Jan Seaman Kelly: Scientific Examination of Questioned Documents
15. Heidi H Harralson: Huber and Headrick's Handwriting Identification
16. Jane Lewis: Forensic Document Examination

Semester 2

A. Course Name: Digital and Cyber Forensics

B. Course Code: 11207124

C. Prerequisite: Proficient in basic computing skills with an understanding of cybersecurity principles, familiarity with legal and ethical considerations, data analysis skills, and the ability to think critically and problem-solve.

D. Rationale: The "Digital and Cyber Forensic" course in MSc Semester 2 is essential in today's digital age, enabling professionals to investigate cybercrimes, analyze digital evidence, and protect against digital threats. It plays a crucial role in identifying and prosecuting cybercriminals, mitigating risks, and maintaining the integrity of digital systems.

E. Course Learning Objective:

CLOBJ 1	Understanding Foundation and gaining a comprehensive understanding of the principles, theories, and methodologies underlying digital forensics, including the legal and ethical considerations involved in handling digital evidence.
CLOBJ 2	Identify and explain the types of cybercrime and also master the investigative techniques.
CLOBJ 3	Develop the ability to conduct thorough forensic examinations of digital devices and systems, including identifying, recovering, and analyzing deleted or hidden data, metadata, and artifacts relevant to investigations.
CLOBJ 4	Understand how digital forensics contributes to cybersecurity efforts by detecting, responding to, and preventing cyber threats, and learn how to implement best practices to enhance the resilience of digital systems and networks.
CLOBJ 5	Cultivate ethical decision-making skills and professional integrity in handling sensitive information, respecting privacy rights, and ensuring impartiality and objectivity throughout the forensic investigation process.

F. Course Learning Outcomes:

CLO 1	Understanding Foundation and gaining a comprehensive understanding of the principles, theories, and methodologies underlying digital forensics, including the legal and ethical considerations involved in handling digital evidence.
CLO 2	Identify and explain the types of cybercrime and also master the investigative techniques.
CLO 3	Develop the ability to conduct thorough forensic examinations of digital devices and systems, including identifying, recovering, and analyzing deleted or hidden data, metadata, and artifacts relevant to investigations.
CLO 4	Understand how digital forensics contributes to cybersecurity efforts by detecting, responding to, and preventing cyber threats, and learn how to implement best practices to enhance the resilience of digital systems and networks.
CLO 5	Cultivate ethical decision-making skills and professional integrity in handling sensitive information, respecting privacy rights, and ensuring impartiality and objectivity

	throughout the forensic investigation process.
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G. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
Lect. Hrs./week	Tut Hrs.	Lab Hrs.	Credit	External		Internal			
				T	P	T	CE	P	
4	-	-	4	60	-	20	20	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

H. Course Content:

Sr. No	Content	Weightage	Teaching Hours
1.	Unit-1 Introduction to Computer Forensic a) Introduction to Traditional Computer Crime, Traditional problems associated with Computer Crime. Introduction to Identity Theft & Identity Fraud. Types of CF techniques – Incident and incident response methodology – Forensic duplication and investigation. Preparation for IR: Creating response tool kit and IR team. – Forensics Technology and Systems – Understanding Computer Investigation – Data Acquisition. b) Processing Crime and Incident Scenes – Working with Windows and DOS Systems. Current Computer Forensics Tools: Software/ Hardware Tools. c) Validating Forensics Data – Data Hiding Techniques – Performing Remote Acquisition – Network Forensics – Email Investigations – Cell Phone and Mobile Devices Forensics.	25%	15
2.	Unit-2 Network Forensic: a) Network Forensic: Collecting and analyzing network-based evidence, reconstructing web browsing, email activity, and windows registry changes, intrusion detection, tracking offenders, etc. b) Mobile Network Forensic: Introduction, Mobile Network Technology, Investigations, Collecting Evidence, Where to seek Digital Data for further Investigations, Interpretation of Digital Evidence on Mobile Network. Software Reverse Engineering: defend against software targets for viruses, worms and other malware, c) improving third-party software library, identifying hostile codes-buffer overflow, provision of unexpected inputs, etc. Computer crime and Legal issues: Intellectual property, privacy issues, Criminal Justice system for forensic, audit/investigative situations and digital crime scene, investigative procedure/standards for extraction, preservation, and deposition of legal evidence in a court of law.	25%	12

3.	Unit-3 Mobile and Wireless Device Forensics: a) Phone Phreaking, Call tampering, Wireless Hack Walkthrough and Man-in-the-Middle-attacks. Overview of WEP attack. Attacks on WEP, WPA and WPA-2 Encryption, fake hotspots. Wireless Public Key Infrastructure. Securing WLAN, WEP Decryption script. b) Overview of Mobile Forensics, Seizure and Preservation of mobile phones and PDA. Types of Evidence present in mobile phones - Files present in SIM card, external memory dump, and evidences in memory card. Mobile phone evidence extraction process, Data Acquisition Methods – Physical, File System, Logical and Manual Acquisition. Mobile Forensic Investigation Toolkit. Tracking of mobile phone location. c) Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations	25%	15
4.	UNIT 4 Social Media Forensics and Cryptography: a) Introduction to Social Media, Security Issues in Social Media, Types of crimes of Social Media – Cyberbullying, Online Grooming, Cyberstalking. Social Media and its impact on Business, Politics, Law and Revolutions, Emerging Trends in social media. b) social media evidence, Types of Data Available on Social Networking Sites, Different evidence collection methods from social networking sites, Intelligence gathering from Social Media- Tools and techniques for intelligence gathering– indirect method, direct method with login, direct method without login. c) Introduction to Cryptography, Symmetric and Asymmetric Cryptosystem Encryption Techniques– Substitutional Cipher and Transpositional Ciphers. Types of keys – Public Key and Private Key. Advanced Encryption Techniques and Security Issues.	25%	18
TOTAL		100%	60 Hrs

I. Text Book and Reference Book:

1. Nina Godbole and SunitBelapore, “Cyber Security: Understanding cyber Crimes, computer Forensics and Legal Perspective, wiley publications, (2011).

2. Shon Harris, All in One CISSP, Exam guide sixth edition, McGraw Hill, (2013).
3. Atul Jain, Cyber Crime: Issue, threats and management, (2004).
4. S. Davidoff, Network Forensics.
5. Keval Ukey, Cyber Forensic: A Legal perspective of data protection and e-commerce.
6. Angus Marshall, Digital Forensics.
7. Thomas J Holt, Cybercrime and Digital forensics An Introduction.

Semester 2

A. Course Name: Digital and Cyber Forensics Lab

B. Course Code: 11207124

C. Prerequisite: Proficient in fundamental Digital and Cyber Forensics. Understanding scientific principles and methods. Strong critical thinking and problem-solving skills.

D. Rationale: The practical lab component of digital and cyber forensic courses offers invaluable hands-on experience, allowing students to apply theoretical knowledge to real-world scenarios.

E. Course Learning Objective:

CLOBJ 1	Gain practical experience in applying forensic techniques and methodologies to analyzedigital evidence obtained from various sources, including computers, mobile devices, and networks.
CLOBJ 2	Develop proficiency in using industry-standard forensic tools and software to acquire, preserve, examine, and analyze digital evidence effectively, ensuring adherence toforensic best practices and standards.
CLOBJ 3	Evaluate proper procedures for handling and documenting digital evidence, includingmaintaining chain of custody, preserving data integrity, and ensuring evidence admissibility in legal proceedings.
CLOBJ 4	Classify simulated forensic investigations and case scenarios to develop investigative skills, critical thinking abilities, and problem-solving techniques in a controlledlaboratory environment.
CLOBJ 5	Employ and Acquire practical skills and competencies that prepare students for real-world challenges in digital forensics, including incident response, cybercrime investigations, and forensic examination of digital devices and systems.

F. Course Learning Outcomes:

CLO 1	Gain practical experience in applying forensic techniques and methodologies to analyzedigital evidence obtained from various sources, including computers, mobile devices, and networks.
CLO 2	Develop proficiency in using industry-standard forensic tools and software to acquire,preserve, examine, and analyze digital evidence effectively, ensuring adherence to forensic best practices and standards.
CLO 3	Evaluate proper procedures for handling and documenting digital evidence, includingmaintaining chain of custody, preserving data integrity, and ensuring evidence admissibility in legal proceedings.
CLO 4	Classify simulated forensic investigations and case scenarios to develop investigative skills, critical thinking abilities, and problem-solving techniques in a controlledlaboratory environment.
CLO 5	Acquire practical skills and competencies that prepare students for real-world challenges in digital forensics, including incident response, cybercrime investigations,and forensic examination of digital devices and systems.

G. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
Lect. Hrs./week	Tut Hrs.	Lab Hrs.	Credit	External		Internal			
				T	P	T	CE	P	
-	-	3	2		30	-	10	10	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

H. Course Content:

Sr.	List of Practical
1	IP Tracking of by using Tracking Link (Grabify IP Logger)
2	Understanding the Ping Command in Network.
3	Image Steganography.
4	Analysis of Data Source Using Autopsy
5	Recover deleted or lost files with using DiskDrill.

I. Text Book and Reference Book:

1. Nina Godbole and SunitBelapore, "Cyber Security: Understanding cyber Crimes, computer Forensics and Legal Perspective, wiley publications, (2011).
2. Shon Harris, All in One CISSP, Exam guide sixth edition, McGraw Hill, (2013).
3. Atul Jain, Cyber Crime: Issue, threats and management, (2004).
4. S. Davidoff, Network Forensics.
5. Keval Ukey, Cyber Forensic: A Legal perspective of data protection and e-commerce.
6. Angus Marshall, Digital Forensics.
7. Thomas J Holt, Cybercrime and Digital forensics An Introduction.

Semester 2

A. Course Name: Basics of statistics

B. Course Code: 11207126

C. Prerequisite: This includes a solid understanding of mathematics, particularly algebra and arithmetic. Additionally, familiarity with basic concepts in probability theory and data analysis is beneficial.

D. Rationale: Statistics provide tools for analysing and interpreting data, which is essential for drawing meaningful conclusions from research findings, forensic evidence, psychological assessments, and criminal justice data.

E. Course Learning Objective:

CLOBJ 1	Grasp foundational statistical concepts such as measures of central tendency, variability, probability, hypothesis testing, and statistical inference.
CLOBJ 2	Develop proficiency in conducting statistical analyses using appropriate techniques such as descriptive statistics, inferential statistics, correlation, regression, and analysis of variance (ANOVA).
CLOBJ 3	Interpret statistical results accurately, including identifying patterns, trends, relationships, and making data-driven conclusions based on statistical evidence.
CLOBJ 4	Apply statistical techniques to real-world scenarios, such as analyzing crime data, psychological assessments, forensic evidence, and legal case studies, to make informed decisions and recommendations.
CLOBJ 5	Critically evaluate statistical claims, research methodologies, and data sources to assess the validity, reliability, and limitations of statistical findings, ensuring ethical and accurate use of statistical information in forensic science, psychology, criminology, and criminal law contexts.

F. Course Learning Outcomes:

CLO 1	Demonstrate a thorough understanding of fundamental statistical concepts, including measures of central tendency, variability, probability theory, and basic inferential statistics.
CLO 2	Develop proficiency in using statistical software and techniques to analyze data sets, interpret results, and draw meaningful conclusions.
CLO 3	Apply statistical reasoning and critical thinking skills to solve real-world problems, make informed decisions based on data, and evaluate the reliability and validity of statistical claims.
CLO 4	Interpret statistical findings accurately and effectively communicate results through written reports, graphical representations, and oral presentations.
CLO 5	Demonstrate an understanding of ethical considerations in statistical analysis, including issues related to data privacy, confidentiality, and integrity, adhering to professional standards in data collection, analysis, and reporting.

G. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
Lect. Hrs./week	Tut Hrs.	Lab Hrs.	Credit	External		Internal			
				T	P	T	CE	P	
2	-	-	2	60	-	20	20	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

H. Course Content:

Sr.	Topic	Weightage	Teaching Hours
1	Unit 1: Basic concepts of Statistics and data analysis Basic definitions and applications of statistics, Distribution of data: normal, binomial and Poisson Sampling: Data collection and presentation: Methods of data presentation-graphical representation by histogram, polygon, curves and pie diagram. Measures of central tendency, correlation and regression: Positive and negative correlation and calculation of Karl-Pearsons's coefficient of correlation, skewness and kurtosis.	50%	15
2	Unit 2: Test of hypothesis: introduction and concepts; test for small and large sample: Parametric Test Z-test, t-test, chi-square test, F-test and ANOVA Non- Parametric Test- Wilcoxon Rank Sum Test, Mann- Whitney U Test, Kruskal Wallis Test, Friedman Test	50%	15
TOTAL		100%	30 Hrs

I. Text Book and Reference Book:

1. Statistics in biology, (1967) Vol. 1: Bliss, C.I.K. McGraw Hill, New York.
2. Practicals: Statistics for experimental biologist (1985): Wardlaw, A.C.
3. Statistical Methods in Biology (2000): Bailey, N.T. J. English Univ. Press.
4. Biostatistics - 7th Edition : Daniel
5. Fundamental of Biostatistics : Khan
6. Bio-statistical Methods : Lachin
7. Statistics for Biologist (1974):Campbell R.C. Cambridge
8. Research Methodology Tools And Techniques : H.C Purohit
9. Research Methodology: An Introduction : Wayne Dean Goddard, Stuart Melville
10. Research Methodology in the Medical and Biological Sciences: PetterLaake (Author)
Haakon Breien Benestad (Author) Bjorn Reino Olsen (Editor)
11. Research Methodology For Biological Science : Gurumani N Gurumani
12. Research Methodology- G.R. Basotia and K.K. Sharma.
13. Research Methodology- C.H. Chaudhary, RBSA Publication
14. Research Methodology: An Introduction - Wayne Goddard & Stuart Melville

15. Research Methodology - Ranjit Kumar
16. Research Methodology: Methods & Techniques - Kothari, C.R.
17. ASTM Standards with respect to the usage of terminology, wording & phraseology while writing reports and research articles/thesis.

Semester 2

A. Course Name: Forensics Science Instrumentation

B. Course Code: 11207125

C. Prerequisite: Basic understanding of chemistry and physics concepts, alongside proficiency in laboratory techniques, is required for comprehending forensic science instrumentation.

D. Rationale: Forensic science instrumentation demands a foundational grasp of scientific principles to operate effectively, ensuring accurate analysis and interpretation of forensic evidence crucial for investigative and legal purposes.

E. Course Learning Objective:

CLOBJ 1	Develop proficiency in using various forensic science instruments for evidence analysis.
CLOBJ 2	Understand the principles underlying the operation of forensic instrumentation and their applications in crime scene investigation.
CLOBJ 3	Enhance critical thinking skills to evaluate and interpret forensic data obtained from instrumentation.
CLOBJ 4	Gain practical experience in troubleshooting and maintaining forensic science instrumentation.
CLOBJ 5	Apply ethical standards and quality control measures in the use of forensic science instrumentation.

F. Course Learning Outcomes:

CLO 1	Ability to operate a range of forensic instruments proficiently, demonstrating competence in evidence analysis.
CLO 2	Comprehensive understanding of the theoretical and practical aspects of forensic instrumentation, facilitating effective crime scene investigations.
CLO 3	Capability to critically analyze forensic data obtained from instrumentation, leading to accurate and reliable conclusions.
CLO 4	Proficiency in troubleshooting and maintaining forensic instrumentation to ensure optimal performance and data integrity.
CLO 5	Adherence to ethical guidelines and quality assurance protocols in the utilization of forensic science instrumentation, promoting integrity and credibility in forensic practice.

G. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
Lect. Hrs./week	Tut Hrs.	Lab Hrs.	Credit	External		Internal			
				T	P	T	CE	P	
4	-	-	4	60	-	20	20	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

H. Course Content:

Sr.	Topic	Weightage	Teaching Hours
1.	Unit 1: Spectrophotometry: U. V -Visible- Types of sources and stability, wavelength selection, filters- cells and sampling devices, detectors, resolution, qualitative and quantitative methods for detection. IR atomic absorption: Dispersive and Fourier Transform spectroscopy, sample handling, qualitative analysis and interpretation of IR spectra. Raman Spectroscopy: Instrumentation, sample handling and illumination, structural analysis. X-ray Spectroscopy: Introduction to X-ray absorption and fluorescence methods, X-ray diffraction, Auger emission spectroscopy (AES), and electron spectroscopy for chemical analysis (ESCA). Nuclear magnetic resonance spectroscopy: Basic principles, theory and instrumentation.	25%	18
2.	Unit 2: Microscopy Techniques Basic principles, working, mechanism, uses & Forensic Applications of Simple and Compound microscope, Comparison microscope, Phase contrast Microscope, Stereoscopic microscope, Polarizing microscope, Fluorescent Microscopy, Infra-red Microscopy, Scanning Electron Microscope (SEM) & Transmission Electron Microscope (TEM)	25%	15
3.	Unit 3: Chromatographic Techniques General principles, Paper chromatography, column chromatography, TLC, Adsorption Chromatography, Partition chromatography, Gas chromatography, Gas liquid chromatography, Ion – Exchange chromatography, Affinity chromatography, HPLC, HPTLC, Capillary chromatography.	25%	12
4.	Unit 4: Immuno-chemical Techniques: General principles, Production of antibodies, Precipitin reaction, Gel immuno-	25%	15

	diffusion, Immuno-electrophoresis, complement fixation, Radio Immuno Assay (RIA), ELISA, Fluorescence immuno assay. Uses & Forensic Applications. Electrophoretic Techniques: General principles, Factors affecting electrophoresis, Electrophoresis, Low voltage thin sheet electrophoresis, High voltage electrophoresis, Sodium dodecyl sulphate (SDS) polyacryl amide gel electrophoresis, Isoelectric focusing (IEF), Isoelectrophoresis, Preparative electrophoresis, Horizontal and Vertical Electrophoresis. Uses & Forensic Applications.		
TOTAL		100%	60 Hrs

I. Reference Books:

1. G.R. Chatwal; Analytical Spectroscopy 2nd Edn, Himalaya Publishing House New Delhi, 2002.
2. Chatwal and Anand, Instrumental methods of Chemical analysis, Himalaya publishing house. ISO:9001:2008 certified.
3. Willard, Merritt, Dean and settle, Instrumental Method of Analysis, Seventh Edition.
4. Forensic Biology – Richard Li
5. Richard Saferstein, An Introduction to Forensic science.
6. Ashraf Mozayani, The forensic Laboratory handbook: Procedures and Practices.
7. Fundamentals of Forensic DNA Typing – John M. Butler
8. Dr. Archana Tripathi, Forensic serology and blood examination.
9. M.K Bhasin, A laboratory manual for human blood analysis.
10. V.S Verma, V.K Agrawal, S.Chand and company, Cell biology, genetics, molecular biology, evolution and ecology.
11. Avinash Upadhyay, Fundamentals of Molecular Biology.

Semester 3

A. Course Name: Forensic Toxicology & Pharmacology

B. Course Code: 11207130

C. Prerequisite: Basic knowledge of chemistry and biology.

D. Rationale: Understand the intersection of toxicology and pharmacology in legal investigations.

E. Course Learning Objective:

CLOBJ 1	Identify common toxic substances encountered in forensic investigations
CLOBJ 2	Understand the pharmacokinetics and pharmacodynamics of various drugs and toxins.
CLOBJ 3	Learn methods for sample collection, preservation, and analysis in forensic toxicology.
CLOBJ 4	Analyze the relationship between drug dosage, toxicity, and potential lethal effects.
CLOBJ 5	Apply principles of forensic toxicology to interpret toxicological findings in legal contexts.

F. Course Learning Outcomes:

CLO 1	Demonstrate proficiency in conducting toxicological analyses using advanced laboratory techniques.
CLO 2	Effectively communicate toxicological findings and interpretations to various stakeholders, including law enforcement, attorneys, and medical professionals.
CLO 3	Apply ethical standards and best practices in forensic toxicology research and analysis
CLO 4	Develop critical thinking skills to assess complex toxicological data and draw evidence-based conclusions.
CLO 5	Exhibit mastery in preparing comprehensive toxicology reports suitable for presentation in legal proceedings and court testimony.

G. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
Lect. Hrs./week	Tut Hrs.	Lab Hrs.	Credit	External		Internal			
				T	P	T	CE	P	
4	-	-	4	60	-	20	20	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

M. Course Content:

Sr. No	Content	Weightage	Teaching Hours
1.	Unit 1: Basics of Forensic Toxicology	25%	15

	Introduction and concepts of forensic toxicological examination and its significance. Introduction to Poisons, form of poisons, classification and methods of administration of poison Mode of action of poison, Diagnosis and management of poisoning cases. Factors affecting the effect of poison and medico-legal aspects in poisoning Collection and preservation of biological evidences (viscera and /or body fluids) and circumstantial evidences in fatal and survival cases. Submission of samples to the laboratory, post-mortem examination, specific analysis plan / approach to toxicological examinations of poisoning samples. Classification of matrices. Laws related to Poisons. Poison Act 1919, Drugs Act 1940 and 1955, Drug and Cosmetic Act 1940 and amendments.		
2.	Unit 2: Methods of extraction; Classical and Modern Methods. Isolation and Extraction of poison/ drug by various classical and modern methods using instrumental techniques. Separation of poison and drugs using chromatographic and electrophoretic techniques. Identification and estimation of poisons and drugs using chromatographic and other instrumental methods. Method of analysis of Inorganic poisons (metallic, non-metallic and anions). Method of analysis of Neutral poison. Method of analysis of Basic drugs / poisons. Method of analysis of Acidic drugs / poisons. Method of analysis of metallic poisons, volatile poisons. Method of quantization of some volatile poisons in biological materials.	25%	15
3.	Unit 3: Insects and animal poisons and their examination. Plant poisons: Classification and characteristics, method of extraction and stripping of plant poisons in matrices and analysis by chemical and instrumental techniques. Miscellaneous poison Analytical aspect of toxicological evidence. Toxicological analysis of decomposed materials. Interpretation of toxicological findings and preparation of reports.	25%	15
4.	Unit 4: Forensic Pharmacology forensic pharmacological: pharmacokinetics and pharmacodynamics, Methods of transportation of toxicant, Absorption, Distribution, Storage of toxicant, Redistribution, Metabolism, Oxidation, Reduction,	25%	15

	Hydrolysis, Conjugation, Excretion, Other routes of elimination pathways of drug metabolism, drug metabolism and drug toxicity, interpretation of analytical data and formation of opinion.		
TOTAL		100%	60 Hrs

N. Text Book and Reference Book:

1. Curry A.S ; Analytical Methods in Human Toxicology : Part II ,CRC Press Ohio (1986)
2. Curry, A.S : Poison Detection in Human Organs, C Thomas Spring field CRC Press (1976)
3. Clark E.G. C : Isolation and Identification of drugs . Vol.I and Vol.2, Academic Press (1986)
4. Niesink R J M : Toxicology - Principle and Application, CRC Press (1996)
5. Sunshine I : Handbook of Analytical Toxicology, CRC Press(1969)
6. Parikh C. K, : Text Book of Medical Jurisprudence, Forensic Medicine and Toxicology, CBS Publ. New Delhi (1999)
7. Laboratory Procedure Manual, Forensic Toxicology :Directorate of Forensic Science MHA Govt (2005)
8. Steward And Stolman : Toxicology Vol.1 and Vol. 2
9. Michel J D etal : Handbook of toxicology CRC Press Publ, USA (1995)
10. Casarett, L J and Doull John ; Toxicology :The Basic Science of Poison, Macmillan Publ. Co. New York (1975)
11. Carvey R.H& Baselt R C ;Introduction to Forensic Toxicology and Biochemicals Publ.Davis C.A (1981)
12. Chada PV Handbook of Forensic Medicine and Toxicology, J P Brothers New Delhi(2004)
13. Modi Jaisingh P : Textbook of Medical Jurisprudence and Toxicology ,M.M. Tripathy Publ.(2001)
14. Zweig G ; Analytical Methods of Pesticides, Academic Press (1966)
15. Doesker A S ; Medical Jurisprudence , Toxicology & Forensic Science All India Reporter Pvt. Ltd. (2010)

Semester 3

A. Course Name: Forensic Biology & Serology

B. Course Code: 11207131

C. Prerequisite: Fundamental understanding of biology and biochemistry.

D. Rationale: Explore the role of biology and serology in criminal investigations, including DNA analysis.

E. Course Learning Objective:

CLOBJ 1	Develop skills in recognizing, collecting, and preserving biological evidence found at crime scenes.
CLOBJ 2	Learn various serological techniques for the detection and analysis of bodily fluids such as blood, semen, and saliva.
CLOBJ 3	Understand the principles and methodologies of DNA extraction, amplification, and profiling in forensic contexts.
CLOBJ 4	Gain proficiency in interpreting DNA profiles and using genetic information to link suspects to crime scenes.
CLOBJ 5	Practice applying forensic biology techniques to real-world case scenarios to develop investigative strategies.

F. Course Learning Outcomes:

CLO 1	Demonstrate competence in performing serological analyses and accurately interpreting results to identify bodily fluids and their origins.
CLO 2	Exhibit proficiency in DNA extraction, amplification, and analysis techniques, leading to successful DNA profiling.
CLO 3	Apply principles of population genetics to interpret DNA profiles and calculate statistical probabilities in forensic casework.
CLO 4	Develop the ability to effectively communicate forensic biology findings through comprehensive reports and expert testimony.
CLO 5	Display ethical awareness and adherence to professional standards in handling and analyzing biological evidence in forensic investigations.

G. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
Lect. Hrs./week	Tut Hrs.	Lab Hrs.	Credit	External		Internal			
				T	P	T	CE	P	
4	-	-	4	60	-	20	20	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

H. Course Content:

Sr. No	Content	Weightage	Teaching Hours
1.	Unit 1:	25%	15

	Scope of Forensic Biology, cell biology Structure and function of cell, basic concept of anatomy and physiology of Skeleton system. DNA profiling structure, analysis and forensic significance: History of DNA fingerprinting, molecular biology of DNA, Comparison of mitochondrial and nuclear DNA maternal inheritance and its genome organization. Sources of DNA evidence. Quantitative PCR assay, Slot Blot Assay, DNA data-basing Electrophoretic. Methods: Agarose gel, SDS-PAGE, Native PAGE, Southern /Northern Blotting Application in disputed paternity cases, child swapping, missing person's identity, civil immigration,		
2.	Unit 2: Immunology Immune system, response, innate and acquired immunity, antigens, heptanes and adjuvant. Immunoglobulin types, Physiochemical properties and function, raising of anti-sera, lectins and their forensic significance, buffer, serological reagents. Hairs and fibers- Morphology and biochemistry of human and animal hair and its microscopic examination, determination of origin, race, site. Types of fibers- forensic aspects of fiber examination, fluorescent, optical properties, refractive index, birefringence, dye analysis etc. identification and comparison of man-made and natural fibers.	25%	15
3.	Unit 3: Body fluids: Blood, semen and saliva Blood: Blood (RBC, WBC and platelets) other variants of blood, blood property (physical, chemical, and biological), Functions of blood, identification of blood, blood grouping systems (A, B, O systems, Rh factor), human and nonhuman blood, Human and Non-human Presumptive and Confirmatory Tests. Semen: composition and function, morphology and spermatozoa, identification of stains of semen by various methods. Saliva: Composition and function.	25%	15
4.	Unit 4: Wildlife Forensics: Importance of wild life species in ecosystem. Endangered and rare species, Wild life Management, Different methods of killing and poaching of the wild life animals. Scientific methods of investigation - identity wild life animals - examination of physical evidences like hair, nails, teeth, ivory, horn, footprints (pugmarks) etc. by conventional and modern methods. Botany: types of wood- Various types of woods, Varieties of timber, seeds and leaves – their identification and matching, Study and identification of pollen grains, starch grains. Morphological and anatomical characteristics of plants yielding drugs of	25%	15

	abuse like opium, Cannabis, Coca plant, Psilocybin mushrooms, Tobacco, etc. Diatoms: Nature, location structure, extraction from various body tissues, including bone marrow, preparation of slides, methods of identification and comparison, forensic significance		
TOTAL		100%	60 Hrs

I. Reference Books:

1. Forensic Biology – Richard Li
2. Richard Saferstein, An Introduction to Forensic science.
3. Ashraf Mozayani, The forensic Laboratory handbook: Procedures and Practices.
4. Fundamentals of Forensic DNA Typing – John M. Butler
5. Dr. Archana Tripathi, Forensic serology and blood examination.
6. M.K Bhasin, A laboratory manual for human blood analysis.
7. V.S Verma, V.K Agrawal, S.Chand and company, Cell biology, genetics, molecular biology, evolution and ecology.
8. Avinash Upadhyay, Fundamentals of Molecular Biology.

Semester 3

A. Course Name: Forensic Ballistics & Ammunition

B. Course Code: 11207132

C. Prerequisite: Foundational knowledge in firearms operation and basic physics.

D. Rationale: Explore the science behind firearms and ammunition to aid in criminal investigations.

E. Course Learning Objective:

CLOBJ 1	Understand the mechanics of firearms operation, including firing mechanisms and ammunition types
CLOBJ 2	Learn to analyze ballistic evidence, including bullet trajectories, impact patterns, and gunshot residue.
CLOBJ 3	Develop skills in firearm identification, including distinguishing characteristics of different makes and models.
CLOBJ 4	Acquire knowledge of gunshot wound ballistics and the effects of bullets on human tissue.
CLOBJ 5	Practice reconstructing shooting incidents using ballistic evidence to determine the sequence of events and establish facts in criminal investigations

F. Course Learning Outcomes:

CLO 1	Demonstrate proficiency in conducting comprehensive analyses of ballistic evidence, including bullet trajectories and firearm identification.
CLO 2	Exhibit the ability to interpret complex ballistic data to reconstruct shooting incidents accurately.
CLO 3	Apply principles of forensic ballistics to provide expert testimony in legal proceedings.
CLO 4	Develop skills in collaborating with law enforcement agencies to assist in criminal investigations involving firearms.
CLO 5	Display ethical responsibility in the handling and interpretation of ballistic evidence, adhering to professional standards and legal protocols.

G. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
Lect. Hrs./week	Tut Hrs.	Lab Hrs.	Credit	External		Internal			
				T	P	T	CE	P	
4	-	-	4	60	-	20	20	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

H. Course Content:

Sr. No	Content	Weightage	Teaching Hours
1.	Unit-1:	25%	15

	Firearms and their components Firearms characteristics & classification of firearms, History and background of firearms, Functional assembly & Operating principle of firearms, Characteristics & Working mechanism of Standard: Rifled firearms, small arms, Shot guns & Non-standard: Improvised, Country made, Imitative firearms, identification of origin. Ammunition & its constructional parts, Classifications of Ammunition on basis of constructional features, Functional assembly of different types of ammunition & their types, Safety aspects for handling firearms and ammunition, cartridge-firing mechanism.		
2.	Unit-2: Types of ballistics & their aspects, Internal ballistics: General elementary & other principle problems: Heat problems, Pressure, Recoil, Vibration & Jump, Barrel Fouling. External ballistics: Trajectory formation & its computation, Vacuum Trajectories & its measurement, Influence of earth trajectory, Effect of air resistance on trajectories, Parameters involved in exterior ballistics. Terminal/Wound ballistics: Effect of projectile on target based on: nature of target, bullet shape, striking velocity, striking angle and nature of target, intermediate targets, range, etc Basic concepts of wound ballistics & phenomenon involved: threshold velocity for penetration of skin / flash / bones, Nature of wound of entry & exit wound, Characterization & evaluation of injuries depending upon Range, Velocity, Projectile Types, Firearm types, etc.	25%	15
3.	Unit-3: Identification of firearms, ammunition and their components: Principles, Processing of Firearm Exhibits involved, Class characteristics & Individual characteristics (Identifiable marks) produced during firing process on cartridge cases & projectiles and their linkage with firearms. Analysis of GSR –Composition of GSR, Location & Collection, Mechanism of formation, Chemical & Instrumental techniques involved in analysis, Shooter Identification technique.	25%	15
4.	Unit-4: Procedure for test-firing and Related Issue, Safety & Operational Steps, Determination of range of fire & its related phenomena, Techniques involved in ballistic studies, Stereo and comparison microscopy, BDAS, IBIS.	25%	15
TOTAL		100%	60 Hrs

I. Reference Books:

1. Hatcher, Jury and Weller: Firearms Investigation, Identification and Evidence; Stackpole Books, Harrisburg, PA; (1977).
2. M. Johari, Identification of Firearms, Ammunition and Firearms Injuries; BPR& D, New Delhi; (1980)

3. Working Procedures Manual: Ballistics, BPR& D pub. (2000).
4. Working Procedure Manual; Chemistry, Explosives and Narcotics, BPR& D Pub. (2000).
5. Saferstein, R., (1995) Criminalistics – An Introduction to Forensic Science, Prentice Hall, Englewood Cliffs, NJ 07632, USA.
6. Kumar, K., (1987) Forensic Ballistics in Criminal Justice, Eastern Book Co., Lucknow, India.
7. B. R Sharma, Firearm in criminal investigations and trials (Reprint 2011).

