COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY

CURRICULUM AND SYLLABUS

For

M.Sc. Forensic Science

(Choice based Credit Semester System- CCSS-PG-2022) for

University Teaching Department

(w.e.f. 2024 Admission)

COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY

KOCHI – 682022

Scheme and Curriculum of the Program

The two-year Post Graduate Programme will be in the semester pattern. There will be four semesters in the entire course, with two semesters in each year. Each semester will have 90 instructional days with a minimum of 6 hours of instructions each day under the five-day system. End-semester examinations will be held within the 90 regular instructional days. The program includes Core, Elective, MOOC, Internship and Project. The papers in the first two semesters will constitute the Core Courses only, in the third semester both Core and Elective and in the fourth semester Project and MOOC are included. The total credit of the program (excluding audit courses) is 80. The following five broad areas of elective subjects offered in this proposed Department for the time being:-

1. Questioned Documents and Forensic Dermatoglyphics
2. Forensic Physics and Ballistics
3. Forensic Chemistry and Toxicology
4. Forensic Biology, Serology and DNA Profiling
5. Cyber Security and Digital Forensics

- ➢ Evaluation of all semester theory/ practical papers will be done in two parts namely by continuous internal evaluation and end semester evaluation.
- ➢ This syllabus and curriculum of M.Sc. Forensic Science course shall follow the Cochin University of Science and Technology Regulations for the Choice Based Credit Semester System-PG for the teaching departments/ schools/ centres of the CUSAT.
- ➢ Students shall undergo 3 months compulsory internship at SFSL/FSL/CEL/CFSL by availing summer vacation. The duration of internship will be from May to July. During the internship period classes of the month of July will be conducted through online mode which includes special lectures of experts from forensic allied fields.
- ➢ Students shall compulsorily register at least one MOOC (Massive Open Online Courses) with a minimum of 2 credits at the beginning of the first semester. MOOC must be approved by the Department Council and a proof of satisfactory completion and marks/grade issued by the authority who conducted the course must be submitted to the Head of the Department. The credit of such a course will be added to the transcript of the fourth semester.

Programme Specific Outcomes (PSOs):

PSOs are specific to a programme and are to be attained at the time of post-graduation from the programme. They are to be identified by a committee with representation from all stakeholders.

M.Sc. Forensic Science Programme

PSOs	Program Specific Outcomes
PSO-1	Understand the principles of Forensic Science.
PSO-2	Recognize and relate the theories and principles of Forensic Science for the scientific processing of evidence in the forensic domain.
PSO-3	Understand and perform the identification, collection, preservation, packing and forwarding of various physical evidence by maintaining the chain of custody.
PSO-4	Understand and facilitate the students to develop a research attitude to do innovative research to apply the inter-disciplinary concepts of various fields of Forensic Science in crime scene investigation.
PSO-5	Provide exposure and facilitate research ambiance and practical experiences with in various specializations in the field of Forensic Science with frequent updates.
PSO-6	Understand and perform laboratory procedures as per standard protocols in the various divisions of Forensic Science, report writing and presentation before court of law.

M.Sc. FORENSIC SCIENCE (2024 ADMISSION ONWARDS)

SUMMARY OF COURSE

Semester	Course Type	Course Mode	No. of Course	Credits/ course	Marks/ Course	Total Credits	Total Marks
FIRST	Core	Theory	4	4	100	16	600
	Core	Practical	2	2	100	4	
SECOND	Core	Theory	4	4	100	16	600
	Core	Practical	2	2	100	4	
THIRD	Core	Theory	2	4	100	8	800
	Core	Practical	2	2	100	4	
	Elect.	Theory	2	4	100	8	
	Elect.	Practical	1	2	100	2	
	Core	Internship*	1	2	100	2	
FOURTH	Core	Project	1	14	200	14	300
	Elect.	MOOC**	1	2	100	2	
Grand Total						**80**	**2300**

Core course	:	Theory – 40 C, Practical- 12 C, Total – 52 C
Elective course	:	Theory – 08 C, Practical- 02 C, Total – 10 C
MOOC	:	02 C
Project	:	14 C
Internship	:	02 C
Grand Total	**:**	**80 C**

C- Credit point.

* Students shall undergo 3 months compulsory internship at SFSL/FSL/CEL/CFSL from May to July and classes of the month of July will be conducted through online mode and would be calculated to student's attendance. The evaluation of internship would be done by the supervisor at the Institute/Organizations of internship followed by post internship report presentation by students at the parent department and combined marks would be considered for credits.

** Students shall compulsorily register for at least one MOOC (Massive Open Online Courses) with a minimum of 2 credits at the beginning of the first semester and it needs to be completed before the fourth semester. The credit of such courses will be added to the transcript of the fourth semester.

*** Students shall compulsorily register and complete an Inter Department Elective (IDE) course with a minimum of 3 credits before the commencement of fourth semester.

SEMESTER-WISE DETAILS

FIRST SEMESTER

Code No. & Course	Course type	L-T-P	Credits	ESE Marks	CE Marks	Total Marks
24-358-0101- FUNDAMENTALS OF FORENSIC SCIENCE, CRIMINAL LAWS AND PSYCHOLOGY	Core	4-1-0	4	50	50	100
24-358-0102- CRIME SCENE INVESTIGATION, MANAGEMENT AND RECONSTRUCTION	Core	4-1-0	4	50	50	100
24-358-0103- INSTRUMENTAL TECHNIQUES	Core	4-1-0	4	50	50	100
24-358-0104- LABORATORY QUALITY MANAGEMENT, RESEARCH METHODOLOGY AND STATISTICS	Core	4-1-0	4	50	50	100
24-358-0105 - LABORATORY - FORENSIC SCIENCE AND CRIME SCENE INVESTIGATION	Core	0-0-4	2	50	50	100
24-358-0106- LABORATORY - INSTRUMENTAL TECHNIQUES, RESEARCH METHODOLOGY AND STATISTICS	Core	0-0-4	2	50	50	100
Total for First Semester			**20**	**300**	**300**	**600**

ESE-End Semester Evaluation, CE- Continuous Evaluation

SECOND SEMESTER

Code No. & Course	Course type	L-T-P	Credits	ESE Marks	CE Marks	Total Marks
24-358-0201- IMPRESSION EVIDENCES AND QUESTIONED DOCUMENTS	Core	4-1-0	4	50	50	100
24-358-0202- FORENSIC PHYSICS AND BALLISTICS	Core	4-1-0	4	50	50	100
24-358-0203- FORENSIC CHEMISTRY	Core	4-1-0	4	50	50	100
24-358-0204- FORENSIC BIOLOGY, SEROLOGY & DNA PROFILING	Core	4-1-0	4	50	50	100
24-358-0205- DIGITAL AND CYBER EVIDENCE AND LABORATORY	Core	3-0-2	4	50	50	100
24-358-0206- LABORATORY - QUESTIONED DOCUMENTS AND FORENSIC PHYSICS	Core	0-0-4	2	50	50	100
24-358-0207- LABORATORY - FORENSIC CHEMISTRY AND BIOLOGY	Core	0-0-4	2	50	50	100
Total for Second Semester			**24**	**350**	**350**	**700**

ESE-End Semester Evaluation, CE- Continuous Evaluation

THIRD SEMESTER

Code No. & Course	Course type	L-T-P	Credits	ESE Marks	CE Marks	Total Marks
24-358-0301- FORENSIC MEDICINE AND TOXICOLOGY	Core	4-1-0	4	50	50	100
24-358-0302- LABORATORY - FORENSIC MEDICINE AND TOXICOLOGY	Core	0-0-4	2	50	50	100
24-358-03XX- ELECTIVE 1	Elective	4-0-0	4	50	50	100
24-358-03XX-ELECTIVE 2	Elective	4-0-0	4	50	50	100
24-358-03YY-PRACTICALS ELECTIVE 1	Elective	0-0-4	2	50	50	100
LIST OF ELECTIVES(THEORY)						
24-358-0303- FORENSIC DERMATOGLYPHICS AND GRAPHOLOGY#	Elective	4-0-0	4	50	50	100
24-358-0304-FORENSIC ACCOUNTING#	Elective	4-0-0	4	50	50	100
24-358-0305- ADVANCED FORENSIC EXAMINATION OF PHYSICAL EVIDENCE AND BALLISTICS#	Elective	4-0-0	4	50	50	100
24-358-0306 - FORENSIC AUDIO VIDEO ANALYSIS#	Elective	4-0-0	4	50	50	100
24-358-0307– PHARMACOLOGY AND DRUG ANALYSIS#	Elective	4-0-0	4	50	50	100
24-358-0308-EXPLOSIVE ANALYSIS AND POST BLAST INVESTIGATION#	Elective	4-0-0	4	50	50	100
24-358-0309- ENVIRONMENTAL BIOTECHNOLOGY AND MICROBIAL FORENSICS#	Elective	4-0-0	4	50	50	100
24-358-0310-WILDLIFE FORENSICS AND ENTOMOLOGY#	Elective	4-0-0	4	50	50	100
24-358-0311- CYBER SECURITY AND DIGITAL FORENSICS#	Elective	4-0-0	4	50	50	100
24-358-0312-ETHICAL HACKING, RECOVERY FORENSIC AND DIGITAL IMAGE PROCESSING#	Elective	4-0-0	4	50	50	100
LIST OF PRACTICALS						
24-358-0313- LABORATORY - FORENSIC DERMATOGLYPHICS AND GRAPHOLOGY #	Elective	0-0-4	2	50	50	100
24-358-0314 - LABORATORY - PHYSICAL EVIDENCE AND BALLISTICS #	Elective	0-0-4	2	50	50	100
24-358-0315- LABORATORY - PHARMACOLOGY AND DRUG ANALYSIS #	Elective	0-0-4	2	50	50	100
24-358-0316- LABORATORY - ENVIRONMENTAL BIOTECHNOLOGY AND MICROBIAL FORENSICS #	Elective	0-0-4	2	50	50	100