Semester 3

A. Course Name: Forensic Medicine & Anthropology

B. Course Code: 11207133

C. Prerequisite: Basic knowledge of human anatomy and physiology.

D. Rationale: Explore the application of medical and anthropological principles in forensic investigations, including identification of human remains.

E. Course Learning Objective:

CLOBJ 1	Understand the principles and techniques of post-mortem examinations, including autopsy procedures and forensic pathology.
CLOBJ 2	Learn to analyze skeletal remains to determine age, sex, ancestry, and other biological characteristics.
CLOBJ 3	Gain proficiency in estimating the time since death using methods such as decomposition stages and entomological analysis.
CLOBJ 4	Develop skills in identifying and documenting evidence of trauma, including blunt force, sharp force, and gunshot injuries.
CLOBJ 5	Acquire knowledge of forensic odontology and its applications in identifying human remains through dental records and bite mark analysis.

F. Course Learning Outcomes:

CLO 1	Demonstrate expertise in conducting post-mortem examinations to determine cause and manner of death with precision.
CLO 2	Exhibit proficiency in estimating time since death using various forensic methods and anthropological techniques.
CLO 3	Apply principles of forensic anthropology to identify individuals from skeletal remains through thorough analysis.
CLO 4	Develop skills in recognizing and interpreting trauma patterns on skeletal remains to reconstruct events leading to death.
CLO 5	Display competence in presenting forensic medical and anthropological findings in court as expert testimony, contributing to legal proceedings with credibility and clarity.

G. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
Lect. Hrs./week	Tut Hrs.	Lab Hrs.	Credit	External		Internal			
				T	P	T	CE	P	
4	-	-	4	60	-	20	20	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

H. Course Content:

Sr. No	Content	Weightage	Teaching Hours
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1.	Unit 1: Forensic Medicine Definition, Nature and scope. Inquest. medicolegal documents, evidences, dying declarations, Medicolegal Autopsy. Infamous conduct, Profession secrecy, malpractice, Negligence, consent, Euthanasia. Examination of decomposed body, methods of reconstruction. Death: Signs of death and changes after death. Somatic death, molecular death, early changes after death- Algor mortis, rigor mortis, cadaveric spasm, heat stiffening, cold stiffening, changes in blood, post-mortem lividity, fluidity of blood Late changes – putrefaction-external and internal changes. Preservation of bodies, Presumption of death-Exhumation.	25%	15
2.	Unit 2: Asphyxial deaths: Classification of asphyxia deaths: Hanging, Strangulation, evidence collection and analysis, establishing manner of deaths, Suffocation, Drowning and traumatic asphyxia, medico legal importance of diatoms, medico legal importance, manner of deaths Injury and Sexual Offenses, Injuries and wounds: Legal aspects of injuries, definitions-Thermal injury, electrical injury and mechanical injuries: abrasions, contusions, Lacerations, Incisions, cut wounds, puncture wound, Firearm and blast injuries, Asphyxial death: Hanging, strangulation, smothering, Gagging, choking, dry and wet Drowning-Battered baby syndrome-methods of torture. Sexual offenses: Potency, sterility, virginity, Pregnancy, abortion, delivery and infanticides. Sexual offences: Natural, Unnatural, Perversions, Rape.	25%	15
3.	Unit 3: Forensic Anthropology Scope of forensic anthropology. Study of human skeleton. Nature, formation, and identification of human bones. Age estimation in childhood and adulthood, Sexual Dimorphism, Population Ancestry, Stature estimation, Individualization & Identification, Evidence for cause and manner of death from bones. Facial Reconstruction Portrait Parle/ Bertillon system Facial superimposition techniques. Cranio facial super imposition techniques – photographic super imposition, video superimposition, Roentgenographic superimposition. Use of somatoscopic and craniometric methods in reconstruction. Importance of tissue depth in facial reconstruction.	25%	15
4.	Unit 4: Forensic odontology- Identification of individuals from teeth. Ages of eruption and other individual characteristics. Age estimation from tooth in prenatal, neonatal and early postnatal child, Age estimation in adults : Gustafson method, Root	25%	15

	transparency, cementum annulations, tooth wear, third molar formation, aspartic acid racemization, ante-mortem and postmortem dental records, forensic odontology in mass disasters, dental trauma and its forensic application, individualization from odontological samples, ABFO guidelines and standards. Forensic Entomology Identification of specific insects and their developmental stages (life cycles), Medico legal importance.		
TOTAL		100%	60 Hrs

Text Book and Reference Book:

1. Smyth, The Cause of Death, Van Nostrand and Company, New York (1982).
2. M. Bernstein, Forensic odontology in, Introduction to Forensic Sciences, 2nd Ed., W.G. Eckert (Ed.), CRC Press, Boca Raton (1997).
3. Dix, Handbook for Death Scene Investigations, CRC Press, Boca Raton (1999).
4. H.B. Baldwin and C.P. May in, Encyclopedia in Forensic Science, Volume 1, J.A. Siegel, P.J. Saukko and G.C. Knupfer (Eds.), Academic Press, London (2000).
5. V.J. Geberth, Practical Homicide Investigation, CRC Press, Boca Raton (2006).
6. T. Bevel and R.M. Gardner, Bloodstain Pattern Analysis, 3rd Edition, CRC Press, Boca Raton (2008).
7. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's, Techniques of Crime Scene Investigation, CRC Press, Boca Raton (2013).
8. Apurba Nandi, Principals of forensic medicine, including toxicology, NCBA.
9. Parikh's text book of medical jurisprudence, forensic medicine and toxicology, CBS, 7th ED. BV Subrahmanyam (2016).

Semester 3

I. Course Name: Research Writing

J. Course Code: 11207134

K. Prerequisite: Basic understanding of academic writing principles and research methodologies.

L. Rationale: Equip students with advanced skills to conduct research effectively and communicate findings professionally.

M. Course Learning Objective:

CLOBJ 1	Learn to formulate clear and focused research questions or hypotheses.
CLOBJ 2	Acquire skills in conducting comprehensive literature reviews to identify gaps and build a theoretical framework.
CLOBJ 3	Understand the principles of research design and methodology appropriate for different academic disciplines.
CLOBJ 4	Develop proficiency in data collection, analysis, and interpretation using relevant qualitative or quantitative techniques.
CLOBJ 5	Master the art of crafting coherent and persuasive research papers, including proper citation and adherence to academic writing conventions.

N. Course Learning Outcomes:

CLO 1	Demonstrate the ability to produce well-structured and logically organized research papers that contribute to the existing body of knowledge.
CLO 2	Exhibit proficiency in critically evaluating and synthesizing information from diverse sources to support research arguments.
CLO 3	Display competence in applying appropriate research methodologies and analytical techniques to address research questions effectively.
CLO 4	Showcase effective communication of research findings through clear and concise writing, suitable for academic and professional audiences.
CLO 5	Develop a scholarly mindset and ethical awareness in conducting and disseminating research, adhering to academic integrity standards and ethical guidelines.

O. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
Lect. Hrs./week	Tut Hrs.	Lab Hrs.	Credit	External		Internal			
				T	P	T	CE	P	
2	2	-	-	10		10	30	-	25

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

P. Course Content:

Sr.	Content	Weightage	Teaching
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No			Hours
1.	Unit 1: Report writing Writing and presenting research, Components of research paper the IMRAD system, title, authors and addresses, abstract, acknowledgements, references, tables and illustration; preparation for publication, submission of manuscript, ordering reprints; presentation of research: oral and poster presentations, presentation in conferences and symposia; presentation and submission of research proposals to the funding agencies. Plagiarism: definition, forms, consequences, unintentional plagiarism, copyright infringement, collaborative work.	50%	15
2.	Unit 2: Referencing System Introduction to Research Tools: Zotero, Mandley, Working on word document a) Different versions of MS-Word b) Uses of MS-Word c) Different tools of MS-word d) Mail merge in word document Introduction to excel a) Different versions of MS- Excel b) Uses of MS-Excel c) Different tools of MS-Excel Use of different formulas in Excel	50%	15
TOTAL		100%	30 Hrs

Q. Text Book and Reference Book:

23. Statistics in biology, (1967) Vol. 1: Bliss, C.I.K. McGraw Hill, New York.
24. Practicals: Statistics for experimental biologist (1985): Wardlaw, A.C.
25. Statistical Methods in Biology (2000): Bailey, N.T. J. English Univ. Press.
26. Biostatistics - 7th Edition : Daniel
27. Fundamental of Biostatistics : Khan
28. Bio-statistical Methods : Lachin
29. Statistics for Biologist (1974):Campbell R.C. Cambridge
30. Research Methodology Tools And Techniques : H.C Purohit
31. Research Methodology: An Introduction : Wayne Dean Goddard, Stuart Melville
32. Research Methodology in the Medical and Biological Sciences: PetterLaake (Author)
Haakon Breien Benestad (Author) Bjorn Reino Olsen (Editor)
33. Research Methodology For Biological Science : Gurumani N Gurumani
34. Research Methodology- G.R. Basotia and K.K. Sharma.
35. Research Methodology- C.H. Chaudhary, RBSA Publication
36. Research Methodology: An Introduction - Wayne Goddard & Stuart Melville
37. Research Methodology - Ranjit Kumar
38. Research Methodology: Methods & Techniques - Kothari, C.R.

39. ASTM Standards with respect to the usage of terminology, wording & phraseology while writing reports and research articles/thesis.

Semester 3

A. Course Name: LAB 1 Forensic Toxicology & Pharmacology

B. Course Code: 11207135

C. Prerequisite: Completion of foundational courses in chemistry and biology.

D. Rationale: Apply theoretical knowledge to practical scenarios, simulating forensic investigations and drug analysis.

E. Course Learning Objective:

CLOBJ 1	Learn to operate and maintain laboratory equipment used in forensic toxicology and pharmacology analyses.
CLOBJ 2	Acquire proficiency in sample preparation techniques, including extraction and purification methods.
CLOBJ 3	Develop skills in qualitative and quantitative analysis of toxic substances and drugs using chromatographic and spectroscopic techniques.
CLOBJ 4	Understand the principles of quality control and assurance in laboratory analyses to ensure accuracy and reliability of results.
CLOBJ 5	Practice adhering to safety protocols and ethical guidelines while conducting experiments in the forensic toxicology and pharmacology laboratory.

F. Course Learning Outcomes:

CLO 1	Demonstrate competence in conducting a range of laboratory tests to identify and quantify toxic substances and drugs accurately.
CLO 2	Exhibit proficiency in interpreting complex laboratory data to draw conclusions regarding the presence and effects of toxins or drugs.
CLO 3	Develop skills in utilizing specialized laboratory equipment and techniques commonly employed in forensic toxicology analysis.
CLO 4	Display the ability to troubleshoot and resolve issues encountered during laboratory procedures to ensure accurate and reliable results
CLO 5	Produce well-structured and scientifically sound laboratory reports documenting experimental procedures, findings, and interpretations in a manner suitable for legal or investigative purposes.

G. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
Lect. Hrs./week	Tut Hrs.	Lab Hrs.	Credit	External		Internal			
				T	P	T	CE	P	
2	-	3	-	-	40	-	-	60	-

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

H. Course Content:

1. Test to differentiate between methanol and ethanol.
2. Extraction of poison by different techniques.
3. Analysis of viscera for volatile poisons (organic and Inorganic)
4. Detection and identification of metallic poisons in viscera in food material by chemical test and instrumental technique.
5. Analysis and identification of various plant poisons- Dhatura, cannabis, nicotine, oleander etc.
6. Extraction and Identification of pesticides.
7. Qualitative and Quantitative analysis of drug by UV-Vis & FTIR spectrophotometer.
8. To carry out quantitative estimation of ethyl alcohol.
9. To carry out Drug degradation study.
10. Drug kinetic study.
11. To separate drugs of abuse by thin layer chromatography.

I. Text Book and Reference Book:

1. Curry A.S ; Analytical Methods in Human Toxicology : Part II ,CRC Press Ohio (1986)
2. Curry, A.S : Poison Detection in Human Organs, C Thomas Springfield CRC Press (1976)
3. Clark E.G. C : Isolation and Identification of drugs . Vol.I and Vol.2, Academic Press (1986)
4. Niesink R J M : Toxicology - Principle and Application, CRC Press (1996)
5. Sunshine I : Handbook of Analytical Toxicology, CRC Press(1969)
6. Parikh C. K, : Text Book of Medical Jurisprudence, Forensic Medicine and Toxicology, CBS Publ. New Delhi (1999)
7. Laboratory Procedure Manual, Forensic Toxicology :Directorate of Forensic Science MHA Govt (2005)
8. Steward And Stolman : Toxicology Vol.1 and Vol. 2
9. Michel J D etal : Handbook of toxicology CRC Press Publ, USA (1995)
10. Casarett, L J and Doull John ; Toxicology :The Basic Science of Poison, Macmillan Publ. Co. New York (1975)
11. Carvey R.H& Baselt R C ;Introduction to Forensic Toxicology and Biochemicals Publ.Davis C.A (1981)
12. Chada PV Handbook of Forensic Medicine and Toxicology, J P Brothers New Delhi(2004)
13. Modi Jaisingh P : Textbook of Medical Jurisprudence and Toxicology ,M.M. Tripathy Publ.(2001)
14. Zweig G ; Analytical Methods of Pesticides, Academic Press (1966)
15. Doesker A S ; Medical Jurisprudence , Toxicology & Forensic Science All India Reporter Pvt. Ltd. (2010)

Semester 3

- A. Course Name: LAB 2 Forensic Biology & Serology
 B. Course Code: 11207136
 C. Prerequisite: Successful completion of foundational biology and chemistry courses.
 D. Rationale: Apply theoretical knowledge to hands-on scenarios, simulating real forensic investigations involving biological evidence.
 E. Course Learning Objective:

CLOBJ 1	Gain proficiency in identifying various bodily fluids such as blood, semen, and saliva through serological testing methods.
CLOBJ 2	Develop skills in DNA extraction techniques from biological samples found at crime scenes or in forensic casework.
CLOBJ 3	Learn to perform polymerase chain reaction (PCR) amplification of DNA to generate suitable samples for analysis.
CLOBJ 4	Acquire knowledge of DNA analysis techniques such as gel electrophoresis and DNA sequencing for forensic applications.
CLOBJ 5	Practice proper documentation and chain of custody procedures to ensure integrity and admissibility of forensic evidence in legal proceedings.

F. Course Learning Outcomes:

CLO 1	Demonstrate proficiency in conducting serological analyses to accurately identify bodily fluids and their origins in forensic contexts.
CLO 2	Exhibit competence in DNA extraction, amplification, and analysis techniques, leading to successful DNA profiling for identification purposes.
CLO 3	Apply principles of forensic biology to interpret DNA profiles and link suspects to crime scenes or victims.
CLO 4	Develop skills in preparing comprehensive forensic reports documenting laboratory procedures, findings, and interpretations for use in legal proceedings.
CLO 5	Display ethical responsibility and adherence to professional standards in handling and analyzing biological evidence, ensuring reliability and credibility in forensic investigations.

G. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
Lect. Hrs./week	Tut Hrs.	Lab Hrs.	Credit	External		Internal			
				T	P	T	CE	P	
2	-	3	-	-	40	-	-	60	-

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

H. Course Content:

1. Collection and examination blood stain.
2. To carry out blood grouping.
3. Analysis of blood stains.
4. Isolate of DNA from buccal cell and blood.
5. To carry out Gel electrophoresis.
6. Tests for saliva
7. Sample preparation of hairs, human and animal hair morphology, measurements (diameter, medullary ratio)
8. Human hair comparison, colour, treatment, pigment shape and distribution, damage, disease, medulla, root, tip – Animal hair diameter, medulla, color banding, scale casts.
9. Examination of Natural and artificial fiber.

I. Reference Books:

1. Forensic Biology – Richard Li
2. Richard Saferstein, An Introduction to Forensic science.
3. Ashraf Mozayani, The forensic Laboratory handbook: Procedures and Practices.
4. Fundamentals of Forensic DNA Typing – John M. Butler
5. Dr. Archana Tripathi, Forensic serology and blood examination.
6. M.K Bhasin, A laboratory manual for human blood analysis.
7. V.S Verma, V.K Agrawal, S.Chand and company, Cell biology, genetics, molecular biology, evolution and ecology.
8. Avinash Upadhyay, Fundamentals of Molecular Biology.

Semester 3

- A. Course Name: LAB 3 Forensic Ballistics & Anthropology
 B. Course Code: 11207137
 C. Prerequisite: Foundational understanding of firearms and human anatomy.
 D. Rationale: Translate theoretical knowledge into practical expertise to analyze ballistics evidence and human remains.
 E. Course Learning Objective:

CLOBJ 1	Learn to operate and maintain specialized equipment used in forensic ballistics and anthropology laboratories.
CLOBJ 2	Acquire proficiency in conducting firearm examinations, including firearm identification and analysis of gunshot residue.
CLOBJ 3	Develop skills in analyzing ballistic evidence to determine bullet trajectory, impact angle, and other relevant factors.
CLOBJ 4	Gain knowledge of anthropological techniques for skeletal analysis, including methods for estimating age, sex, and stature.
CLOBJ 5	Practice applying forensic ballistics and anthropology principles to real-world case scenarios, enhancing investigative capabilities.

F. Course Learning Outcomes:

CLO 1	Demonstrate proficiency in analyzing ballistic evidence to determine firearm type, trajectory, and impact patterns accurately.
CLO 2	Exhibit competence in identifying and interpreting skeletal remains, including estimation of age, sex, ancestry, and trauma analysis.
CLO 3	Apply principles of forensic ballistics and anthropology to reconstruct shooting incidents and identify individuals from skeletal remains with precision.
CLO 4	Showcase the ability to communicate forensic findings effectively through written reports and expert testimony in legal proceedings.
CLO 5	Display ethical awareness and adherence to professional standards in handling and analyzing forensic evidence, ensuring integrity and reliability in investigative outcomes.

G. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
Lect. Hrs./week	Tut Hrs.	Lab Hrs.	Credit	External		Internal			
				T	P	T	CE	P	
2	-	3	-	-	40	-	-	60	-

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

H. Course Content:

1. Characteristics of Firearms-Caliber, Choke, Trigger pull, and Proof marks.
2. Examination and comparison of fired bullet with reference to caliber, rifling characteristics, and identification of firearm
3. Examination and comparison of fired cartridge case with reference to caliber, firing pin, breech face, chamber indentations, extraction, and ejector marks by comparison microscope
4. Determination of shot numbers from size and weight of shots
5. Chemical tests for powder residue and barrel wash
6. Instrumental examination of GSR.
7. Examination of skeletal remains- Long bones- Femur, Humerus,
8. Identification of individuals by long bones and stature estimation
9. Determination of sex and age from Skull with mandible
10. Determination of sex from pelvis and sacrum.
11. Identification of individuals by dental examination
12. Anthropometry.- Identification of individuals (in living)
13. Postmortem examination in various Asphyxial deaths.
14. Postmortem examination of various homicidal/ accidental injuries

I. Text Book and Reference Book:

1. K. Smyth, The Cause of Death, Van Nostrand and Company, New York (1982).
2. M. Bernstein, Forensic odontology in, Introduction to Forensic Sciences, 2nd Ed., W.G. Eckert (Ed.), CRC Press, Boca Raton (1997).
3. J. Dix, Handbook for Death Scene Investigations, CRC Press, Boca Raton (1999).
4. H.B. Baldwin and C.P. May in, Encyclopedia in Forensic Science, Volume 1, J.A. Siegel, P.J. Saukko and G.C. Knupfer (Eds.), Academic Press, London (2000).
5. V.J. Geberth, Practical Homicide Investigation, CRC Press, Boca Raton (2006).
6. T. Bevel and R.M. Gardner, Bloodstain Pattern Analysis, 3rd Edition, CRC Press, Boca Raton (2008).
7. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's, Techniques of Crime Scene Investigation, CRC Press, Boca Raton (2013).
8. Apurba Nandi, Principals of forensic medicine, including toxicology, NCBA.
9. Parikh's text book of medical jurisprudence, forensic medicine and toxicology, CBS, 7th ED. BV Subrahmanyam (2016).

Semester 4
Specialization in Digital Forensics

- A. Course Name: Advanced Instrumentation in Digital Forensics
 B. Course Code: 11207148
 C. Prerequisite: Basic knowledge of computer systems, networking, and digital forensic principles.
 D. Rationale: This course equips learners with advanced tools and techniques to analyze and investigate digital evidence effectively.
 E. Course Learning Objective:

CLOBJ 1	Understand the role of advanced instrumentation in digital forensic investigations.
CLOBJ 2	Explore various tools used for data acquisition, analysis, and recovery.
CLOBJ 3	Learn to handle and preserve digital evidence using forensic tools.
CLOBJ 4	Develop expertise in analyzing complex digital artifacts.
CLOBJ 5	Gain practical knowledge of advanced forensic software and hardware.

F. Course Learning Outcomes:

CLO 1	Explain the importance of advanced instrumentation in digital forensics.
CLO 2	Identify and utilize tools for effective data acquisition and analysis.
CLO 3	Demonstrate proper handling and preservation of digital evidence.
CLO 4	Analyze complex digital artifacts with appropriate methodologies.
CLO 5	Operate advanced forensic tools and technologies for real-world investigations.

G. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
Lect. Hrs./week	Tut Hrs.	Lab Hrs.	Credit	External		Internal			
				T	P	T	CE	P	
4	-	-	4	60	-	20	20	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

H. Course Content:

Sr. No	Content	Weightage	Teaching Hours
1.	Unit 1: Unit -1 Advance Linux for Cyber Security Linux architecture, Advance Linux commands, Manage Linux file system, Manage SWAP, User Management and Permissions, introduction Shell scripting, SELinux Security, Firewall in Linux Linux bash, Linux Filters, AWK commands, Programming with Linux, Linux I/O Redirection, Linux Unix tools, Shell commands, Shell scripting, Linux Misc, Linux pmap, Linux free commands, Linux Man pages, Linux Error codes.	25%	15
2.	Unit 2: Cryptography Foundations of Cryptology, Cipher methods- Substitution cipher, Transposition cipher, Cryptographic algorithms- Symmetric encryption Modular Arithmetic-Chinese Remainder Theorem –Introduction to Finite Fields- DES Algorithm & Analysis, AES Algorithm – Components Analysis, Asymmetric encryption- The RSA system-The knapsack system, Publickey systems based on elliptic curves. Digital signatures, Digital certificates, Steganography, securing web transactions with SET, SSL, and S-HTTP, securing wireless networks with WEP and	25%	15

	WPA, Securing TCP/IP with IPsec.		
3.	Unit 3: Advance Network & Wireless Attacks Network Sniffing, Wireshark, packet analysis, display and capture filters, Ettercap, DNS Poisoning, ARP Poisoning, Denial of services, Vulnerability scanning, Nessus, secure system configurations, SSL Striping, Setup network IDS/IPS, Router attacks, VPN Pen-testing, VOIP Pentesting, Protocols, MAC Filtering, Packet Encryption, Packet Sniffing, ARP Replay attack, Fake Authentication Attack, De authentication, Attacks on WEP , WPA and WPA-2 Encryption, fake hotspots, evil twin attack, fluxion framework.	25%	15
4.	Unit 4: Advance IoT Security Evolution of Internet of Things, Enabling Technologies, M2M Communication, IoT World Forum (IoTWF) standardized architecture, Simplified IoT Architecture, Core IoT Functional Stack, Fog, Edge and Cloud in IoT, Functional blocks of an IoT ecosystem, Sensors, Actuators, Smart Objects and Connecting Smart Objects. Case Studies/Industrial Applications.	25%	15
TOTAL		100%	60 Hrs

I. Text Book and Reference Book:

1. Network Forensics: Tracking Hackers through Cyberspace 1st Edition by Sherri Davidoff
2. A Practicals: Guide to Computer Forensics Investigations Book by Darren R. Hayes
3. Digital Evidence and Computer Crime: Forensic Science, Computers and Book by Eoghan Casey
4. Cyber Forensics: A Field Manual for Collecting, Examining, and Preserving Book by Albert J. Marcella
5. Handbook of Digital Forensics and Investigation Book by Eoghan Casey
6. Practicals: Windows Forensics Paperback – Import, 16 Jun 2016 by Ayman Shaaban (Author), Konstantin Sapronov (Author)
7. Windows Forensics Paperback – Import, 16 Jul 2016 by Philip Polstra

Semester 4
Specialization in Digital Forensics

- A. Course Name: Advanced Concepts of Digital Forensics
 B. Course Code: 11207149
 C. Prerequisite: Basic understanding of digital forensics principles and processes.
 D. Rationale: This course delves into advanced methodologies and frameworks to address complex challenges in digital forensic investigations.
 E. Course Learning Objective:

CLOBJ 1	Understand advanced theories and practices in digital forensics.
CLOBJ 2	Explore techniques for investigating emerging technologies and platforms.
CLOBJ 3	Analyze methods to detect, trace, and counteract sophisticated cybercrimes.
CLOBJ 4	Develop proficiency in advanced data recovery and evidence reconstruction.
CLOBJ 5	Learn to apply forensic frameworks to ensure admissibility of evidence in court.

F. Course Learning Outcomes:

CLO 1	Explain advanced concepts and methodologies in digital forensics.
CLO 2	Investigate cyber incidents involving modern technologies and platforms.
CLO 3	Trace and mitigate complex cyber threats using advanced forensic tools.
CLO 4	Perform data recovery and reconstruction in challenging scenarios.
CLO 5	Apply forensic best practices to produce reliable and admissible evidence.

G. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
Lect. Hrs./week	Tut Hrs.	Lab Hrs.	Credit	External		Internal			
				T	P	T	CE	P	
4	-	-	4	60	-	20	20	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

H. Course Content:

Sr. No	Content	Weightage	Teaching Hours
1.	Unit 1: Memory Forensics Examinations, Tools for memory acquisition, Identify Rogue Processes, Analyze Process DLLs and Handles, Review Network Artefacts, Look for Evidence of Code Injection, Check for Signs of a Rootkit, Acquire Suspicious Processes and Drivers, Memory Analysis Techniques with Redline, Advanced Memory Analysis with Volatility, Code Injection, Malware, and Rootkit Hunting in Memory, Perform In-Memory Windows Registry Examinations, Extract Typed Adversary Command Lines, Investigate Windows Services, Hunting Malware Using Comparison Baseline Systems, Dumping Hashes and Credentials from Memory, Prefetch and Shimcache Extraction via Memory	25%	5
2.	Unit 2: Linux Installation and Package Management, GNU and Unix Commands, Devices, Linux File systems, File system Hierarchy, Function of Kernel, Linux Kernel, Kernel Makefiles, Introduction to Netcat, Use of netcat in forensics, Forensic tools in Linux, File System Imaging	25%	15

3.	Unit 3: Live response using Linux distributions, use of kali Linux, D.E.F.T., SANS SIFT work station, collecting volatile data – kernel version, login history, network connections, running processes, loaded kernel modules, system logs, Dumping RAM, use of LiME, volatility profiles	25%	12
4.	Unit 4: Detecting use mode rootkits, file carving, file system image analysis, use of the sleuth kit, autopsy, bulk extractor, foremost, timeline analysis, reversing linux malware, digging deeper into ELF	25%	13
5.	Unit 5: Smartphone forensics – Introduction to smartphone, smartphone components and identifiers, forensic impact of flash memory, preserving smartphone evidence, forensic acquisition process, logical, file system and physical acquisition, introduction to forensic tools for smartphone, android memory capturing, introduction to JTAG technology, introduction to cellular network, different cellular networks – GSM, GPRS, EDGE, UMTS, LTE, VOLTE Generations and evolution of cellular network, structure of mobile phone cellular network, cell site (base transceiver station).		
TOTAL		100%	45 Hrs
Sr.	List of Practical		
1	Static Malware analysis of given sample		
2	Dynamic Malware analysis of given sample		
3	Unpacking packed malware		
4	Finding resource of sample using resource hacker		
5	Finding signature of given sample		
6	Memory and registry analysis		

I. Text Book and Reference Book:

1. Reversing: Secrets of Reverse Engineering 1st Edition by Eldad Eilam
2. Hacking the Xbox: An Introduction to Reverse Engineering 1st Edition by Andrew Huang
3. Practicals: Reverse Engineering: x86, x64, ARM, Windows Kernel, Reversing Tools, and Obfuscation 1st Edition by Bruce Dang Guide to Computer Forensics and Investigations Book by Amelia Phillips, Bill Nelson, and Christopher Steuart

Semester 4
Specialization in Digital Forensics

- A. Course Name: Reverse Engineering & Malware Analysis
 B. Course Code: 11207150
 C. Prerequisite: Basic understanding of computer systems, programming, and cybersecurity concepts.
 D. Rationale: This course provides in-depth knowledge and practical skills to dissect, analyze, and understand malicious software through reverse engineering techniques.
 E. Course Learning Objective:

CLOBJ 1	Understand the fundamentals of reverse engineering and its applications in cybersecurity.
CLOBJ 2	Learn techniques to analyze and deconstruct malware behavior.
CLOBJ 3	Explore tools and methodologies for reverse engineering malware.
CLOBJ 4	Develop skills to identify, classify, and mitigate malware threats.
CLOBJ 5	Gain knowledge on ethical and legal considerations in reverse engineering.

F. Course Learning Outcomes:

CLO 1	Explain the role of reverse engineering in malware analysis and threat mitigation.
CLO 2	Analyze malware behavior using appropriate reverse engineering techniques.
CLO 3	Utilize advanced tools for dissecting and understanding malicious software.
CLO 4	Identify and classify different types of malware based on their characteristics.
CLO 5	Apply ethical principles and follow legal frameworks in reverse engineering practices.

G. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
Lect. Hrs./week	Tut Hrs.	Lab Hrs.	Credit	External		Internal			
				T	P	T	CE	P	
4	-	-	4	60	-	20	20	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

H. Course Content:

Sr. No	Content	Weightage	Teaching Hours
1.	Unit 1: Basic Static Malware Analysis Introduction to malware, Types of Malware – Virus, worms, Trojan, ransomware, backdoor, The Goals of Malware Analysis, Malware Analysis Techniques, Basic Static Techniques: Hashing, Finding Strings, Packed and Obfuscated Malware, Portable Executable File Format, Linked Libraries and Functions, PE File Headers and Sections. Virtual Machine for Malware Analysis	25%	5
2.	Unit 2: Basic Dynamic Malware Analysis Basic Dynamic Analysis: Executing Malware in safe environment, Monitoring with Process Monitor, Viewing Processes with Process Explorer, Comparing Registry Snapshots with Regshot, Faking a Network, Packet Sniffing with Wireshark,	25%	15
3.	Unit 3: Advance Static Malware Analysis Introduction to x86 disassembly: Architecture, Main Memory, Instructions, Opcodes and Endianness, Operands, Registers, Simple Instructions, Stack,	25%	12

	Conditionals, Branching, Analyzing Malicious Windows Programs: Windows API, Windows Registry, Networking APIs, Kernel vs. User Mode, Native API		
4.	Unit 4: Advance Dynamic Malware Analysis Debugging: Source-Level vs. Assembly-Level Debuggers, Kernel vs. User-Mode Debugging, Using a Debugger, Exceptions, Modifying Execution with a Debugger. Malware Behavior: Reverse Shell, RAT, Botnet, Process injection, Hook injection, APC injection.	25%	13
5.	Unit 5: Reverse Engineering Introduction to X86 and x64 Architecture: Register Set and Data Types, Data movement, Canonical Address, Function Invocation, Windows Kernel: Windows fundamental, Survey of Obfuscation techniques. Piracy and Torrent Files, Deep Web and Dark Net.		
TOTAL		100%	45 Hrs
Sr.	List of Practical		
1	Static Malware analysis of given sample		
2	Dynamic Malware analysis of given sample		
3	Unpacking packed malware		
4	Finding resource of sample using resource hacker		
5	Finding signature of given sample		
6	Memory and registry analysis		

I. Text Book and Reference Book:

1. Reversing: Secrets of Reverse Engineering 1st Edition by Eldad Eilam
2. Hacking the Xbox: An Introduction to Reverse Engineering 1st Edition by Andrew Huang
3. Practicals: Reverse Engineering: x86, x64, ARM, Windows Kernel, Reversing Tools, and Obfuscation 1st Edition by Bruce Dang Guide to Computer Forensics and Investigations Book by Amelia Phillips, Bill Nelson, and Christopher Steuart

Semester 4
Specialization in Digital Forensics

J. Course Name: Advanced Instrumentation in Digital Forensics

K. Course Code: 11207148

L. Prerequisite: Basic knowledge of computer systems, networking, and digital forensic principles.

M. Rationale: This course equips learners with advanced tools and techniques to analyze and investigate digital evidence effectively.