24-358-0317- LABORATORY - CYBER SECURITY AND DIGITAL FORENSICS #	Elective	0-0-4	2	50	50	100
IDE	Elective	4-0-0	3	50	50	100
24-358- 0318 Internship **	Core		2	-	100	100
Total for Third Semester			**21**	**300**	**400**	**700**

ESE-End Semester Evaluation, CE- Continuous Evaluation, # only two Elective Courses and its corresponding practical need to be opted by the student.

BASIC ELIGIBILITY FOR SELECTING ELECTIVE COURSES:

24-358-0303 24-358-0304 24-358-0313	Students from all streams mentioned in the admission criteria of M.Sc. Forensic Science programme.
24-358-0305 24-358-0306 24-358-0314	Students should have studied Physics as a core/ complementary course for at least 2 semesters in the graduation level.
24-358-0307 24-358-0308 24-358-0315	Students should have studied Chemistry/ Biochemistry as a core/ complementary course for at least 2 semesters in the graduation level.
24-358-0309 24-358-0310 24-358-0316	Students should have studied Zoology/ Botany/ Chemistry/ Microbiology/Medical Microbiology/ Biochemistry/ Medical Biochemistry/ Biotechnology/ Genetics as core/ complementary courses for at least 2 semesters in the graduation level.
24-358-0311 24-358-0312 24-358-0317	Students should have studied Computer Science/ Information Technology as a core/ complementary course for at least 2 semesters in the graduation level.

*Students having B.Sc. Degree in Forensic Science/ B.Voc. Forensic Science/ B.Voc. Applied Microbiology & Forensic Science is eligible to select any of the Elective Courses as mentioned above.

*** Students shall undergo 3 months compulsory internship at SFSL/FSL/CEL/CFSL by availing summer vacation. The duration of internship will be from May to July and classes of the month of July will be conducted through online mode which includes special lectures of experts from forensic allied fields and would be calculated to student's attendance. The evaluation of internship would be done by the supervisor at the Institute/Organizations of internship followed by post internship report presentation by students at the parent department based on an assessment proforma issued by the Centre for Integrated Studies. Combined marks would be considered for credits.

FOURTH SEMESTER

Code No. & Course	Course type	L-T-P	Credits	ESE Marks	CE Marks	Total Marks
24-358-0401- PROJECT	Core	-	14	100	100	200
24-358-0402 MOOC*	Elective	-	2	100	-	100
Total for Fourth Semester			16	**200**	**100**	**300**

ESE-End Semester Evaluation, CE- Continuous Evaluation

***** Students shall compulsorily register for at least one MOOC (Massive Open Online Courses) with a minimum of 2 credits at the beginning of the first semester and it needs to be completed before the fourth semester. MOOC must be approved by the Department Council and a proof of satisfactory completion and marks/grade issued by the authority who conducted the course must be submitted to the Head of the Department. The credit of such courses will be added to the transcript of the fourth semester.

Professional Competency Course (PCC)

PCC is a 2-credit course and should be conducted during the second semester of the programme. The credit of the PC course will not be considered while calculating the SGPA/CGPA. But the student has to obtain minimum pass requirements in this course, which is compulsory for an overall pass in the programme.

One particular PCC may be selected for all the students in a batch in the department or each student in a batch may choose one PCC. The exact title of the course may be decided by the department and students can take any skill based courses approved by the department. Students are encouraged to take courses on professional communication & documentation, computer forensics tools, computer programming languages, data processing and analysis software, tools related to hardware/ network analysis, computer/ mobile operating systems, AI/ML, and cybersecurity & cyber law. Either a single faculty from the department may be in charge of this course for a batch or each student may be assigned to a particular faculty in the department, in charge of this PCC, which will be decided by the Department council/ HoD.

FIRST SEMESTER

24-358-0101- FUNDAMENTALS OF FORENSIC SCIENCE, CRIMINAL LAWS AND PSYCHOLOGY

COs	Course Outcome Statements	
CO1	Understand the significance of forensic science in society and the fundamental principles of forensic science and significance of various evidences.	K2
CO2	Students will explain the history and development and divisions and working of forensic science laboratory and duties of a Forensic Scientist.	K5
CO3	Understand Criminal Major & Minor Acts and about crime, causation and theories of crime, criminal justice system and Indian Constitution and Acts governing social legislations	K2
CO4	Understand about and crime scene management and use and the application of Forensic psychology and psychiatry	K2
CO5	Students will analyse and evaluate forensic photography techniques using simulated crime scenes	K5
K1– Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate		

Course Outcomes	Programme Specific Outcomes					
	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO1	**3**	**2**	**3**	**1**	**1**	**0**
CO2	**3**	**3**	**3**	**1**	**2**	**3**
CO3	**2**	**3**	**2**	**1**	**1**	**3**
CO4	**3**	**2**	**3**	**3**	**2**	**0**
CO5	**3**	**2**	**2**	**0**	**2**	**1**

Module I: Introduction to Forensic Science **(14 hrs)**

Forensic Science: Definition and Scope of Forensic Science, History and Development of Forensic Science, Laws and Basic principles of Forensic Science. Branches of forensic science, Forensic Science Laboratory: Organizational structure & services of state and central Forensic Science Laboratories in India (FSL,CFSL etc.). Services provided by other institutions (GEQD, FPB etc.). Mobile FSL- Role & Functioning. The forensic scientist: Education, training and code of conduct of forensic scientists. Forensic science in international perspectives, including set up of INTERPOL, FBI etc. Modern Concepts in Forensic Science.

Module II: Criminal law major & minor Acts and Indian Constitution (20 hrs)

Introduction, Comparison of new criminal laws with IPC CrPC and IEA. **The Bharatiya Nyaya Sanhita2023**: Relevant definitions and general explanations in S.2&3, S.20-24,63, 80,100,101,106,109-110,118-125, 178-185, 227-229,234,238-241, 274-276,303,309-310,318, 330,336. **The Bharatiya Nagarik Suraksha Sanhita 2023**: Relevant definitions, Hierarchy, power and basic procedure in criminal courts, Basic provisions related to FIR, Procedure for investigation, Arrest, Summons and warrant, S.194 ,196, 329. **The Bharatiya Sakshya Adhiniyam 2023**: Relevant definitions, S.22-23, 26, 39-41, 55-63,72-75, 140-143,159

Indian Constitution: Preamble, Fundamental Rights, Directive Principles of State Policy, Fundamental duties. Minor Acts and Special laws: Forensically relevant sections of NDPS Act 1985, Prevention of Food and Adulteration Act 1954, Drugs and Cosmetic Act 1940, Arms Act 1959, The Explosives Act 1884, Information Technology Act 2000,The Protection of Children from Sexual Offences Act (POCSOAct) 2012, Juvenile Justice (Care and Protection of Children) Act, 2015. Prevention of Domestic Violence Act 2005, Dowry Prohibition Act 1961.

Module III: Crime and Criminal Justice System (14 hrs)

Crime: Definition, Types of Crime, Causes of Crime, Schools of Criminology, Theories of Criminology, Punitive Aspects (Theories of punishment), Probation & Parole, Correctional Institutions. Victimology-Victim-Offender relationship, Types of Victims, post-crime effects on the victim, relief and compensatory aids, therapies, etc. **Criminal Justice System in India:** Structure and functional process. Courts: type, hierarchy and function. Role of police in criminal investigation and accountability to law, people and society. Custodial death, Police and Human Rights.

Module IV: Forensic Psychology and Psychiatry (12 hrs)

Forensic Psychology: Introduction, Functions and Role of Forensic Psychologist. Tests used in Forensic Psychology Assessment. Psychometric Tools used in Forensic Psychology, Psychological autopsy, Forensic Behavioural Analysis, Serial Killers, Modus operandi, Portrait Parle. **Forensic Psychiatry:** Introduction to different mental illness, Impulsive control stress disorder, Psychopathy and sociopathy, post-traumatic stress disorder and post-partum stress disorder, Tests for Insanity and Testamentary capacity.