N. Course Learning Objective:

CLOBJ 1	Understand the role of advanced instrumentation in digital forensic investigations.
CLOBJ 2	Explore various tools used for data acquisition, analysis, and recovery.
CLOBJ 3	Learn to handle and preserve digital evidence using forensic tools.
CLOBJ 4	Develop expertise in analyzing complex digital artifacts.
CLOBJ 5	Gain practical knowledge of advanced forensic software and hardware.

O. Course Learning Outcomes:

CLO 1	Explain the importance of advanced instrumentation in digital forensics.
CLO 2	Identify and utilize tools for effective data acquisition and analysis.
CLO 3	Demonstrate proper handling and preservation of digital evidence.
CLO 4	Analyze complex digital artifacts with appropriate methodologies.
CLO 5	Operate advanced forensic tools and technologies for real-world investigations.

P. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
Lect. Hrs./week	Tut Hrs.	Lab Hrs.	Credit	External		Internal			
				T	P	T	CE	P	
4	-	-	4	60	-	20	20	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

Q. Course Content:

Sr. No	Content	Weightage	Teaching Hours
1.	Unit 1: Unit -1 Advance Linux for Cyber Security Linux architecture, Advance Linux commands, Manage Linux file system, Manage SWAP, User Management and Permissions, introduction Shell scripting, SELinux Security, Firewall in Linux Linux bash, Linux Filters, AWK commands, Programming with Linux, Linux I/O Redirection, Linux Unix tools, Shell commands, Shell scripting, Linux Misc, Linux pmap, Linux free commands, Linux Man pages, Linux Error codes.	25%	15
2.	Unit 2: Cryptography Foundations of Cryptology, Cipher methods- Substitution cipher, Transposition cipher, Cryptographic algorithms- Symmetric encryption Modular Arithmetic-Chinese Remainder Theorem –Introduction to Finite Fields- DES Algorithm & Analysis, AES Algorithm – Components Analysis, Asymmetric encryption- The RSA system-The knapsack system, Publickey systems based on elliptic curves. Digital signatures,	25%	15

	Digital certificates, Steganography, securing web transactions with SET, SSL, and S-HTTP, securing wireless networks with WEP and WPA, Securing TCP/IP with IPsec.		
3.	Unit 3: Advance Network & Wireless Attacks Network Sniffing, Wireshark, packet analysis, display and capture filters, Ettercap, DNS Poisoning, ARP Poisoning, Denial of services, Vulnerability scanning, Nessus, secure system configurations, SSL Striping, Setup network IDS/IPS, Router attacks, VPN Pen-testing, VOIP Pentesting, Protocols, MAC Filtering, Packet Encryption, Packet Sniffing, ARP Replay attack, Fake Authentication Attack, De authentication, Attacks on WEP , WPA and WPA-2 Encryption, fake hotspots, evil twin attack, fluxion framework.	25%	15
4.	Unit 4: Advance IoT Security Evolution of Internet of Things, Enabling Technologies, M2M Communication, IoT World Forum (IoTWF) standardized architecture, Simplified IoT Architecture, Core IoT Functional Stack, Fog, Edge and Cloud in IoT, Functional blocks of an IoT ecosystem, Sensors, Actuators, Smart Objects and Connecting Smart Objects. Case Studies/Industrial Applications.	25%	15
TOTAL		100%	60 Hrs

R. Text Book and Reference Book:

8. Network Forensics: Tracking Hackers through Cyberspace 1st Edition by Sherri Davidoff
9. A Practicals: Guide to Computer Forensics Investigations Book by Darren R. Hayes
10. Digital Evidence and Computer Crime: Forensic Science, Computers and Book by Eoghan Casey
11. Cyber Forensics: A Field Manual for Collecting, Examining, and Preserving Book by Albert J. Marcella
12. Handbook of Digital Forensics and Investigation Book by Eoghan Casey
13. Practicals: Windows Forensics Paperback – Import, 16 Jun 2016 by Ayman Shaaban (Author), Konstantin Sapronov (Author)
14. Windows Forensics Paperback – Import, 16 Jul 2016 by Philip Polstra

Semester 4
Specialization in Digital Forensics

J. Course Name: Advanced Concepts of Digital Forensics

K. Course Code: 11207149

L. Prerequisite: Basic understanding of digital forensics principles and processes.

M. Rationale: This course delves into advanced methodologies and frameworks to address complex challenges in digital forensic investigations.

N. Course Learning Objective:

CLOBJ 1	Understand advanced theories and practices in digital forensics.
CLOBJ 2	Explore techniques for investigating emerging technologies and platforms.
CLOBJ 3	Analyze methods to detect, trace, and counteract sophisticated cybercrimes.
CLOBJ 4	Develop proficiency in advanced data recovery and evidence reconstruction.
CLOBJ 5	Learn to apply forensic frameworks to ensure admissibility of evidence in court.

O. Course Learning Outcomes:

CLO 1	Explain advanced concepts and methodologies in digital forensics.
CLO 2	Investigate cyber incidents involving modern technologies and platforms.
CLO 3	Trace and mitigate complex cyber threats using advanced forensic tools.
CLO 4	Perform data recovery and reconstruction in challenging scenarios.
CLO 5	Apply forensic best practices to produce reliable and admissible evidence.

P. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
Lect. Hrs./week	Tut Hrs.	Lab Hrs.	Credit	External		Internal			
				T	P	T	CE	P	
4	-	-	4	60	-	20	20	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

Q. Course Content:

Sr. No	Content	Weightage	Teaching Hours
1.	Unit 1: Memory Forensics Examinations, Tools for memory acquisition, Identify Rogue Processes, Analyze Process DLLs and Handles, Review Network Artefacts, Look for Evidence of Code Injection, Check for Signs of a Rootkit, Acquire Suspicious Processes and Drivers, Memory Analysis Techniques with Redline, Advanced Memory Analysis with Volatility, Code Injection, Malware, and Rootkit Hunting in Memory, Perform In-Memory Windows Registry Examinations, Extract Typed Adversary Command Lines, Investigate Windows Services, Hunting Malware Using Comparison Baseline Systems, Dumping Hashes and Credentials from Memory, Prefetch and Shimcache Extraction via Memory	25%	5
2.	Unit 2: Linux Installation and Package Management, GNU and Unix Commands, Devices, Linux File systems, File system Hierarchy, Function of Kernel, Linux Kernel, Kernel Makefiles, Introduction to Netcat, Use of netcat in forensics, Forensic tools in	25%	15

	Linux, File System Imaging		
3.	Unit 3: Live response using Linux distributions, use of kali Linux, D.E.F.T., SANS SIFT work station, collecting volatile data – kernel version, login history, network connections, running processes, loaded kernel modules, system logs, Dumping RAM, use of LiME, volatility profiles	25%	12
4.	Unit 4: Detecting use mode rootkits, file carving, file system image analysis, use of the sleuth kit, autopsy, bulk extractor, foremost, timeline analysis, reversing linux malware, digging deeper into ELF	25%	13
5.	Unit 5: Smartphone forensics – Introduction to smartphone, smartphone components and identifiers, forensic impact of flash memory, preserving smartphone evidence, forensic acquisition process, logical, file system and physical acquisition, introduction to forensic tools for smartphone, android memory capturing, introduction to JTAG technology, introduction to cellular network, different cellular networks – GSM, GPRS, EDGE, UMTS, LTE, VOLTE Generations and evolution of cellular network, structure of mobile phone cellular network, cell site (base transceiver station).		
TOTAL		100%	45 Hrs
Sr.	List of Practical		
1	Static Malware analysis of given sample		
2	Dynamic Malware analysis of given sample		
3	Unpacking packed malware		
4	Finding resource of sample using resource hacker		
5	Finding signature of given sample		
6	Memory and registry analysis		

R. Text Book and Reference Book:

4. Reversing: Secrets of Reverse Engineering 1st Edition by Eldad Eilam
5. Hacking the Xbox: An Introduction to Reverse Engineering 1st Edition by Andrew Huang
6. Practicals: Reverse Engineering: x86, x64, ARM, Windows Kernel, Reversing Tools, and Obfuscation 1st Edition by Bruce Dang Guide to Computer Forensics and Investigations Book by Amelia Phillips, Bill Nelson, and Christopher Steuart

Semester 4
Specialization in Digital Forensics

J. Course Name: Reverse Engineering & Malware Analysis

K. Course Code: 11207150

L. Prerequisite: Basic understanding of computer systems, programming, and cybersecurity concepts.

M. Rationale: This course provides in-depth knowledge and practical skills to dissect, analyze, and understand malicious software through reverse engineering techniques.

N. Course Learning Objective:

CLOBJ 1	Understand the fundamentals of reverse engineering and its applications in cybersecurity.
CLOBJ 2	Learn techniques to analyze and deconstruct malware behavior.
CLOBJ 3	Explore tools and methodologies for reverse engineering malware.
CLOBJ 4	Develop skills to identify, classify, and mitigate malware threats.
CLOBJ 5	Gain knowledge on ethical and legal considerations in reverse engineering.

O. Course Learning Outcomes:

CLO 1	Explain the role of reverse engineering in malware analysis and threat mitigation.
CLO 2	Analyze malware behavior using appropriate reverse engineering techniques.
CLO 3	Utilize advanced tools for dissecting and understanding malicious software.
CLO 4	Identify and classify different types of malware based on their characteristics.
CLO 5	Apply ethical principles and follow legal frameworks in reverse engineering practices.

P. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
Lect. Hrs./week	Tut Hrs.	Lab Hrs.	Credit	External		Internal			
				T	P	T	CE	P	
4	-	-	4	60	-	20	20	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

Q. Course Content:

Sr. No	Content	Weightage	Teaching Hours
1.	Unit 1: Basic Static Malware Analysis Introduction to malware, Types of Malware – Virus, worms, Trojan, ransomware, backdoor, The Goals of Malware Analysis, Malware Analysis Techniques, Basic Static Techniques: Hashing, Finding Strings, Packed and Obfuscated Malware, Portable Executable File Format, Linked Libraries and Functions, PE File Headers and Sections. Virtual Machine for Malware Analysis	25%	5
2.	Unit 2: Basic Dynamic Malware Analysis Basic Dynamic Analysis: Executing Malware in safe environment, Monitoring with Process Monitor, Viewing Processes with Process Explorer, Comparing Registry Snapshots with Regshot, Faking a Network, Packet Sniffing with Wireshark,	25%	15
3.	Unit 3: Advance Static Malware Analysis Introduction to x86 disassembly: Architecture, Main Memory, Instructions, Opcodes and Endianness, Operands, Registers, Simple Instructions, Stack, Conditionals, Branching, Analyzing Malicious Windows Programs: Windows API, Windows Registry, Networking APIs,	25%	12

	Kernel vs. User Mode, Native API		
4.	Unit 4: Advance Dynamic Malware Analysis Debugging: Source-Level vs. Assembly-Level Debuggers, Kernel vs. User-Mode Debugging, Using a Debugger, Exceptions, Modifying Execution with a Debugger. Malware Behavior: Reverse Shell, RAT, Botnet, Process injection, Hook injection, APC injection.	25%	13
5.	Unit 5: Reverse Engineering Introduction to X86 and x64 Architecture: Register Set and Data Types, Data movement, Canonical Address, Function Invocation, Windows Kernel: Windows fundamental, Survey of Obfuscation techniques. Piracy and Torrent Files, Deep Web and Dark Net.		
TOTAL		100%	45 Hrs
Sr.	List of Practical		
1	Static Malware analysis of given sample		
2	Dynamic Malware analysis of given sample		
3	Unpacking packed malware		
4	Finding resource of sample using resource hacker		
5	Finding signature of given sample		
6	Memory and registry analysis		

R. Text Book and Reference Book:

4. Reversing: Secrets of Reverse Engineering 1st Edition by Eldad Eilam
5. Hacking the Xbox: An Introduction to Reverse Engineering 1st Edition by Andrew Huang
6. Practicals: Reverse Engineering: x86, x64, ARM, Windows Kernel, Reversing Tools, and Obfuscation 1st Edition by Bruce Dang Guide to Computer Forensics and Investigations Book by Amelia Phillips, Bill Nelson, and Christopher Steuart

Semester 4_
Specialization in Questioned Documents, Fingerprint & Photography

- A. Course Name: Advanced Concept of Fingerprint Examination and Photography
 B. Course Code: 11207156
 C. Prerequisite: Advanced Concept of Fingerprint Examination and Photography" is a foundational understanding of forensic science principles and basic fingerprint identification techniques.
 D. Rationale: The advanced concept of fingerprint examination and photography lies in enhancing forensic accuracy and reliability in criminal investigations.
 E. Course Learning Objective:

CLOBJ 1	Understand advanced techniques in fingerprint examination and analysis for forensic investigations.
CLOBJ 2	Develop proficiency in the use of modern photography methods to capture high-quality fingerprint evidence.
CLOBJ 3	Apply advanced fingerprint comparison techniques for identification and criminal justice purposes.
CLOBJ 4	Investigate the legal and ethical considerations in fingerprint examination and its use in court proceedings.
CLOBJ 5	Explore the latest technological advancements in fingerprint detection and preservation methods.

F. Course Learning Outcomes:

CLO 1	Demonstrate advanced knowledge of fingerprint pattern analysis and classification techniques.
CLO 2	Apply forensic photography principles to document fingerprint evidence effectively.
CLO 3	Evaluate the significance of various fingerprint examination methods for criminal investigations.
CLO 4	Analyze the latest technological advancements in fingerprint detection and identification.
CLO 5	Synthesize best practices for preserving and presenting fingerprint evidence in a legal context.

G. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
Lect. Hrs./week	Tut Hrs.	Lab Hrs.	Credit	External		Internal			
				T	P	T	CE	P	
3	-	2	4	60	25	20	20	25	150

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

H. Course Content:

Sr. No	Content	Weightage	Teaching Hours
1.	Unit 1: Introduction of Fingerprint Science, Principles, Anatomy and biological significance of skin, Composition of sweat, secretory glands, History of finger print, formation of ridges, finger print patterns, ridge characteristics, ridge counting, ridge tracing etc.; Role of fingerprint bureau.	25%	5

2.	Unit 2: Fingerprint types: Visible, plastic, latent prints, recording of the plain and rolled prints, collection of fingerprints from dead bodies, development of latent prints, lifting and preservation of fingerprints, comparison of fingerprints, examination of fake or artificial prints, automated fingerprint recording and identification, AFIS, Henry's classification of fingerprint.	25%	15
3.	Unit 3: Chemical development of latent prints: Iodine fuming, cyanoacrylate esters acceleration procedures, Fluorescent and other chemical alternatives, Ninhydrin, Silver nitrate reagent, and other chemical methods. Special surfaces and situations: bloody prints, tape and sticky surfaces and skin, Post treatment procedures.	25%	12
4.	Unit 4: Physical development of latent prints: powder-based fingerprint development technique, laser light source, Photo luminescent: Fluorescence and Phosphorescence, use of nanoparticles in fingerprint development, metal deposition process, use of silver & gold particles in development of latent prints, digital imaging methods, optical methods, X ray, SEM methods.	25%	13
5.	Unit 5: Fingerprint Molecular Identification: Importance of the molecules detected from the fingerprint residues, factors influencing them; Importance of ridgeology, poroscopy & edgeoscopy in personal identification, application of the pores dimensions and ridge dimensions in the personal identification, scope of establishing the personal identity– characteristics and traits, RUVIS and other advancements.	25%	15
TOTAL		100%	60 Hrs

Sr.	List of Practical
1	Analysis of fingerprints with microscopic techniques for the ridge dimensions with the complete identification profiling
2	10-digit classification system.
3	Development of fingerprints using different chemical developing techniques
4	Development of fingerprints using physical development techniques
5	Examination and development of fingerprints on different surfaces
6	Using alternative light sources for examination of fingerprints on different surfaces
7	Collection and preservation of fingerprint evidence
8	Understanding AFIS method of fingerprints analysis

I. Text Book and Reference Book:

1. Nabar B. S. (2019). Forensic Science in Crime Investigation. Asia Law House
2. Mehta, M. K. (1963). Identification of Thumb Impression and the Cross Examination of FingerPrints. N. M. Tripathi (P) Ltd, Bombay
3. Lee, H. C., & Gaensslen, R. E. (2001). Advances in fingerprint technology. Boca Raton, Fla: CRC Press

4. Holder, E. H., Robinson, L. O., & Laub, J. H. (2011). The fingerprint sourcebook. U.S. Dept. of Justice, Office of Justice Programs, National Institute of Justice
5. Daluz, M. H. (2014). Fingerprint analysis laboratory workbook. CRC Press
6. Bleay, S. M., Croxton, R. S., Puit, M. D. (2018). Fingerprint Development Techniques: Theory and Application. Wiley
7. Scott, B. F. (2013). Fingerprint Classification and Interpretation Simplified. Pearson Education.
8. Henry E. R. (1993). Classification & Usage of Fingerprint. Fourth Edition.

Semester 4_
Specialization in Questioned Documents, Fingerprint & Photography

- A. Course Name: Advanced Concepts of Questioned Document Examination
 B. Course Code: 11207155
 C. Prerequisite: Basic knowledge of forensic science, handwriting analysis, and document authentication techniques.
 D. Rationale: To enhance the understanding and application of modern scientific techniques in analyzing and authenticating questioned documents for forensic investigations.
 E. Course Learning Objective:

CLOBJ 1	Analyze the principles of handwriting and signature verification.
CLOBJ 2	Evaluate modern techniques in ink, paper, and printing process analysis.
CLOBJ 3	Interpret alterations, forgeries, and erasures in documents.
CLOBJ 4	Apply advanced instrumentation for document examination.
CLOBJ 5	Develop expert opinions for legal and forensic contexts.

F. Course Learning Outcomes:

CLO 1	Analyze handwriting, signatures, and typewriting for authenticity and forgery detection.
CLO 2	Examine alterations, erasures, and obliterations in questioned documents.
CLO 3	Apply advanced techniques for ink, paper, and printing process analysis.
CLO 4	Interpret security features in currency, passports, and other secure documents.
CLO 5	Develop expert reports and provide testimony in questioned document cases.

G. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
Lect. Hrs./week	Tut Hrs.	Lab Hrs.	Credit	External		Internal			
				T	P	T	CE	P	
3	-	2	4	60	25	20	20	25	150

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

H. Course Content:

Sr. No	Content	Weightage	Teaching Hours
1.	Unit 1: Basics of Questioned Documents, Terminology, Nature and problems of document examination, Care and custody of documents, classification of documents, Security Documents,	25%	5
2.	Unit 2: Procurements of standards- admitted / specimen writings, Handling and packing of documents, Preliminary examination of documents, Principles of hand writing & signature identification. Disguise writings.	25%	15
3.	Unit 3: Forgeries & its types and their detections, Examination of alterations, erasers, overwriting, addition and obliterations, Examination of counterfeit currency notes, passport, credit card,	25%	12

	visa, seal and other mechanical impressions. Use of digital technology in the perpetration of white-collar crimes and their detection, digitally manipulated and machine generated documents-their nature, examination and reporting as well as evidence impact.		
4.	Unit 4: Printing Devices- impact and non- impact printing, Examination of modern printing techniques, Decipherment of secret & indented writings, ESDA and Examination of charred documents, Examination of typescripts, Xerox- Analog and Digital, computer printouts.	25%	13
5.	Unit 5: Determination of sequence of strokes, age of document, Physical matching of Documents, Photography of questioned documents, Instrumental techniques used for document examinations. Examination of ink and paper, VSC	25%	15
TOTAL		100%	60 Hrs

Sr.	List of Practical
1	Identification of Handwriting-general characteristics, natural variations, fundamental divergences and individual characteristics.
2	To detect Simulated and traced forgeries.
3	To study the handwriting of a person suffering from illness and handwriting written on the usual surface.
4	Examination of additions, alterations, and obliterations in the documents.
5	Examination of mechanical and chemical use of erasers on the documents
6	Examination of indented handwriting.
7	Examination of writing inks by TLC/ Paper chromatography
8	Examination of sequence of intersecting strokes
9	Examination of disguised writings

I. Text Book and Reference Book:

1. Rev. ED.; Ordway Hilton; Scientific Examination. I of Questioned Documents, Elsevier, New York;
2. Albert S. Osborn; Questioned Documents, Second Ed.; Universal Law Publishing, Delhi;
3. Albert S. Osborn; The Problem of Proof~ Second Ed.; Universal Law Publishing, Delhi;
4. Charles C. Thomas, Typewriting Identification I.S.Q.D.; Billy Prior Bates; Springfield, Illinois, USA

Semester 4
Specialization in Questioned Documents, Fingerprint & Photography

- A. Course Name: Advanced Instrumentation in Forensic Physical Sciences
 B. Course Code: 11207154
 C. Prerequisite: Basic understanding of instrumental techniques used for physical evidences.
 D. Rationale: This course bridges the gap between physical sciences and forensic investigations by emphasizing the application of sophisticated tools and techniques for crime scene analysis, evidence collection, and data interpretation.
 E. **Course Learning Objective:**

CLOBJ 1	Master the principles and applications of advanced forensic instruments
CLOBJ 2	Analyze forensic evidence using instrumental techniques
CLOBJ 3	Interpret Data from advanced instrumental techniques
CLOBJ 4	Understand the interaction of radiation with matter.
CLOBJ 5	Examine the theories related to instrumental phenomena.

F. Course Learning Outcomes:

CLO 1	Contribute to the improvement of forensic practices by staying informed on new technologies.
CLO 2	Perform routine analysis of microscopic evidences.
CLO 3	Apply the procedure of spectroscopy during analysis of physical evidences.
CLO 4	Produce scientifically valid results from advanced instrumental analyses that can be presented as evidence in a court of law
CLO 5	Operate instruments to analyze bullets, documents etc.

G. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
Lect. Hrs./week	Tut Hrs.	Lab Hrs.	Credit	External		Internal			
				T	P	T	CE	P	
4	-	3	-	-	40	-	-	60	-

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

H. Course Content:

Sr. No	Content	Weightage	Teaching Hours
1.	Unit 1: Introduction, scope, application and limitations of Forensic Physics, Electromagnetic spectrum, sources of radiations, their utility and limitations, Interaction of radiation with matter and its consequences- Reflection, absorption, transmission, scattering, emission, fluorescence, phosphorescence. Conventional sources for UV, visible, infrared rays, x-rays, α -rays and gamma rays, laser light as source of radiation, components of lasers, basic principles if He, Ne, Argon, dye laser, semi-conductor laser, Formation of a hologram, Reconstruction of the hologram.	20%	9
2.	Unit 2: Detection of radiations: photographic detectors, thermal detectors, photoelectric detectors, PMT and semiconductor detectors X-rays: Production; continuous and characteristic X-rays	20%	9

	and their spectra; Mosley's law; diffraction of X-rays by crystals; Bragg's law; Compton Effect.		
3.	Unit 3: Basic Concepts-Atomic and molecular spectroscopy, Analysis of physical evidences using Ultra violet and visible spectrophotometry, IR spectroscopy, Raman spectroscopy, FT-IR spectroscopy, Atomic Absorption Spectroscopy (AAS), Atomic Emission Spectrometry (AES), Mass spectroscopy, NMR spectroscopy: Principles, theory and instrumentation, forensic applications, ICPMS, ICP-AES, comparison of ICP vs AAS methods, quantitative analysis, applications.	20%	9
4.	Unit 4: Introduction to Microscopy, Types of Microscopes, Principles and Working of microscopes and their forensic applications, Advanced Microcopy: Scanning Electron Microscope, TEM, Atomic Force Microscope.	20%	9
5.	Unit 5: Specialized Instrumentation: Introduction to VSC and its Models, ESDA, Projectina, Paper Brightness Tester (TAPPI), Docu-box, BDAS, Integrated Ballistics Identification System, etc.		
TOTAL		100%	45 Hrs
Sr.	List of Practical		
1	Examinations of physical evidence by EDXRF technique.		
2	Examinations of RI of physical evidence by Abbe's and Digital Refractometer.		
3	Particle size analysis of physical evidences.		
4	Examination and analysis of various physical evidences by Comparison and Stereomicroscope.		
5	Examinations of physical evidence by SEM technique.		
6	Examination of various physical evidence by ICP technique.		
7.	Examination and analysis of various physical evidences by DTA method.		
8.	Examination of Structural materials.		

I. Text Book and Reference Book:

1. R.S. Khandpur; Handbook of Analytical Instruments, Tata McGraw Hill Pub. Co. New Delhi (2004)
2. James W. Robinson; Atomic Spectroscopy, 2nd Edn. Revised & Expanded, Marcel Dekkar, Inc, NY. (1996)
3. V.B. Patania; Spectroscopy, Campus Books International, (2004)
4. Robert M. Silverstein & Francis X Webster; Spectrometric Identification of Organic Compounds , 6th Edn., John Wiley & sons, Inc. (1997)
5. Jerry Workman, Jr, Art Springsteen; Applied Spectroscopy- A compact reference for Practitioners, Academic Press (1997)
6. N. Subrahmanyam & Brij Lal; A text Book of Optics, S. Chand & Co. (2004)
7. Gurdeep R. Chatwal & Sham K. Anand; Instrumental Methods of Chemical Analysis, Himalaya Pub. House (2004)
8. G.R. Chatwal; Analytical Spectroscopy 2nd Edn, Himalaya Pub. House (2002)
9. K.C. Thomson & R.J. Renolds; Atomic Absorption Fluorescence & Flame Emission Spectroscopy, A Practicals: Approach, 2nd Edn. Charles Griffith & Co. (1978)
10. Hobart H. Willard, Lynne L. Merrett Jr, John A Dean Frank A. Settle Jr.; Instrumental Methods of Analysis, 7th Edn. CBS pub. & Distributors (1986)
11. Kamlesh Bansal; Analytical Spectroscopy Campus, Books International (2000)
12. P.S. Kalri; Spectroscopy of Organic Compounds, 4th Edn, New Age International Pub. (2001)
13. Douglas A. Skoog, F.James Holler & Timothy A. Nieman; Principles of Instrumental Analysis, 5th Edn. Thomas Books Co. (2003)
14. E.R.Mengel; Fluorescence in Forensic Science in Encyclopedia of Analytical Chemistry, Wiley & sons (2000)
15. B. Caddy; Forensic Examination of Glass and Paints Analysis and Interpretation ISBN 0784 05749 (2001)
16. David A. Crown; The Forensic Examination of Paints and Pigments, Taylor & Francis, NY (2001)
17. Richard Saferstein; Criminalistics-An Introduction to Forensic Science 5th Ed., Prentice Hall (1995).

18. Arora, S. P. & Bindra, S. P., "A text book of Building Construction", Dhanpat Rai & Sons, Delhi. (2010)
19. Boudreau JE, etal; Arson & Arson Investigation, Survey & Assessment National Institute of Law Enforcement, U.S. Deptt of Justice, US Govt Printing Press (1977)

Semester 4
Specialization in Forensic Chemistry and Toxicology

- A. Course Name: Advanced Instrumentation in Forensic Chemical Sciences
 B. Course Code: 11207142
 C. Prerequisite: Basic understanding of instrumental techniques used for chemical evidences.
 D. Rationale: This course is designed to equip students with in-depth knowledge and practical skills in the use of modern and sophisticated instruments for forensic chemical analysis.

E. Course Learning Objective:

CLOBJ 1	Understand the theories and principles of various instrumental methods.
CLOBJ 2	Develop expertise in forensic instrumentation applications
CLOBJ 3	Operate and interpret data from sophisticated instruments
CLOBJ 4	Evaluate emerging trends in forensic instrumentation
CLOBJ 5	Discuss the role of forensic instrumental analysis in the legal system

F. Course Learning Outcomes:

CLO 1	Apply advanced instrumental techniques in Forensic Chemistry
CLO 2	Solve real-world forensic problems using instrumental techniques
CLO 3	Demonstrate knowledge of nuclear and radiochemical analysis
CLO 4	Perform instrumental operations with great clarity of the concept.
CLO 5	Critically assess the advantages and limitations of different instrumental techniques in forensic applications.

G. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
Lect. Hrs./week	Tut Hrs.	Lab Hrs.	Credit	External		Internal			
				T	P	T	CE	P	
4	-	3	-	-	40	-	-	60	-

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

H. Course Content:

Sr. No	Content	Weightage	Teaching Hours
1.	Unit 1: Instrumental methods: Theory, principle, components, sample handling, interpretation and applications ; Ultra violet and visible spectrophotometry, Atomic Absorption Spectrometry (AAS), Atomic Emission Spectrometry (AES), ICP-AES, comparison of ICP vs AAS methods, Fluorescence and phosphorescence spectrophotometry, Infrared spectrophotometry, Dispersive and Fourier transform spectrophotometry, (FTIR), X-ray spectroscopy.	20%	9
2.	Unit 2: Chromatographic Techniques: General principles, Paper chromatography, column chromatography, TLC, Adsorption chromatography, partition chromatography, Gas	20%	9

	chromatography, Gas-liquid chromatography, Ion-exchange chromatography, Exclusion (permeation) chromatography, Affinity chromatography, HPLC, HPTLC, Capillary Chromatography.		
3.	Unit 3: Microscopy: Basic principles, working, mechanism, uses & Forensic Applications of Simple and Compound microscope, Comparison microscope, Phase contrast Microscope, Stereoscopic microscope, Polarizing microscope, Fluorescent Microscopy, Infrared Microscopy, Scanning Electron Microscope (SEM) & Transmission Electron Microscope (TEM). pH, Buffer	20%	9
4.	Unit 4: Forensic nuclear chemistry: Introduction to nuclear forensics, nuclear threats, Nuclear explosive devices, Radioactivity, Radioactive decay rates and Half-lives, Methods of detection and measurement of radio actives (G.M and Scintillation Counter). Applications of Radioisotopes. Activation analysis: Neutron activation analysis, principle, technique, applications and steps involved in neutron activation analysis. Isotope dilution analysis: Principle, types of isotope dilution analysis, typical applications of isotope dilution analysis.	20%	9
5.	Unit 5: Immuno-chemical Techniques: General principles, Production of antibodies, Precipitin reaction, Gel immuno-diffusion, Immuno-electrophoresis, complement fixation, Radio Immuno Assay (RIA), ELISA, Fluorescence immuno assay. Uses & Forensic Applications. Electrophoretic Techniques: General principles, Factors affecting electrophoresis, Electrophoresis, Low voltage thin sheet electrophoresis, High voltage electrophoresis, Sodium dodecylsulphate (SDS) polyacrylamide gel electrophoresis, Isoelectric focusing (IEF), Isoelectrophoresis, Preparative electrophoresis, Horizontal and Vertical Electrophoresis. Applications in the field of forensic science.	20%	9
TOTAL		100%	45 Hrs
Sr.	List of Practicals		
1	Analyze forensic related compounds by UV-Vis. Spectrophotometer.		
2	Identification of compounds using thin layer chromatography		
3	Analyze forensic related compounds using HPLC.		
4	Analyze forensic related compounds using Gas chromatography.		
5	Analyze forensic related compounds using IR spectroscopy.		
6	Observe a sample under compound and stereo microscope.		