Module V: Interrogation and Interviewing Techniques (12 hrs)

Polygraph/Lie Detector Test, Brain Fingerprinting/Brain-Mapping, Narco-analysis Admissibility in the court of law, NHRC guidelines, Indian scenario, case studies. Importance of Investigative Interviewing, P.E.A.C.E Model of Interviewing, Cognitive Interviewing, Ethical Interviewing, Other Interview Techniques. Interrogation and the related Techniques, Brain Electrical Oscillation

Signature Profiling (BEOS), Voice-Stress Analysis/ Layered Voice Analysis, reliability, Limitations, NHRC Guidelines, Admissibility on the Court, Case Studies.

Recommended Reading:

1. Houck, M.M & Siegel, J.A; Fundamentals of Forensic Science, Acadamic 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 Investigative Techniques, CRC Press, USA, 2003.
5. Saferstein; Criminalistics- An Introduction of Forensic Science, Prentice Hall Inc, USA,2007.
6. Barry, A.J. Fisher; Techniques of Crime Scene Investigation, 7th Ed, CRC Press, NewYork, 2003.
7. H.L. Blitzer and J.Jacobia; Forensic Digital Imaging and Photography, Academic Press, London, 2002
8. Swansan, C.R, Terrbles, L & Taylor,R.W; Police Administration, Prentice Hall, USA, 1998.
9. Lyman, M.D; Criminal Investigation – The Art & the Science, Prentice Hall, New Jersey, 2002.
10. O'Hara CE & Osterburg, JW; An Introduction to Criminalistics., Indiana University. Press, London, 1972.
11. The Indian Evidence Act,(1872), Amendment Act (2002); Universal Law Publishing Co., 2003.
12. The Code of Criminal Procedure (1973) Amendment Act, (2001); Universal Law Publishing Co., 2002.
13. Rattan Lal & Dhiraj Lal; The Indian Penal Code, 28th Ed. Wadhwa & Co. Nagpur, 2002.
14. D.A. Bronstein, Law for the Expert Witness, CRC Press, Boca Raton (1999).
15. Vipa P. Sarthi, Law of Evidence, 6th Edition, Eastern Book Co., Lucknow (2006).
16. A.S. Pillia, Criminal Law, 6th Edition, N.M. Tripathi Pvt Ltd., Mumbai (1983).
17. R.C. Nigam, Law of Crimes in India, Volume I, Asia Publishing House, New Delhi (1965).
18. (Chief Justice) M. Monir, Law of Evidence, 6th Edition, Universal Law Publishing Co. Pvt. Ltd., New Delhi (2002).
19. Krishna Mohan Mathur, (1994), *Indian Police, Role and Challenges*, Gyan Publishing House, New Delhi.
20. Morley, W.H., (1958), *Administration of Justice in India*, New Delhi, Metropolitan.

21. Nehad Ashraf, (1992), *Police and Policing in India*, Common Wealth Publishers, New Delhi.
22. Rosenbaum, Dennis P., Arthur J. Lurigio, and Robert C. Davis (1998). *The Prevention of Crime: Social and Situational Strategies*. Wadsworth Publishing. Belmont CA
23. Brendan Maguire & Polly F. Radosh, (1999), *Introduction to Criminology*, Wadsworth Publishing Company, Boston, U.S.A.
24. Reid Sue Titus, (2006). *Crime and Criminology*. Mc Graw Hill Publishers.
25. Edwin H. Sutherland and Donald R. Cressey (1974), *Principles of Criminology*, Lippincott, Philadelphia.
26. Williams, F.P. and McShane, M.D. (2004) *Criminological Theory*. Upper Saddle River, NJ: Prentice Hall.
27. John E.Conklin, J.E., (1981), *Criminology*, Macmillan, London.
28. Introduction to Forensic Psychology' by Bruce Arrigo
29. 'Forensic & Criminal Psychology' by Dennis Howitt.
30. 'Abnormal Psychology' by Halgin&Whitbourne.
31. 'Abnormal Psychology', by Robert C. Carson, James N. Butcher, Susan Mineka, Jill M. Hooley thirteenth Edition, Thirteenth Edition.
32. Mental Disorders and Treatment' by Katherine Marsland.
33. 'Handbook of Forensic Psychology' by Prof. Dr.VimalaVeeraraghavan.

24-358-0102- CRIME SCENE INVESTIGATION, MANAGEMENT AND RECONSTRUCTION

COs	Course Outcome Statements	
CO1	Understand about various physical evidence, collection packing and analysis.	K5
CO2	Students will understand and familiarize crime scene investigation and management techniques using simulated crime scenes	K2
CO3	Understand the crime scene reconstruction techniques .	K2
CO4	Critically discuss about the advanced forensic psychological techniques like polygraph, narco analysis and brain- mapping	K3
CO5	Understanding the legal validity of interrogation techniques using case studies	K2
K1– Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate		

Course Outcomes	Programme Specific Outcomes					
	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO1	**2**	**3**	**3**	**1**	**2**	**3**
CO2	**3**	**2**	**3**	**1**	**1**	**2**
CO3	**3**	**3**	**3**	**1**	**1**	**2**
CO4	**1**	**2**	**1**	**2**	**3**	**2**
CO5	**0**	**1**	**2**	**0**	**0**	**2**

Module I: Evidences **(14 hrs)**

Definition, types (testimonial and real evidence) (oral & circumstantial), understanding the nature of physical evidences. Transfer & Persistence, contamination. Forensic significance of physical evidences. Class and Individualization. Known and questioned items, Relationship and context. Collection, preservation, packing and forwarding of different types of evidences (Fingerprint, hair, fibre, glass, soil, Questioned documents, impression evidences, etc.) to the FSL. Comparison of evidence and controls, Analysis of evidence and Controls, Admissibility of scientific evidence, Frye case and Daubert standard. Ethics in forensic science. Report writing and Evidence evaluation: Components of reports and report format in respect of crime scene and laboratory findings.

Module II: Crime scene investigation **(18 hrs)**

Introduction, Types of Crime Scenes (Indoor, Outdoor, Mobile, Water). Various Crime Scenes (Homicide, Suicide, Accidental, Theft etc.). Crime scene protection and processing methodology-assessing, observing, documenting, searching, collecting, analyzing. Crime Scene Documentation (Sketching, Photography, Videography and Notes-taking). Digital imaging of crime scene and 3D scanning techniques. Various Crime Scene Search methods. Locating, Prioritize, Collection of probative value evidences and maintenance of chain of custody. Safety, Universal precautions for handling hazardous materials, personal protective equipment.

Module III: Introduction & Components of Crime Scene Management **(14 hrs)**

Information, Manpower, Technology & Equipment and Logistics Management. Role of various experts at crime scene. Security, safety and preservation of crime scene. Contamination control. Scene Survey and initial documentation. Co-ordination amongst various agencies involved in investigation. Co-ordination of Interstate investigation agencies. Case studies and report writing of crime scene visits. **Advances in crime scene management:** Tele forensic technology for crime scene investigation. Mobile kits and equipment, their utility on crime scene. Technology innovation in crime scene management. National and International scenario of crime scene management.

Module IV: Crime Scene Reconstruction **(14 hrs)**

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.). Role of Logic in CSR. Writing a reconstruction report. Correlation of crime scene analysis with behavioural analysis. Digital Aids in Reconstruction (3-D Photography/Videography, Computer aided Reconstruction). Blood spatter analysis: Historical perspective, Introduction, terminologies, biological and physical properties of human blood. Droplet dynamics- in-flight and on-impact, directionality, point of convergence and point of origin. Spatter Types, Altered bloodstain patterns, Artifactual bloodstain patterns. Documentation, Evaluation & importance of Bloodstain evidences. Manual and Computer-assisted reconstruction of BPA. Dealing with risks associated with blood-borne pathogens.

Module V: Forensic Photography **(12 hrs)**

Introduction, cameras and its working principle, attachments of camera, type of lenses, Crime scene and laboratory forensic photographic methods, Types of photography, Photomicrography and macro photography. Surveillance photography, Digital photography, Digital imaging, Photogrammetry, Juxtapose charts and demonstrative photographs. Significance of photography in Forensic Science. Use of photography in Crime scene reconstruction. Basic concept of videography/high speed videography.

Recommended Reading:

1. Houck, M.M & Siegel, J.A; Fundamentals of Forensic Science, Acadamic Press, London, 2006.
2. Sharma, B.R; Forensic Science in Criminal Investigation & Trials, Universal Publishing Co., New Delhi, 2003
3. James, S.H and Nordby, J.J; Forensic Science- An Introduction to Scientific and Investigative Techniques, CRC Press, USA, 2003.
4. Saferstein; Criminalistics- An Introduction of Forensic Science, Prentice Hall Inc, USA,2007.
5. Barry, A.J. Fisher; Techniques of Crime Scene Investigation, 7th Ed, CRC Press, NewYork, 2003.
6. Lyman, M.D; Criminal Investigation – The Art & the Science, Prentice Hall, New Jersey, 2002.
7. O'Hara CE & Osterburg, JW; An Introduction to Criminalistics., Indiana University. Press, London, 1972.
8. Ross M Gardner, Practical Crime Scene Analysis and Reconstruction (practical aspects of criminal and forensic investigation 2009.
9. Robert Ogle , Crime Scene Investigation and Reconstruction 2017.
10. W. Jerry Chisum, Brent E Turvey Crime reconstruction 2011.
11. Tom Bevel ,Blood Stain Pattern Analysis 2008.
12. Everett Baxter Jr. Complete Crime Scene Investigation 2022.
13. Fish Jacqueline Crime Scene Investigation Case Studies Tylor and Francis 2013.

24-358-0103- INSTRUMENTAL TECHNIQUES

COs	Course Outcome Statements	
CO1	Understand the use of analytical instruments used in forensic science laboratories.	K2
CO2	Understand the working principles and sample preparation techniques of various instruments.	K2
CO3	Understand different types of microscopy and spectroscopic techniques.	K2
CO4	Understand various biochemical, radiochemical and nuclear techniques used for forensic analysis.	K2
CO5	Explain the techniques and instrumentations used in biotechnology and molecular biology.	K4
K1– Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate		

Course Outcomes	Programme Specific Outcomes					
	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO1	**0**	**1**	**2**	**3**	**2**	**3**
CO2	**0**	**2**	**3**	**3**	**3**	**3**
CO3	**0**	**2**	**2**	**3**	**2**	**3**
CO4	**0**	**1**	**2**	**3**	**3**	**3**
CO5	**0**	**1**	**2**	**3**	**3**	**3**

Module I: Spectroscopic methods **(14 hrs)**

Electromagnetic radiations. General properties of electromagnetic radiations: Wave and Quantum mechanical properties, interaction of EMR with matter. Electronic spectra and molecular structure. Internal standards and standard addition, calibration methods. Ultraviolet and visible spectroscopy: Instrumentation and Applications. Infrared Spectroscopy: Molecular vibration, Theory of IR absorption, IR Sources and Instrumentation, FT-IR Applications. Raman Spectroscopy: Theory of Raman & FT-Raman spectroscopy, Instrumentation, Applications. Instrumentation and Applications of Flame emission spectrometry, Atomic absorption spectrometry and Atomic Fluorescence Spectrometry.

Module II: Emerging and Hyphenated Spectroscopy (14 hrs)

Mass Spectroscopy: Theory, Instrumentation and Applications. Inductively coupled plasma-Mass Spectroscopy: Theory, Instrumentation and Applications. X-Ray Spectroscopy: Theory, Types, Instrumentation, Applications and Applications. Nuclear Magnetic Resonance Spectroscopy: Theory, Instrumentation and Applications.

Module III: Separation and Detection Techniques (16 hrs)

Introduction to Chromatography: Partition, Adsorption, Ion exchange, Size Exclusion Chromatography, their principle and types of chromatography. Forensic applications of Chromatography. Gas Chromatography: Principle, instrumentation and applications. Gas-liquid and gas- solid chromatography, GC – MS, GC – MS – MS (Tandem). Gas Chromatography – Head Space: Principle, instrumentation and applications. High Performance Liquid Chromatography: Principle, instrumentation and applications, LC – MS, LC – MS – MS (Tandem). Electrophoretic technique: General principle, factors affecting electrophoresis, low voltage thin sheet electrophoresis, High voltage electrophoresis, Sodium Dodecyl Sulphate (SDS) polyacrylamide gel electrophoresis, Isoelectric focusing (IEF), Preparative electrophoresis, Horizontal and Vertical Electrophoresis.

Module IV: General Principles of Biology and Microscopy (12 hrs)

pH and Buffers, Physiological solution. Centrifugation Techniques- Basic principle of sedimentation, various types of centrifuges, Density Gradient Centrifugation, Preparative Centrifugation, analysis of sub-cellular fractions, Ultra centrifuge- Refrigerated Centrifuges. Microscopy- Basic principles of microscopy, Simple and Compound microscope; Comparison microscope, Phase contrast microscope, Stereoscopic microscope, Polarizing microscope, Fluorescence microscopy, IR microscopy, Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM).

Module V: Molecular Biology Techniques and Immunoassays (16 hrs)

Blotting and Hybridization techniques- Southern, Northern and Western blotting techniques, Dot and Slot blots, Molecular probes and hybridization. Polymerase Chain Reaction (PCR)- Basic PCR and its modifications: Inverse PCR, Anchored PCR, PCR for mutagenesis, Asymmetric PCR, Real time PCR and its applications, RACE, Applications of PCR in forensic science. Construction and screening of genomic and cDNA libraries. Gene silencing techniques, Animal Tissue Culture, Hybridoma and Monoclonal antibodies- Organ Culture, Cell cultures. Production of human and humanized antibodies, Uses of monoclonal antibodies. Immuno-chemical Technique, General principles, Production of antibodies, Precipitin reaction, Gel immune-diffusion, Immunoelectrophoresis, complement fixation, Radio Immuno Assay (RIA), Enzyme-linked Immuno Sorbent Assay (ELISA), Fluorescence immune assay.

Recommended reading:

1. D.A.Skoog, F.J.Holler and T.A.Neman, Harcoust Principles of Instrumental Analysis, College publishers, Singapore
2. G.D.Christian and J.E.O'Reilly, Instrumental Analysis, Allyn and Bacon, Inc., Boston.
3. F.W.Fifield and D.Kealey, Principles and practice of Analytical Chemistry, International Textbook Company, London.
4. R.P.Bauman, Absorption Spectroscopy, John Wiely, New York.
5. M.Donhrow, Instrumental Methods in Analytical Chemistry; Their Principles and practice Vol.2, optical method, Pitaman, New York.
6. G.G.Guilbanlt, Practical Fluorescence: Theory, Methods and Practice, Marcel Dekker, New York.
7. S.Udenfriend, Fluorescence Assay in Biology and Medicine, Academic Press, New York.
8. W.J.Price, Spectrochemical Analysis by Atomic Absorption, Hyden, London.
9. R.S.Alger, Electron Paramagnetic Resonance: Techniques and Applications, Interscience, New York.
10. Analytical Chemistry by open Learning, John Wiley & Sons, New York.
11. J.C.Giddings, Dynamics of Chromatography, Marcel Dekker, New York.
12. R.C.Grob, Modern Techniques of Gas Chromatography, Marcel Dekker, New York.
13. J.A.Dean, Chemical Separation Methods, BanNostrand Reinhold Co., New York.
14. R.E.Smith, Ion Chromatography Applications, C.R.C. Press, Inc., Boca Raton.
15. R.E.Smith, Supercritical Fluid Technology, C.R.C. Press, Inc., Boca Raton.
16. G.Zweig and J.R.Whitaker, Paper Chromatography and Electrophoresis, Academic Press, New York.
17. Walker J.M. & Rapley R. (2009). Molecular Biology and Biotechnology. UK, Royal Society of Chemistry.
18. Joshi A. R. (2002). A Textbook of Practical Biochemistry. India, B. Jain Publishers.

24-358-0104- LABORATORY QUALITY MANAGEMENT, RESEARCH METHODOLOGY AND STATISTICS

COs	Course Outcome Statements	
CO1	Explain the use of analytical standards used in forensic science laboratories.	K3
CO2	Understand the quality policies and accreditation process of a forensic science laboratory.	K2
CO3	Explain about the Laboratory Information Management System and laboratory safety.	K3
CO4	Understand the basics of research methodology.	K2
CO5	Understand the application of statistics in forensic science case works and research.	K2
K1– Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate		

Course Outcomes	Programme Specific Outcomes					
	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO1	**1**	**1**	**2**	**1**	**2**	**3**
CO2	**1**	**1**	**3**	**0**	**1**	**3**
CO3	**1**	**1**	**3**	**1**	**1**	**3**
CO4	**1**	**2**	**1**	**1**	**1**	**1**
CO5	**0**	**1**	**1**	**0**	**0**	**0**

Module I: Introduction to Chemical and Analytical standards (12 hrs)

Standards for analysis- Basic Chemical and Analytical standards, reference materials, high purity substances, certified reference materials, working standards. Matrix effect in standards. Biological standards, biochemical standard, microbial cell lines and standards

Module II: Quality Management and Laboratory Accreditation (12 hrs)

Introduction, quality system, plan, inspection and testing. Quality assurance training. Laboratory Accreditation – ISO 9000, ISO 14000, ISO 17000 series of standards, ISO/IEC 17025. Accreditation Boards – NABL guidelines for accreditation in India, Proficiency testing system, internal quality control, Inter and intra laboratory testing programmes.