I. Text Book and Reference Book:

1. Willard H Hetal; Instrumental Methods of Analysis, CBS publ. (1986).
2. Clark E.G. C: Isolation and Identification of drugs. Vol.I and Vol.2, Academic Press (1986)
3. Banwell C. L ;& Elani M. M. C ; Fundamental of Molecular Spectroscopy 4th Edn., Tata MacGraw Hill Pub. Co. (1995).
4. Thomson K. C & Renolds R. J ; Atomic Absorption Fluorescence & Flame Emission Spectroscopy, A Practicals: Approach ,2nd Edn. Charles Griffin & Co. (1978).
5. Skoog D.A etal; Principles of Instrumental Analysis, Thomas Book Co. (2003).

6. Chatwal G. R ; Analytical Spectroscopy 2nd Edn. Himalaya Publ. House(2002)
7. Chatwal G.R & Anand S. K ; Instrumental Methods of Chemical Analysis Himalaya Publ. House (2004).
8. Smith, F. (2004). Handbook of forensic drug analysis. Elsevier.
9. Laboratory Procedure Manual, Forensic Toxicology :Directorate of Forensic Science MHA Govt (2005).

Semester 4

Advanced concept of Forensic Toxicology & Pharmacology

- S. Course Name: Advanced concept of Forensic Toxicology & Pharmacology
T. Course Code: 11207143
U. Prerequisite: The course requires a foundational understanding of toxicology, pharmacology, biochemistry, analytical techniques, and forensic science principles to effectively study advanced topics in forensic toxicology and pharmacology.
V. Rationale: This course aims to provide advanced knowledge in forensic toxicology and pharmacology, enabling students to apply scientific principles in forensic investigations, focusing on poisons, drug interactions, pharmacokinetics, and analytical methods for legal contexts.

W. Course Learning Objective:

CLOBJ 1	Understand and classify poisons and warfare agents
CLOBJ 2	Comprehend forensic pharmacology and drug interactions
CLOBJ 3	Analyse pharmacokinetic processes in forensic contexts
CLOBJ 4	Apply advanced analytical techniques for toxicology and forensic analysis
CLOBJ 5	Evaluate recent advancements in forensic toxicology research

X. Course Learning Outcomes:

CLO 1	Demonstrate comprehensive knowledge of poisons and warfare agents
CLO 2	Analyse and interpret drug-receptor interactions and pharmacodynamics
CLO 3	Evaluate pharmacokinetic processes relevant to forensic science
CLO 4	Utilize advanced analytical techniques for forensic toxicology investigations
CLO 5	Assess the impact of recent advancements in forensic toxicology research

Y. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
Lect. Hrs./week	Tut Hrs.	Lab Hrs.	Credit	External		Internal			
				T	P	T	CE	P	
3	-	2	4	60	25	20	20	25	150

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

Z. Course Content:

Sr. No	Content	Weightage	Teaching Hours
1.	Unit 1: Introduction to advancements in Forensic Toxicology Poisons: Definition of Poison, characteristics of an ideal poison, Classification of poisons based on their origin and Chemical nature, mode of action, signs and symptoms, fatal dose, fatal period, Animal and Vegetable Poison. Warfare agents: Introduction, types, their sources, Sign and symptoms, fatal dose, fatal period, antidotes, action required after such attacks, detection and identification. Recent research in the development and preventions of warfare agents Food Adulteration: Food Adulteration Act, Various adulterants in household and food products and their detection.	20%	12

	Court testimony in NDPS Act, Limitation of chemical analysis of drugs, Case studies and ground for acquittal and grant of bail. Relevant Organizations – NCB, WADA, UNODC, SWGDRUG		
2.	Unit 2: Forensic Pharmacology (Pharmacodynamics-I) Sites and mechanisms of action of drugs; Receptor classification, Drug-receptor interactions and signal transduction mechanisms, Dose-effect relationships; agonists, partial agonists and antagonists, Factors that modify drug actions; side effects, overdose, idiosyncratic and allergic reactions; teratogenesis and foetal toxicity, Variability of drug effects: factors depending on the drug, on the patient, on the treatment schedule, Drug interactions.	20%	10
3.	Unit 3: Forensic Pharmacology (Pharmacokinetics -II) The movement of drug molecules across cell membranes, the blood-brain barrier and the placental filter, Routes of administration and drug adsorption, binding to plasma proteins. Drug distribution, metabolism and elimination, Drug bioavailability and half-life, Pharmacokinetic parameters evaluation, Time course of drug plasma concentrations after single and repeated administrations, Pharmacognosy: Definition and aim of Pharmacognosy; definition and classification of plant drug; factors affecting the activity: natural, endogenous, exogenous and preparation-dependent.	20%	14
4.	Unit 4: Methods of Analysis Centrifugation Methods, Extraction methods from biological matrices, Method of analysis of Inorganic poisons (metallic, non-metallic and anions), Neutral poison, Basic drugs / poisons, Acidic drugs / poisons, metallic poisons, volatile poisons, method of quantization, Immuno – chemical, Electrophoresis, Advanced Chromatographic & Spectroscopic Techniques.	20%	12
5.	Unit 5: Recent Advances in Forensic Toxicology Recent trends in analytical procedures in forensic toxicology, Analytical Forensic Toxicology, Entomotoxicology, Toxicological Databases, Post – mortem Forensic Toxicology, biomarkers in Forensic Toxicology, Advances in Dope testing and other interdisciplinary areas.	20%	12
TOTAL		100%	60 Hrs

AA. List of Practical

1. Analysis of narcotic substances by preliminary tests.
2. Analysis of psychotropic substances by preliminary tests.
3. Thin layer chromatography for common drugs encountered.
4. Identification of metals by preliminary examination.
5. Identification of different vegetable poison by colour test, chromatography etc.
6. Extraction and identification of drugs/ toxicants from biological matrix and their detection.
7. Analysis of steroids using thin layer chromatography.

BB. Text Book and Reference Book:

1. Parikh, C. K. (1988). Parikh's text book of medical jurisprudence and toxicology. CBS Publishers & Distributors.
2. Casarett, L J and Doull John ; Toxicology :The Basic Science of Poison, Macmillan Publ. Co. New York (1975)
3. Richardson, T. (2000). Pitfalls in forensic toxicology. Annals of clinical biochemistry, 37(1), 20-44.
4. Drummer, O. H., & Odell, M. (2001). The forensic pharmacology of drugs of abuse (pp. 368-441). London: Arnold.
5. Levine, B. (Ed.). (2003). Principles of forensic toxicology. Amer. Assoc. for Clinical Chemistry.
6. Hodgson, E. (Ed.). (2004). A textbook of modern toxicology. John Wiley & Sons.
7. Katzung, B. G., Masters, S. B., & Trevor, A. J. (Eds.). (2004). Basic & clinical pharmacology.
8. Laboratory Procedure Manual, Forensic Toxicology :Directorate of Forensic Science MHA Govt (2005)
9. Kelly, T. (2012). Clarke's analysis of drugs and poisons.
10. Hitner, H., & Nagle, B. T. (2012). Pharmacology: an introduction. McGraw-Hill.
11. Modi, R. B. J. P. (2013). A textbook of medical jurisprudence and toxicology. Elsevier.
12. Smith, F. (2004). Handbook of forensic drug analysis. Elsevier.
13. Laboratory Procedure Manual, Forensic Toxicology: Directorate of Forensic Science MHA Govt (2005).
14. Khan, J. I., Kennedy, T. J., & Christian Jr, D. R. (2011). Basic principles of forensic chemistry. Springer Science & Business Media.
15. Kobilinsky, L. (Ed.). (2011). Forensic chemistry handbook. John Wiley & Sons.
16. Chalmers, J. M., Edwards, H. G., & Hargreaves, M. D. (Eds.). (2012). Infrared and Raman spectroscopy in forensic science. John Wiley & Sons.

M. Sc Semester 4
Specialization in Forensics Chemistry & Toxicology

CC. Course Name: Advanced Concepts of Forensic Chemistry

DD. Course Code: 11207144

EE. Prerequisite: Basic understanding of organic and inorganic chemistry, instrumental analysis, and forensic science fundamentals.

FF. Rationale: The course aims to provide advanced knowledge in forensic chemistry, emphasizing trace evidence, narcotics, beverages, and modern analytical techniques. Students will explore recent trends and interdisciplinary approaches, enhancing their skills for forensic investigations and research.

GG. Course Learning Objective:

CLOBJ 1	Introduce the classification, adulteration, and analysis of fertilizers, insecticides, and pesticides.
CLOBJ 2	Equip students with knowledge of trace evidence analysis, including dyes, explosives, and fibres.
CLOBJ 3	Develop expertise in the forensic analysis of beverages, including detection of alcohols and associated legal aspects.
CLOBJ 4	Familiarize students with advanced analytical techniques, such as NMR, neutron activation analysis, and isotope dilution.
CLOBJ 5	Highlight recent trends in forensic chemistry, including nanotechnology and sports forensics.

HH. Course Learning Outcomes:

CLO 1	Analyse fertilizers, insecticides, and pesticides using chemical and instrumental methods.
CLO 2	Examine trace evidence and apply chemical and instrumental techniques for its analysis.
CLO 3	Conduct comprehensive analysis of alcoholic and non-alcoholic beverages for forensic purposes.
CLO 4	Utilize advanced analytical methods for forensic applications, including nuclear chemistry.
CLO 5	Demonstrate understanding of recent forensic chemistry developments, including nanotechnology and statistical applications.

II. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
Lect. Hrs./week	Tut Hrs.	Lab Hrs.	Credit	External		Internal			
				T	P	T	CE	P	
4	-	4	-	-	40	-	-	60	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

JJ. Course Content:

Sr. No	Content	Weightage	Teaching Hours
1.	Unit I: Fertilizers, insecticides and pesticides Introduction, classification, common adulterants, types, components, standard or substandard or substituted, Tests used for the same including TLC, other chemical methods, UV-Vis spectrophotometer and gas liquid chromatography	20%	5
2.	Unit II: Trace Evidence Analysis	20%	15

	Different type of dyes, role of dyes in crime investigation, food colours (edible and nonedible dyes), dyes used in cosmetic and pharmaceutical, Chemical analysis and instrumental methods of analysis of dyes. Analysis of trace evidence: drugs, explosives, petroleum products, cosmetics, dyes, Trap cases, fibres, oils, fats, greases, industrial dusts, chemicals and plant material.		
3.	Unit III: Forensic Analysis of beverages Types of beverages – alcoholic and non-alcoholic, Analysis of beverages: alcoholic and non-alcoholic, country made liquor, illicit liquor and medicinal preparations containing alcohol, hooch tragedies and their significance, detection and determination of ethanol, methanol, furfural acetate aldehyde, ester by colour test and instrumental technique, breath analyzer, relevant sections of Excise Act. Case studies related to alcohol analysis.	20%	12
4.	Unit IV: Advances Analytical Techniques Forensic nuclear chemistry: Introduction to nuclear forensics, nuclear threats, Nuclear explosive devices, Radioactivity, Radioactive decay rates and Half-lives, Methods of detection and measurement of radio actives (G.M and Scintillation Counter), Applications of Radioisotopes, Nuclear Magnetic Resonance (NMR). Neutron Activation analysis: Neutron activation analysis, principle, technique, applications and steps involved in neutron activation analysis. Isotope dilution analysis: Principle, types of isotope dilution analysis, typical applications of isotope dilution analysis. Advanced spectroscopic, microscopic & chromatographic techniques	20%	15
5.	Unit V: Recent trends in Forensic Chemistry Current research and developments in the field of forensic chemistry and its interdisciplinary areas. Forensic Nanotechnology: Basic principles & theories, Synthesis, characterization of Nanoparticles, applications in Forensic science. Chemo – metrics & Statistics, CBRN analysis, Sports Forensics.	20%	13
TOTAL		100%	60 Hrs.

Text Book and Reference Book:

1. Saferstein, R. Criminalistics: An Introduction to Forensic Science.
2. Bell, S. Forensic Chemistry.
3. Ahuja, S., & Jespersen, N. Modern Instrumental Analysis.
4. Dean, J. R. Applications of Analytical Techniques to Forensic Science.
5. Liang, Y. Z., & Xie, P. Chemometrics and Data Analysis in Forensic Science.

6. O'Connor, J. J., & Redsicker, D. R. (1996). *Practicals: fire and arson investigation*. CRC Press.
7. Urbanski T; *Chemistry and Technology of Explosives*, Pergamon Press (1985).
8. Sharma, B. R. (1990). *Forensic science in criminal investigation and trials*. Central Law Agency.
9. Yinon, J. (1999). *Forensic and environmental detection of explosives*. John Wiley & Sons.
10. Akhavan Jacqueline: *Chemistry of Explosive*, The Royal Society of Chemistry (2004)
11. Bouquard, T. J. (2004). *Arson investigation: the step-by-step procedure*. Charles C Thomas Publisher.
12. *Laboratory Manual on Explosives*, Directorate of Forensic Science MHA Govt. of India (2005).
13. Beveridge, A. (Ed.). (2011). *Forensic investigation of explosions*. CRC press.
14. Kobilinsky, L. (Ed.). (2011). *Forensic chemistry handbook*. John Wiley & Sons.
15. Almirall, J. R., & Furton, K. G. (Eds.). (2016). *Analysis and interpretation of fire scene evidence*. CRC Press.
16. Skoog D.A et al; *Principles of Instrumental Analysis*, Thomas Book Co. (2003).
17. Chatwal G. R; *Analytical Spectroscopy* 2nd Edn. Himalaya Publ. House (2002)
18. Chatwal G.R & Anand S. K; *Instrumental Methods of Chemical Analysis* Himalaya Publ. House (2004).

Semester 4_
Specialization in Biological sciences

KK. **Course Name:** Advanced Concepts of Biology & Instrumentation in Biological Science

LL. **Course Code:**11207145

MM. **Prerequisite:** Fundamental knowledge of biology, including cell biology, molecular biology, and basic laboratory techniques.

NN. **Rationale:** This subject integrates advanced biological concepts with the practical application of modern instrumentation, equipping students to analyze complex biological systems and conduct innovative research.

OO. **Course Learning Objective:**

CLOBJ 1	Gain an in-depth understanding of complex biological mechanisms at cellular and molecular levels.
CLOBJ 2	Learn the principles and applications of advanced tools and technologies in biological research.
CLOBJ 3	Develop skills to interpret and analyze experimental data using modern software and methodologies.
CLOBJ 4	Formulate and execute experiments to investigate advanced biological concepts using sophisticated instrumentation.
CLOBJ 5	Bridge the gap between theoretical biology and practical laboratory applications to address scientific questions.

PP.Course Learning Outcomes:

CLO 1	Demonstrate a thorough understanding of advanced biological concepts and their real-world applications.
CLO 2	Operate and apply advanced biological instruments for research and diagnostics.
CLO 3	Effectively analyze and interpret biological data using computational tools and statistical methods.
CLO 4	Design, conduct, and troubleshoot experiments addressing specific biological hypotheses.
CLO 5	Solve complex biological problems by integrating advanced concepts and instrumentation techniques.