Module III: Laboratory management system **(12 hrs)**

Type of laboratories, administration, laboratory design. Laboratory Information Management system (LIMS). Chain of custody of samples covered by the LAN system. Security system.
Validation and safety equipment.

Module IV: Research Methodology **(20 hrs)**

Development of hypothesis, formulation of objectives, Types of research- descriptive vs. analytical, applied vs. fundamental, quantitative vs. qualitative, conceptual vs. empirical. Literature search/ review, Impact factors of journals. Sampling methods and tools of data collection - Observation, interview schedule, questionnaire, and semantic differential. Report and thesis writing, oral and poster presentations. Intellectual property rights, copyright, plagiarism in scientific research & communications.

Module V: Statistics **(16 hrs)**

Types of data, basic concept of frequency distribution. Measure of central values- Mean, median and mode. Measure of dispersion- standard deviation. Probability- theory and definition of probability, Bayes theorem of probability, conditional probability and coincidence probability, probability-normal distribution. Regression and correlation analysis. Likelihood ratio, Multivariate analysis-PCA, factor analysis; Chi-square test, ANOVA, SPSS, Microsoft Excel, and open source software. Types of errors and interpretation of findings.

Recommended Reading:

1. Statistics and the evaluation of evidence for forensic scientists / Colin G.G. Aitken, Franco Taroni. 2nd ed. John Wiley & Sons Ltd., 2004.
2. Woodget, B. W. and Cooper, D.: Sample and Standards, ACOL Series, Wiley 1987.
3. Dux, J. P., HandBook of Quality Assurance for Analytical Chemistry Laboratory, Van Nostrand, 1986.
4. Duncan, W. L.: Total Quality: Key Terms and Concepts, 1995.
5. Shah, D. H.: QA Manual, Business Horizons, 2000.
6. Kumar, K.: Quality Management, ABD Pub., 2000.
7. Ross, J.: Total Quality Management, Vanity Book, Intl., 1995.
8. Seiler, J. P., Good Laboratory practice, Springer, 2000.
9. Diwan, P.,: Quality in Totality, Manager's Guide to TQM and ISO 9000, Deepti&Deepti Pub., 2000.
10. Gyani, G. J.,:Training Manual on ISO 9000; 2000 and TQM, Raj Pub., 1999
11. Olson, M. H. and Davis, G. B.: Management Information Systems, McGraw Hill, 1998.
12. Specific Guidelines for Accreditation of Forensic Science Laboratories, DST, 1998.

13. Guide for Safety in The Chemical Laboratory: Manufacturing Chemist's Association, 1972.
14. Steere N. V.(Ed.): HandBook of Laboratory Safety, CRC, 1967.
15. Tilstone, W. J. and Lothridge, K.: Crime Laboratory Management, Taylor and Francis, 2004.
16. Clair, J. S: Crime Laboratory Management, Academic Press, 2003.
17. Miller, J. C. and Miller, J. N.: Statistics for Analytical Chemistry, Ellis Horwood, 1988.Fisher, R. A.: Statistical Methods for Research Workers, John Wiley, 1954.
18. Sokal, R. R. and Rolf, F. J.: Biometry – Principles and Practices of Statistics in Biological Research, Freeman, 1981.
19. BhaskarRao T.: Methods of Biostatistics, Paras, 2001.
20. Rama Krishnan P., Biostatistics, Saras, 1995.
21. Rao,V.K., Biostatistics– A Manual of Statistical methods for use in Health, Nutrition and Anthropology, Jaypee Medical Pub., 1996.

24-358-0105- LABORATORY - FORENSIC SCIENCE AND CRIME SCENE INVESTIGATION

COs	Course Outcome Statements	
CO1	Students will gain knowledge about the importance of various forensic establishments in India and abroad.	K3
CO2	Students will gain knowledge of forensic science laboratories and duties of a Forensic Scientist.	K3
CO3	Analyse the FIR, Medico Legal report, portrait parle	K4
CO4	Analysing crime scene investigation through sketching, searching , photography and report writing	K4
CO5	Students will gain knowledge and demonstrate the process of collection and packing of various evidence	K5
K1– Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate		

Course Outcomes	Programme Specific Outcomes					
	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO1	**1**	**0**	**0**	**2**	**2**	**3**
CO2	**3**	**3**	**3**	**3**	**3**	**3**
CO3	**1**	**2**	**3**	**1**	**1**	**3**
CO4	**3**	**3**	**3**	**2**	**2**	**2**
CO5	**2**	**3**	**3**	**2**	**3**	**3**

1. Descriptive study of organizational structure of a forensic science laboratory (FSL & CFSL).
2. Report of the visit to the Police station/ Correctional institution .
3. Format of Medico legal report.
4. Format of FIR in a crime case.
5. Portrait Parle.
6. Antisocial Personality Disorder test.
7. Demonstration/ working of Polygraph: Testing of individuals.
8. Narco Analysis- Demo/ working/ principle/ framing questionnaire.
9. Brain mapping- Demo/ working/ principle/ interpretation of results.
10. Photography of indoor and outdoor crime scenes. Presentation of evidence through photographs and charts.

11. Document photographic techniques -close up photography, UV,IR, Transmitted and oblique light photography.
12. Photography of secret writing.
13. Crime scene investigation (indoor/outdoor/mobile/water)
14. Crime scene sketching (baseline method/polar coordinate method etc.)
15. Blood spatter analysis (height of fall, angle of impact, velocity etc.)
16. Crime scene reconstruction of various scenarios.
17. Collection and packing of various evidences.

Reference

1. DFS manual
2. Crime Scene Investigation and Reconstruction 4th Edition by Robert Ogle

24-358-0106- LABORATORY - INSTRUMENTAL TECHNIQUES, RESEARCH METHODOLOGY AND STATISTICS

COs	Course Outcome Statements	
CO1	Students will gain knowledge and demonstrate the biochemical techniques used for forensic analysis of chemical evidence.	K3
CO2	Students will gain knowledge and demonstrate the instrumental techniques used for the examination of biological evidence in forensic science.	K3
CO3	Students will gain knowledge on the basics of research methodology.	K3
CO4	Students will gain knowledge on the application of statistics in forensic science case works and research.	K3
K1– Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate		

Course Outcomes	Programme Specific Outcomes					
	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO1	**1**	**3**	**3**	**2**	**3**	**3**
CO2	**1**	**3**	**3**	**2**	**3**	**3**
CO3	**1**	**1**	**2**	**1**	**1**	**1**
CO4	**1**	**1**	**2**	**1**	**1**	**1**

1. Working principle of Simple, Compound and Comparison Microscope.
2. Determination of pH of biological fluids using pH meter.
3. Separation of DNA by electrophoresis.
4. Preliminary forensic examination of body fluids.
5. Microscopic and spectrophotometric examination of textile fabrics.
6. Microscopic examination of different body hairs.
7. Determination of refractive indices of glass and liquids.
8. Physical matching of cloth piece and/ or rope piece and/ or garments.
9. Experiments on UV absorption of drug/ dyes/ chemicals.
10. Experiments on IR spectroscopy of paints/ drugs/ organic compounds.
11. Comparison of polythene films by IR spectrophotometry.
12. Identification of drugs/ solvents by Gas Chromatography and Gas Chromatography – Mass Spectrometry (GC-MS).

13. Identification and Estimation of Volatile Substances by chemical and Gas Chromatography– Head Space technique (GC-HS).
14. Computation of measures of central tendency and dispersion in anthropometric data of school children.
15. Regression analysis and correlation analysis of a data of heights and weights of a group of students.
16. Construct frequency curve, frequency polygon, bar diagram, histogram and pie diagram using suitable data.
17. Designing of an experiment for the comparison of efficacy of a few diets on different types of animals by the method of ANOVA.
18. Regression analysis and correlation analysis of a data of heights and weights of a group of students.
19. Data analysis by SPSS.
20. Formulate a hypothesis of any scientific observation done by the student.