QQ. Teaching & Examination Scheme:

Teaching Scheme				Examination Scheme					Total
Lect. Hrs./week	Tut Hrs.	Lab Hrs.	Credit	External		Internal			
				T	P	T	CE	P	
4	-		4	60	25	20	20	60	150

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

RR. Course Content:

Sr. No	Content	Weightage	Teaching Hours
1.	Unit 1: Genomics: The completion of the Human Genome Project in 2003 marked a major milestone in genomics, enabling researchers to study the complete set of genes in humans. Since then, advancements in DNA sequencing technologies have made	20%	10

	genome sequencing faster and more affordable, leading to breakthroughs in personalized medicine, genetic diseases, and evolutionary biology		
2.	Unit 2: Synthetic Biology: Synthetic biology combines principles from biology, engineering, and computer science to design and construct new biological components, systems, and organisms. This field has contributed to the creation of artificial life forms, the production of biofuels and pharmaceuticals, and the development of biosensors for environmental monitoring. Stem Cell Research: Advances in stem cell research have paved the way for regenerative medicine. Scientists can now reprogram adult cells into induced pluripotent stem cells (iPSCs), which have the potential to develop into various cell types. This technology holds promise for tissue engineering, organ transplantation, and understanding the development of diseases. Single-Cell Analysis: Traditional methods of studying biological samples often involve analyzing large populations of cells, masking cellular heterogeneity. However, recent technological advancements now allow researchers to analyze individual cells, providing insights into cellular diversity, rare cell types, and dynamic cellular processes.	20%	10
3.	Unit 3: Microbiome Research: The human microbiome, consisting of trillions of microorganisms living in and on our bodies, has emerged as a major area of study. Advancements in sequencing and bioinformatics have enabled the characterization of microbial communities, leading to discoveries of their roles in health, disease, and various physiological processes. Neuroscience: Significant progress has been made in understanding the complex workings of the brain. Techniques such as optogenetics, which use light to control neurons, and functional magnetic resonance imaging (fMRI) have allowed researchers to explore brain function and connectivity, leading to insights into cognition, behavior, and neurological disorder. Bioinformatics and Data Analysis: The explosion of biological data generated by highthroughput sequencing and other technologies requires sophisticated computational tools for analysis. Bioinformatics has played a crucial role in managing, analysing, and interpreting large-scale biological datasets, facilitating discoveries in genomics,	20%	10

	proteomics, and systems biology. These advancements in biological sciences have not only expanded our knowledge but also have the potential to transform healthcare, agriculture, environmental conservation, and many other fields in the future		
4.	Unit 4: Microscope: Used for examining and analyzing microscopic evidence such as hairs, fibres, and biological samples. DNA Sequencer: Enables the sequencing and analysis of DNA samples for identification and comparison purposes. Polymerase Chain Reaction (PCR) Machine: Utilized to amplify specific regions of DNA for further analysis, such as DNA profiling or DNA sequencing. Thermal Cycler: Required for performing PCR reactions, which involve the amplification of DNA segments using thermal cycling. Spectrophotometer: Measures the absorption and transmission of light by a sample, allowing quantification of DNA, RNA, proteins, and other compounds. Microarray Scanner: Used for analyzing gene expression and DNA variation through hybridization with DNA microarrays. Real-time Polymerase Chain Reaction (qPCR) Machine: Measures the amplification of DNA or RNA in real-time, enabling quantification and analysis of gene expression or pathogen detection. Automated DNA Extraction System: Facilitates the rapid and efficient extraction of DNA from various biological samples, streamlining the process. Biological and biochemical techniques: General principles of Biological/ Bio-chemical Analysis, pH and buffers, Physiological solution, cell and tissue culture, Cell fractionation, Biological variations etc.	20%	10
5.	Unit 5: Centrifugation Techniques, Immuno-chemical Technique, General principles, Production of antibodies, Precipitin reaction, Gel immune-diffusion, Immunoelectrophoretic, complement fixation, Radio Immune Assay (RIA), Enzymelinked Immunosorbents Assay (ELISA), Fluorescence immunoassay. Chromatographic Techniques, Electrophoretic Technique: General principles, Factors affecting electrophoresis, Low voltage thin sheet electrophoresis, High voltage electrophoresis, Sodium dodecyl sulphate (sDS) polyacrylamide gel electrophoresis, Isoelectric	20%	10

	focusing (IEF), Isoelectrophoresis, Preparative electrophoresis, Horizontal and Vertical Electrophoresis, Application of these techniques in Forensic science.		
TOTAL		100%	45 Hrs

SS. Text Book and Reference Book:

1. "Molecular Biology of the Cell" by Alberts et al.
2. "Principles and Techniques of Biochemistry and Molecular Biology" by Wilson and Walker
3. "Lehninger Principles of Biochemistry" by Nelson and Cox
4. "Biophysical Chemistry: Principles and Techniques" by Upadhyay, Upadhyay, and Nath
5. "Introduction to Instrumental Analysis" by Robert D. Braun
6. "Techniques in Molecular Biology" by Surzycki
7. "Fundamentals of Light Microscopy and Electronic Imaging" by Douglas B. Murphy and Michael W. Davids
8. "Analytical Techniques in Biochemistry and Molecular Biology" by Rajan Katoch

Semester 4
Specialization in Biological Sciences

TT. **Course Name:** Advanced concepts of Forensic biology. Serology & Wildlife forensics

UU. **Course Code:** 11207146

VV. **Prerequisite:** Basic understanding of biology, genetics, and forensic science principles.

WW. **Rationale:** This subject combines advanced forensic biology, serology, and wildlife forensics to equip students with specialized skills for analyzing biological evidence and addressing crimes involving wildlife and biological materials.

XX. **Course Learning Objective:**

CLOBJ 1	Gain a deep understanding of biological evidence analysis, including DNA profiling and tissue examination.
CLOBJ 2	Learn advanced techniques for identifying and analyzing biological fluids in forensic contexts.
CLOBJ 3	Develop knowledge of wildlife crime investigation, species identification, and conservation law enforcement.
CLOBJ 4	Use advanced instrumentation and molecular methods to evaluate forensic evidence accurately.
CLOBJ 5	Integrate biological and forensic principles to solve complex cases involving human and wildlife evidence.

YY. **Course Learning Outcomes:**

CLO 1	Demonstrate expertise in analyzing biological materials and interpreting forensic evidence.
CLO 2	Perform accurate identification and analysis of biological fluids using state-of-the-art techniques.
CLO 3	Apply forensic methods to investigate wildlife crimes and contribute to biodiversity conservation.
CLO 4	Operate advanced analytical tools and molecular techniques for forensic investigations.
CLO 5	Exhibit awareness of ethical practices and legal frameworks in forensic biology and wildlife crime investigations

ZZ. **Teaching & Examination Scheme:**

Teaching Scheme				Examination Scheme					Total
Lect. Hrs./week	Tut Hrs.	Lab Hrs.	Credit	External		Internal			
				T	P	T	CE	P	
4	4	-	4	60	25	20	20	25	150

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

AAA. **Course Content:**

Sr. No	Content	Weightage	Teaching Hours
1.	Unit 1: Forensic Microbiology Introduction to microbiology, cell wall composition of Gram positive and Gram negative bacteria. Microbial growth and environmental factors affecting the growth. Sterilization techniques - Physical agents: Dry heat, wet heat and cold sterilization, filtration, radiation; Chemical agents (Disinfectants, antibiotics, alcohols) and their	20%	10

	mechanisms. Different methods for isolation of microorganisms from forensic samples like vomit, stool, stomach wash and residual food. Introduction to biological warfare, general properties of various biological warfare agents and their toxic effects. Popular case studies of bioterrorism.		
2.	Unit 2: Stages of human growth and development- Prenatal growth, Postnatal growth & their characteristics, Factor affecting growth- Genetic & Environmental. Methods of studying Human Growth, Methods of assessing age-chronological age, dental age, skeletal age, secondary sex character age and morphological age Origin & Sex determination from skeletal remains and its medico-legal importance	20%	10
3.	Unit 3: Techniques of complete and partial identification from skeletal remain- Calculation of stature of long bones, stature reconstruction in various population groups, racial differences in human skeleton. Facial reconstructions, Cranio-facial superimposition, Video superimposition, Techniques for recovering, preservation & analysis of skeletonized/decomposed human remains. Other methods of establishing identity: Dactyloscopy, Bite mark, Tattoo marks, Deformities, Scars. Disaster Victim Identification Examination and identification of dead bodies in mass disasters, mutilated bodies, fragmentary skeletal remains and bones. Determination of age, sex, race and species origin from bones and assessment of stature.	20%	10
4.	Unit 4: Immune system & response, innate and acquired immunity, antigens, antibodies, haptenes and adjuvants, Immunoglobulin- its types, physico-chemical properties and function, raising of anti-sera, forensic significance of Lectins, Buffers and serological reagents, methods of sterilization. Formation & composition of blood, theories and biochemical tests for the identification of blood, Blood groups – history, biochemistry and genetics of ABO, Rh, Mn and other systems, Methods of ABO blood grouping from blood stains and other body fluids/stains, blood group specific ABH substances. Secretors and non- secretors, determination of sex & race from blood groups, Lewis	20%	10

	antigen, Bombay Blood groups, HLA antigens and HLA typing, Role of sero-genetic markers in individualization and paternity disputes.		
4.	Unit 5: Introduction & scope of wildlife forensics, Protected and endangered species of animals and plants, Sanctuaries and their importance, Types of wildlife crimes, different methods of killing and poaching of wildlife animals. Scientific methods of investigation - identity wild life animals - examination of physical evidences like hair, nails, teeth, ivory, horn, footprints (pugmarks) etc. by conventional and modern methods. Identification of wild life animals with using Genetic techniques.	20%	5%
TOTAL		100%	45 Hrs

BBB. Text Book and Reference Book:

1. "Forensic Biology" by Richard Li
2. "Forensic Science: An Introduction to Scientific and Investigative Techniques" by Stuart H. James and Jon J. Nordby
3. "Essentials of Forensic Biology" by Alan Gunn
4. "Wildlife Forensics: Methods and Applications" by Jane E. Huffman and John R. Wallace
5. "Forensic Serology: Mechanisms and Techniques" by Vinay Sharma
6. "DNA Technology in Forensic Science" by National Research Council
7. "Wildlife DNA Analysis: Applications in Forensic Science" by Adrian Linacre and Shanan Tobe
8. "Mammalogy Techniques Manual" by Robert S. Sikes and William L. Gannon

Semester 4
Advanced Concepts of Forensic DNA Profiling

A. **Course Name:** M.Sc.

B. **Course Code:** 11207147

C. **Prerequisite:** This course will emphasize depth of knowledge about DNA, fundamental of various techniques along with advancement, importance of DNA profiling in civil and criminal cases.

D. **Rationale:** To enhance the understanding and application of modern scientific techniques in analyzing and authenticating questioned documents for forensic investigations.

E. **Course Learning Objective:**

CLOBJ 1	Understand the concept of forensic biology, serology and DNA profiling.
CLOBJ 2	Apply knowledge of DNA profiling in civil and criminal cases.
CLOBJ 3	Examine various cases through existing techniques used in DNA.
CLOBJ 4	Interpret advance methodologies in DNA analysis.
CLOBJ 5	Demonstrate application of DNA on various structural bases and forensically importance data base

F. **Course Learning Outcomes:**

CLO 1	Demonstrate knowledge of DNA and related concepts of it.
CLO 2	Explain various application of DNA profiling in criminal Justice system.
CLO 3	Explore analytical techniques and applications along with information about genetic and enzymes.
CLO 4	Emphasize on advancement in DNA profiling and forensic data base.
CLO 5	Interpret genetically modification, genetic inherited characteristics along with population structure.

G. **Teaching & Examination Scheme:**

Teaching Scheme				Examination Scheme					Total
Lect. Hrs./week	Tut Hrs.	Lab Hrs.	Credit	External		Internal			
				T	P	T	CE	P	
3	-	2	4	60	25	20	20	25	150

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

H. **Course Content:**

Sr. No	Content	Weightage	Teaching Hours
1.	Unit 1: An overview of molecules involved in the flow of genetic information, double helical structure of DNA, alternate forms of DNA double helix, denaturation and renaturation of DNA, DNA binding proteins, factors affecting DNA stability. Types and structure of RNA, RNA-DNA hybrid helices, DNA repair, direct and indirect evidences for DNA and RNA as the genetic material, Chemical nature of DNA and RNA, Replication of DNA in prokaryotes and eukaryotes, genetic code, degeneracy and universality of genetic code, transcription and translation machinery, Nature and structure of human genome and its diversity, mt-DNA, Y-Chromosomes and the peopling, migration, of modern humans, Concept of gene – Conventional and modern views. Fine structure of gene, split gene, pseudogene, non-coding gene, overlapping genes and multiple gene families.	20%	10
2.	Unit 2: History of DNA profiling applications in disputed paternity	20%	10

	cases, child swapping, missing person's identity, civil immigration, veterinary, wild life and agriculture cases, Legal perspectives – legal standards for admissibility of DNA profiling– procedural & ethical concerns, status of development of DNA profiling in India & abroad, limitations.		
3.	Unit 3: Outline of genetic manipulations, enzymes in genetic manipulation, basic molecular cloning procedures, isolation of specific nucleic acid sequences– complementary DNA, genomic library construction, preparation of plasmid DNA , sub cloning , colony hybridization, Nick translation, Oligo-nucleotide probes, expression of genes, Nucleic acid hybridization and DNA sequencing. Electrophoresis: Gel & Capillary electrophoresis their Principle and theory, Capillary electro chromatography: instrumentation and applications.	20%	12
4.	Unit 4: Advanced Methodologies in Forensic DNA Analysis: Fundamentals of RFLP and PCR based DNA typing, STR genotyping, Result of STR marker analysis and its interpretation, Mini STRs, VNTRs, Single Nucleotide Polymorphism (SNP) and its applications in forensic investigation, Mitochondrial DNA analysis in Forensic investigation, Forensic significance of Y-STR analysis, Non-human DNA analysis. Evaluation of results, frequency estimate calculations and interpretation, Allele frequency determination, Match probability – Database, Quality control, Certification and Accreditation. Factors affecting accuracy of Forensic DNA typing.	20%	13
5.	Unit 5: Recent Developments and future Directions in DNA profiling: Types of Next Generation Sequencing techniques: principles, Instrumentation and Applications. Methods of DNA sequencing, Prediction of physical characteristics, such as eye, hair, and skin color based solely on DNA using Next Generation Sequencing, Molecular autopsy, Population Genetics and Bioinformatics: Concept of population structure, Indian population structure, Hardy-Weinberg equilibrium, causes of evolution- admixture, selection, mutation, drift, Linkage disequilibrium, Phylogenetic tools, Paternity/ maternity indices, sibship indices, Population Genetics in Forensic DNA typing, Genetic genealogy in the genomic era. Forensically important databases – BOLD, Hapmap, STRBase, DNA databases- CODIS.	20%	15
TOTAL		100%	60 Hrs.
Practicals			
1. DNA extraction from various forensic samples.			
2. Quantity and quality assessment of DNA extracted by various methods from different forensic samples: hair, body fluids, vegetables, plants, nails, teeth, bones			
3. Demonstration PCR amplifications and STR typing through vertical polyacrylamide gel electrophoresis and silver staining			
4. Demonstration PCR amplifications and STR typing with automatic DNA sequencer			

I. Text Book and Reference Book:

1. Rudin, Norah; An Introduction to Forensic DNA Analysis, CRC Leviw Publishers, (2002)
2. Inman, Keith; An Introduction to Forensic DNA Analysis, CRC Press, (1997)
3. Herrmann, Bernd; Ancient DNA, Springer Publishing Co., (1994)
4. Vij, Krishan ; Basics of DNA and Evidentiary Issues, Jaypee Brothers, (2004)

5. Kobiinsky, Lawrence; DNA, John Wiley & Sons, (2005)
6. Glover, D.M.; . DNA Cloning 4: Mammalian systems, IRL Press, (1995)
7. Nickoloff, Jac A; DNA Damage and repair, Humana Press,(1998)
8. Newton, David E. ; DNA Evidence and Forensic Science, Viva books private limited, (2010)
9. Kirby, Lorne; DNA fingerprinting, W H Freeman and Co, (1992)
10. T.Burke, Terry; DNA Fingerprinting: Approaches and applications., Birkhauser Verlage, (1991)
11. Robertson, J; DNA in forensic science, Ellis Horwood Ltd., (1990)
12. Easteal, Simon; DNA profiling, Harwood academic Publishers, (1993)
13. Epplen, Jorg T.; DNA profiling and DNA fingerprinting, Birkhauser Verlage, (1999)
14. Alcamo, I Edward; DNA technology, Harcourt Academic Press, (1999)
15. Singh, Yashpal; DNA tests in Criminal Investigation Trial & Paternity Disputes, Alia Law Agency, (2006)
16. An Introduction to Genetic Analysis, 6th Edition – Anthony J. F. Griffiths et. al., W.H. Freeman and Co. ISBN: 978-716726043
17. Bioinformatics – A practicals: guide to the analysis of genes and proteins, 3rd Edition – Andreas D. Baxevanis and B.F. Francis Oullette, Wiley-Liss, ISBN: 978-0471478782
18. Bioinformatics for Beginners: Genes, Genomes, Molecular Evolution, Databases and Analytical Tools, 1st Edition (2014) - Supratim Choudhury, Academic Press, ISBN: 978-0124104716