Reference

1. Kothari, C.R.. (2004). Research methodology : Methods and techniques (2nd revised edition). New Delhi: New Age International (P) Limited, Publishers.
2. Skoog, Douglas A. (1992). Principles of instrumental analysis. Fort Worth :Saunders College Pub.,
3. Alston, M. (2018). Research for Social Workers: An introduction to methods (4th ed.). Routledge. https://doi.org/10.4324/9781003117094

SECOND SEMESTER

24-358-0201- IMPRESSION EVIDENCES AND QUESTIONED DOCUMENTS

COs	Course Outcome Statements	
CO1	Understand the fundamental principles on which the science of fingerprinting is based.	K2
CO2	Describe the physical and chemical techniques of developing fingerprints on crime scene evidence.	K2, K3, K4
CO3	Describe the significance of foot, palm, ear and lip prints and the forensic application of biometrics	K2, K3
CO4	Understand the importance of examining questioned documents and tools required for examination of questioned documents.in crime cases.	K2, K3, K4
CO5	Understand the biometric evidences and its recent developments	K2,K3,K4
K1– Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate		

Course Outcomes	Programme Specific Outcomes					
	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO1	**2**	**3**	**3**	**3**	**2**	**1**
CO2	**2**	**3**	**3**	**1**	**3**	**3**
CO3	**2**	**3**	**3**	**1**	**3**	**3**
CO4	**2**	**3**	**3**	**1**	**3**	**3**
CO5	**1**	**2**	**3**	**2**	**1**	**3**

Module I: Questioned Documents **(16 hrs)**

Scope and importance of forensic document examination. Classification of documents. Procurements of standards- admitted/ specimen writings. Handling and packing of documents. Preliminary examination of documents. Physical matching of Documents. Introduction to Principles of hand writing & signature identification. Determination of sequence of strokes. Forgeries and its types and their detections. Examination of alterations, erasers, overwriting, addition and obliterations. Decipherment of secret, indented and charred documents. Photography of questioned documents. Examination of counterfeit currency notes, passport, credit card, visa, seal and other mechanical impressions. Examination of typescripts, xerox and computer printouts, Instrumental techniques used for document examinations. Document Expert in trial court.

Module II: Fingerprints and Developing Techniques (16 hrs)

History of Fingerprint Science, main function of FPB. Development of Fingerprint Science. Composition of sweat and secretion of sweat. Classification: Pattern types and Ridge characteristics. Ridge tracing, Ridge counting. Various systems for Fingerprint classification. Henry classification system, numerical value, symbol, primary classification, secondary classification, sub-secondary classification and final classification, NCIC classification, AFIS classification. Development, Identification and Presentation of Fingerprint. Known prints and rolled impressions,
Direct or Inked prints. Development of Latent Prints and Lifting techniques. Physical and chemical Methods: Powder techniques & various chemical techniques, Processing of Post developed prints. Fingerprint comparison and Identification. Introduction to AFIS.

Module III: Impression evidences (14 hrs)

Types of Impression Evidence, Significance of Impression Evidence. Foot impression and developing techniques. Footwear Impressions (General Characteristic). Casting 3 Dimensional Footwear impressions. Comparison of footwear impressions. Tire Impressions Evidence, skid mark, Serial numbers restoration. Lip Prints, Ear Prints, Bite marks-Nature, Location, Types, Classification. Development, Lifting, Evaluation, Analysis, Minutiae Identification and comparison with reference/control sample(s), Forensic Significance.

Module IV: Tool marks and Tyre marks (14 hrs)

Tire Impressions Evidence, COLLECTION and preservation, forensic examination and comparison techniques. Skid mark. Tool marks, various types, Development, Lifting, Evaluation, Analysis. Serial numbers restoration. Forensic examination of cables, cut wires, locks, keys, real and imitation, jewelry, tungsten filaments, seals (postal, metallic), fuse, fuse wire, construction materials and debris, duplicate labels- container identification.

Module V: Biometrics (12 hrs)

Biometric evidence such as finger impressions, retina, iris pattern, voice, gait pattern. Face recognition, 3D face recognition, Geometric Morphometrics, automatic forensic dental identification, hand vascular pattern technology, Multibiometric systems. Recent developments, biometric databases.

Recommended Reading:

1. Wood Ordway Hilton; Scientific Examination of Questioned Documents. Revised Edition, Elsevier, NY (1982).
2. Albert S. Osborn; Questioned Documents, 2nd Ed., universal Law Pub., Delhi (1998).
3. Albert S Osborn; The Problem of Proof, 2nd Ed., Universal Law Pub. Delhi (1998).

4. Charles C. Thomas; I.S.Q.D. Identification System for Questioned Documents, Billy Prior Bates Springfield, Illinois, USA (1971).
5. Wilson R. Harrison; Suspect Documents Their Scientific Examination, Universal Law Pub. Delhi Indian Reprint (2001).
6. Hard less H.R; Disputed Documents. Handwriting and Thumb – Print Identification, profusely illustrated, Law Book, Allahabad (1988).
7. Morris Ron N; Forensic Handwriting Identification, Acad Press, London (2001).
8. Kurtz Sheila; Graphotypes a new Plant on Handwriting Analysis, Crown Pub. Inc., USA (1983).
9. Lerinson Jay; Questioned Documents, Acad Press, London (2001) Vacca John R;
10. Computer Forensics- Computer crime scene Investigation, Firewall Medial, An imprint of Laxmi Pub(2002).
11. Casey Eoghan; Handbook of computer crime Investigation, Forensic Tools & Technology- Academic Press (2002).
12. Ellen Davin; Questioned Documents – Scientific Examination, Taylor & Francis, Washington (1997).
13. Roy A Huber, AM Headrick, Handwriting Identification-Facts & Fundamental, CRC Press (1999).
14. Andrea Mc Nichol, Jeffrey A Nelson; Handwriting Analysis Putting it to work for you, Jaico Books, Delhi (1994).
15. Morris (2000); Forensic Handwriting Identification (fundamental concepts & Principals).
16. Madinger J & Zalopany AR; (1999) -Money Laundering- CRC Press.
17. Manning CA;(1999) -Financial Investigation & Forensic Accounting- CRC Press.
18. Brewster F.; Contested Documents and Forgeries," The Eastern Law House, Kolkata.
19. Quirke AJ; Forged Anonymous & Suspect Documents- 1930, Reorge Rontledge & Sons Ltd, London.
20. Katherine M Kappenhaver, CDE-Forensic Document Examination-Humana Press.
21. Jan Seaman Kelly & Brian S Lindblom-Scientific Examination of Questioned DocumentsTaylor Francis Group London and New York.
22. Iannavelli, A.V; Ear Identification, Forensic Identification Series, Paramount, (1989).
23. 21.Jain, A.K., Flynn, P & Ross A.A., Handbook of Biometrics, Springer, New York (2008).
24. Saferstein, R; Forensic Science Handbook. Vol. I, II, (Ed.), Prentice Hall, New Jersey, 1988.
25. Houck, M.M & Siegel, J.A; Fundamentals of Forensic Science, Acadamic Press, London, 2006.
26. Sharma, B.R; Forensic Science in Criminal Investigation & Trials, Universal Publishing Co., New Delhi, 2003

27. James, S.H and Nordby, J.J; Forensic Science- An Introduction to Scientific and Investigative Techniques, CRC Press, USA, 2003.
28. Saferstein; Criminalistics- An Introduction of Forensic Science, Prentice Hall Inc, USA,2007.
29. Barry, A.J. Fisher; Techniques of Crime Scene Investigation, 7th Ed, CRC Press, NewYork, 2003

24-358-0202- FORENSIC PHYSICS AND BALLISTICS

COs	Course Outcome Statements	
CO1	Describe different types of firearms and ammunitions.	K4
CO2	Describe the importance of fiber, soil, glass, paint and other physical evidence in crime cases and its basic examinations.	K4
CO3	Understanding IBIS,BDAS etc.	K2
CO4	Understand the importance of analysis audio video in crime cases.	K2
CO5	Understand the forensic analysis of firearm evidence- GSR and the concept of wound ballistics	K2
K1– Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate		

Course Outcomes	Programme Specific Outcomes					
	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO1	**1**	**3**	**3**	**2**	**1**	**3**
CO2	**1**	**3**	**3**	**2**	**1**	**3**
CO3	**0**	**3**	**3**	**2**	**2**	**3**
CO4	**1**	**3**	**3**	**2**	**2**	**3**
CO5	**1**	**3**	**3**	**2**	**2**	**3**

Module I: Glass and Fiber Evidence **(14 hrs)**

Introduction to glass, Types of glass and their compositions, Forensic examination of glass fractures under different conditions, determination of direction of impact: hackle marks, backward fragmentation. Physical measurements of glass, colour and fluorescence, physical matching, density comparison, physical measurements, refractive index by refractometer, elemental analysis, and interpretation of glass evidence, Case studies. Types of fibres (Natural & Artificial), Chemical and Instrumental analysis of paint, interpretation of Paint Evidence, Case studies.

Module II: Soil and Paint Evidence **(12 hrs)**

Soil and its composition, Classification of soil, Collection and preservation of soil as evidence. Analysis of soil samples: Physical, chemical and instrumental, interpretation of soil evidence, Case studies. Introduction, Composition, Manufacture of Paint; Types of paint. Forensic Examination of Paints and Coatings: Collection and Preservation of paint samples, macroscopic and microscopic techniques for the characterization of Paint Fragments, Physical. Chemical and Instrumental analysis of paint, interpretation of Paint Evidence, Case studies.

Module III: Firearms, Ammunition and Ballistics (18hrs)

Characteristics and classification of firearms, History and background of firearms, Functional assembly and Operating principle of firearms. Characteristics and Working mechanism of Standard: Rifled firearms, Small arms, Shotguns and Non-standard: Improvised, Country made, Imitative firearms, identification of origin. Types of ammunitions- classification and constructional features of different types of cartridges, types of primers and priming composition, propellants and their compositions, velocity and pressure characteristics under different conditions, various types of bullets and compositional aspects. Safety aspects for handling firearms and ammunition, cartridgefiring mechanism. Ballistics: Internal ballistics: General elementary and other principle problems: Heat problems, Pressure, Recoil, Vibration and 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 and phenomenon involved: threshold velocity for penetration of skin / flash / bones, Nature of wound of entry and exit wound, Characterization and evaluation of injuries depending upon Range, Velocity, Projectile Types, Firearm types, etc.

Module IV: Examination of Firearm Evidence (14 hrs)

Identification of firearms, ammunition and their components: Principles, Processing of Firearm Exhibits involved, Class characteristics and Individual characteristics (Identifiable marks) produced during firing process on cartridge cases and projectiles and their linkage with firearms. GSR – Composition of GSR, Location & Collection, Mechanism of formation, Chemical and Instrumental techniques involved in analysis, Shooter Identification technique. Determination of range of fire and its related phenomena, Techniques involved in ballistic studies, Stereo and comparison microscopy, BDAS, IBIS.

Module V: Audio - Video Analysis (14 hrs)

Speaker Identification and tape authentication. Voice production theory, speech signal processing and pattern recognition, acoustic parameters of sound, analogue to digital conversion, Frequency and time domain representation of speech signal, fast Fourier transform. Authentication of audiovideo signal, Interpretation of voice evidence and Case studies. Introduction to video technology. Forensic analysis of audio/video in video recording: Authentication of video recording, Visual examination technique on video frame sequence, Video image analysis- object, costumes, Facial image recognition from video frame image, Video signal analysis.

Recommended reading:

1. Caddy, B; Forensic Examination of Glass and Paint Analysis and Interpretation, CRC Press, New York, 2001.
2. Shaw, D; Physics in the Prevention and Detection of Crime, Contem Phys. Vol.17, 1976.
3. Saferstein, R; Forensic Science Handbook. Vol. I, II, (Ed.), Prentice Hall, New Jersey, 1988.
4. Working Procedure Manual; Physics BPR & D Publication, 2000.
5. Sharma, B.R; Forensic Science in Criminal Investigation and Trials (3rd Ed.), Universal Law Publishing Co., New Delhi, 2001.
6. Hess, K.P; Textile Fibers and their Use, 6th Edn, Oxford and IBH Publishing Co., 1974.
7. Philip Rose; Forensic Speaker Identification; Taylor and Francis Forensic Science Series, London.
8. Bengold & Nelson Moryson- Speech and Audio signal processing; John Wiley & Sons, USA,
9. Raymond C Murray & John C.F Tedrew; Forensic Geology; Prentice Hall, New Jersey.
10. B. Caddy; Forensic Examination of glass and paints analysis and interpretation, ISBN 0784 05749.
11. Philip Rose; Forensic Speaker Identification; Taylor & Francis Forensic Science series, London.
12. Bengold & Nelson Morgan; Speech and Audio Signal Processing; John Wiley and Sons, USA.
13. Ray D. Kent and Charles Read; Acoustic analysis of speech.
14. Phil Rose & James R Robertson; Forensic speaker identification.
15. J. Howard Mathews; Charles C. Thomas, Firearms Identification, Vols. 1, 2, & 3; Springfield, Illinois.
16. Hatcher, Jury And Weller, Firearms Investigation, Identification And Evidence; Stackpole Books, Harrisburg, P A
17. Vincent Di Maio, Gunshot Wounds; CRC Press, Washington, Dc.
18. Brain J. Heard; Hand Book of Firearms And Ballistics; John Willey, England.
19. TA, Warlow; Firearms, The Law And Forensic Ballistics; Taylor And Francis, London.
20. Karl G. Sellier et al.; Wound Ballistics and the Scientific Background; Elsevier, London.
21. M. Johari, Identification of Firearms, Ammunition and Firearms Injuries; BPR&D, New Delhi.

22. L V. Hogg; The Cartridges Guide - A Small Arms Ammunition Identification Manual; The Stackpole Co., Harrisburg, P A.
23. Gary J. Ordog, Management of Gunshot Wounds, Elsevier, New York.
24. Working Procedures Manual: Ballistics, BPR&D Pub.
25. D.B. Fry; The Physics of Speech, Cambridge University Press. (2004)
26. David Cheshire; The Complete Book of Video Techniques Subjects Equipment, Dorling Kindersley, London (1992)
27. Des Lyver & Graham Swainson; Basics of Video Production, 2nd Ed. Focal Press (1999)
28. Dwight Bolinger et. al.; Aspects of Language, Third Edition, Harcourt Brace Jovanovich College Publishers, USA. (1981)
29. Gloria J. Borden et. al. Speech Science Primer (Physiology, Acoustics and perception of Speech), 6th Ed, a Wolters Kluwer Company, USA. (2011)
30. Harry Hollien; Forensic Voice Identification, Academic Press, London. (2001)
31. Harry Hollien; The Acoustics of Crime- The New Science of Forensic Phonetics, Plenum Press, New York and London (1990)

24-358-0203- FORENSIC CHEMISTRY

COs	Course Outcome Statements	
CO1	Explain the substances involved in forensic chemistry (liquor, drugs, etc.) and its examination.	K3
CO2	Explain different types of poisons, its mode of action, symptoms of poisoning and role of forensic toxicologist.	K4
CO3	Understand about arson, cycle of fire and explosives, various IEDs and its forensic investigation.	K2
CO4	Explain about the adulterants in food products, cement, petroleum and pharmaceutical products and its forensic examination.	K4
CO5	Understand various biochemical, radiochemical and nuclear techniques used for forensic analysis of chemical evidence.	K2
K1– Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate		

Course Outcomes	Programme Specific Outcomes					
	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO1	**1**	**3**	**3**	**2**	**1**	**3**
CO2	**0**	**3**	**3**	**2**	**2**	**3**
CO3	**1**	**3**	**3**	**1**	**1**	**3**
CO4	**1**	**3**	**3**	**2**	**1**	**3**
CO5	**1**	**3**	**3**	**2**	**2**	**3**

Module I: Arson and Explosives **(12 hrs)**

Introduction to Arson, Types of Fires, and Causes of fire, Patterns of fire. Liquid and solid incendiaries, Analysis of Fire Debris, Petroleum products. Classification and chemistry of explosives. Various types of IEDs and their reconstruction. Mechanism of explosion and their effects. Examination of explosive and explosion residues.

Module II: Narcotic Drug and Psychotropic substances **(16 hrs)**

Introduction to Controlled drugs and Substances, Classification of controlled substances. Narcotic Drugs and psychotropic substances as under NDPS Act. Commonly abused drugs, Designer Drugs. Drugs of abuse in sports, Date rape drugs and their forensic examination, Types of cases/exhibits, preliminary screening, presumptive test, inorganic analysis, micro-chemical methods of analysis, Examination procedures involving standard methods and instrumental techniques, Drug

dependence and Drug Tolerance. Alcoholic and Non-alcoholic beverages: country made liquor, illicit liquor and medicinal preparations containing alcohol and drugs as constituents. Types of cases/exhibits, preliminary screening, presumptive test, inorganic analysis, micro-chemical methods and instrumental. Analysis. Forensic significance of non-alcoholic beverages.

Module III: Application of forensic chemistry in adulteration (18 hrs)

Introduction to adulteration, type of adulterant cases, Volatile and non-volatile adulterants. Introduction to petroleum products and adulteration in petroleum products. Analysis of Petrol, Kerosene and Diesel as per BIS Specifications. Adulteration of alcoholic and non-alcoholic beverages, food stuffs, cosmetics etc. Organic and inorganic Industrial products, chemical fertilizers, pesticides, insecticides, metallic and non- metallic products. Collection, packing, preservation, extraction and analysis of samples.

Module IV: Miscellaneous Chemical Evidences (12 hrs)

Bribe Trap Cases: Examination of Chemicals used in bribe trap cases. Inks: Forensic Examination of inks by various techniques, Dating and aging of inks. Polymers: Forensic examination of plastics and adhesives. Introduction to classification and forensic analysis of dyes. Forensic importance of environmental toxicology.

Module V: Forensic Nanotechnology (14 hrs)

Introduction to forensic nanotechnology, application in forensic investigation, role in preventive forensic. Introduction to forensic engineering, structural failures, determination of adulterants, analysis of bitumen and road materials. Forensic analysis of cement- mortar, concrete. Introduction to nuclear Forensics, Nuclear threats, nuclear explosive devices, Radio activity, method of detection and measurement of radio actives. Application of radioisotopes. Instrumental techniques in nuclear forensic chemistry.

Recommended reading:

1. Curry: Analytical Methods in Human Toxicology, Part II, 1986.
2. Curtis Klaassen, Casarett & Doll Toxicology: The Basic Science of poisons, 8th Edtion, Mc Graw Hill,2013
3. Moffat, A.C.: Osselton, D. M. Widdop, B.: Clarke's Analysis of Drugs and Poisons in Pharmaceuticals, body fluids and postmortem material, 3rd ed., Pharmaceutical Press,2004.
4. Holfmann, F.G.: Handbook of Drug and Alcohol Abuse.
5. Reject Paul. M.P, Forensic Toxicology, SSBT, New Delhi, 2009
6. Sunshine, I: Guidelines for Analytical Toxicology Programme, Vol-I, CRC press, 1950.
7. Sunshine, I: Handbook of Analytical Toxicology, press, 1969.
8. Mule, S. J. et al.: Immunoassays for Drugs subjects to ab, CRC Press, 1974.
9. Connors, K.: A text book of Pharmaceuticals analysis, Interscience, New York, 1975.

10. Niesink, RJM; Toxicology- Principles and Applications, CRC Press, 1996.
11. Jaisingh P Modi, A Textbook of Medical Jurisprudence and Toxicology ,Edited by Justice K Kannan,26th Edition,2019,LexisNexis .
12. Morrison R.T and Boyd R. N; Organic Chemistry 6th Ed Prentice Hall, 2003.
13. Laboratory procedure Manual, Forensic Toxicology: Directorate of Forensic Science, MHA, Govt. of India, 2005.
14. Laboratory Procedure Manual: Petroleum Products, Directorate of Forensic Science, MHA, Govt. of India, 2005.
15. Working Procedure Manual on Chemistry; Directorate of Forensic Science MHA Govt. of India, 2005.
16. Welcher F; Standard Methods of Chemical Analysis, 6th Ed.Van Nostrand Reinhold, New York, 1969.
17. Watson C. A; Official and Standardised Methods of Analysis, Royal Society of Chemistry, UK, 1994.
18. Roger Brown; Hand book of polymer testing-Physical methods Marcel Dekker 1999
19. Narayan T V Modern techniques of bomb detection and disposal 1995
20. H J Arnikar Essentials of nuclear chemistry 1987
21. H J M Bowen chemical application of radio isotopes 1969
22. G Friedlander introduction to nuclear and radiochemistry 1981
23. P D Vowels and D W experiments in environmental chemistry

24-358-0204- FORENSIC BIOLOGY, SEROLOGY & DNA PROFILING

COs	Course Outcome Statements	
CO1	Explain about different body fluids and its forensic importance.	K3
CO2	Explain about hair, diatoms, entomology and its forensic importance.	K4
CO3	Understand about the causes of death and medico legal examination of unnatural deaths.	K2
CO4	Explain about DNA and its forensic significance.	K4
CO5	Understand about structure of cell, DNA, basic concept of anatomy and physiology of the human body.	K2
K1– Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate		

Course Outcomes	Programme Specific Outcomes					
	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO1	**2**	**3**	**3**	**2**	**2**	**3**
CO2	**1**	**2**	**2**	**1**	**1**	**3**
CO3	**1**	**3**	**3**	**2**	**2**	**3**
CO4	**2**	**3**	**3**	**2**	**1**	**3**
CO5	**0**	**3**	**3**	**2**	**3**	**3**

Module I: Body fluids, Cell biology, Physiology and Biotechnology (16 hrs)

Types, distribution, Composition and function of forensically relevant biological fluids and cells. Blood and its variants: Blood composition, Blood cell antigens, Forensic significance of ABO blood group, Hb blood group, Rh blood group, Kell blood group, Duffy blood group, Kidd blood group, Diego blood group, MNS blood group, etc. origin, grouping, etc. Forensic collection, packing and examination of body fluids. and cells. Structure and function of cell – Plant cell and animal cell. Cellular organelles. Chromosomes, structure of DNA and RNA, Abnormalities. Basics of Human anatomy and physiology. Basics of forensic microbiology. Bio chemistry- structure and functional group properties of amino acids, protein and peptides, carbohydrates, lipids, fatty acids etc.

Module II: Forensic DNA Analysis **(16 hrs)**

Sources of DNA, extraction/ isolation of DNA from stains, tissues, hair, nails, buccal swabs, blood, semen and other samples. FTA cards for isolation of DNA. DNA typing systems – length polymorphisms, short tandem repeats and single nucleotide polymorphisms. Introduction to DNA profiling. Introduction to mitochondrial DNA and its forensic importance.

Module III: Forensic Anthropology and Odontology **(14 hrs)**

Anthropology Introduction: The human skeleton, Collecting Human remains, analysis of skeleton materials, facial reproductions, Interpretations, case studies. Sex, age, race, and stature estimation from long bones, mandible and sternum. Facial Reconstruction 2-D, 3-D, etc. Definition and Scope of Forensic Odontology, Types of dentition, Basic structure of human teeth, types of teeth & their morphology, and determination of age from teeth using various methods, dental anomalies and their role in Personal Identification.

Module IV: Forensic Palynology and Diatom Analysis **(12 hrs)**

Methods of identification and comparison, various types of planktons and diatoms and their forensic importance; Limnology, Diatoms types and morphology, methods of isolation from different tissues. Study and identification of pollen grains. Introduction to marine forensics. Introduction to microbial forensics.

Module V: Botanical Evidences and Wildlife Forensic **(14 hrs)**

Introduction to forensic Botany and Wildlife forensic. Various types of woods. Varieties of timber, seeds and leaves – their identification and matching. Study and identification of pollen grains, starch grains. paper and pulp identification. Morphological and anatomical characteristics of plants yielding drugs of abuse like opium, Cannabis, Coca plant, Psilocybin mushrooms, Tobacco, etc. Endangered and rare species- examination of physical evidence like hair, nails, teeth, ivory, horn, footprints (pugmarks) etc. by conventional and modern methods. Wild Life Protection Act, case studies. Morphological, anatomical and microscopic examination of hair- human and animal. Characteristics of hair to determine the species origin, race, sex and site; case studies. Forensic entomology.

Recommended Reading:

1. Mclay, W.D.S; Clinical forensic medicine, Cambridge University Press, London, 1990.
2. Shepherd, R; Simpson‟s forensic medicine, Oxford University press, London, 2003.
3. Mant, A.K; Taylor‟s priniciples & practice of medical jurisprudence, Wingking Tong company ltd., Hong Kong, 2003
4. Maio, D.J. & Maio V.J; Forensic pathology, CRC press, Costa Rica, 1993.
5. Wecht, C.H; Legal medicine annual, Academic Press Publisher, Massachussets, 1970.
6. Polson C.H; Essentials of forensic medicine, Pergamon press, London, 1973.

7. Lahiri, S.K; Elements of medical jurisprudence, Prabasi press, Calcutta, 1973.
8. Flzinga, R.J; Fundamentals of Entomology, Prentice Hall of India pvt ltd, New Delhi, 1978.
9. Smith, D.G.V; A manual of Forensic Entomology, Ithaca New York Camstock Univ. Press, New York, 1986.
10. Byrd, J.H. & Castner, J.L; Forensic Entomology, The utility of Anthropods in legal Investigation, CRC Press, New York, 2000.
11. Harvey, Warren; Dental identification and forensic, Henry Kimption Publishers, (1976).
12. Singh, Inderbir; Human Osteology, Jayee Brothers, (2004).
13. Joseph, J; Human Osteology, Jaypee Brothers, (1996).
14. Marion, Krogman Wilton; Human skeleton in forensic medicine, Charles C Thomas, (1986).
15. Singh, Inderbir; Textbook of human osteology, Jaypee Brothers, (2002).
16. P.L. Williams & R. Warwick; Gray‟ Anatomy, Churchill Livingston, London,(1980).
17. Krogman, W.M.. The Human Skeleton in Forensic Medicine, Chalres C Thomas, Springfield, (1973).
18. K.J. Reich; Forensic Osteology: Advances in the identification of Human remains, Charles C Thomas, (1998).
19. William M. Bass;Human Osteology: A Laboratory and Field Manual, Missouri Archaeological Society (1995).
20. Reddy,V.R; Dental Anthropology, Inter-India Publication, New Delhi, 1985.
21. Kroeber; Anthropology, Oxford & IBH Publishing Company, New Delhi, 1972.
22. Pickering, R. & Bachman D; The use of Forensic Anthropology, CRC Press, Costa Rica, 2009.
23. Bose, N K; Anthropology, Narayana Press, Denmark, 1972.
24. James, R; Forensic examination of hair, Taylor & Francis, 2ND Ed. London, 1999.
25. Shubhra, G; Introduction to forensic examination, Selective Scientific Books, New Delhi, 2008. Michael, W. Haney, H.A. & Freas, L.E; The Forensic Anthropology Laboratory, CRC Press, 2008. Brown, T; Gene cloning and DNA analysis: An Introduction , 5th ed. Blackwell publishing, London, 2006.
26. Butler, J; Advanced Topics in Forensic DNA Typing: Methodology, 1st Ed., Academic Press, London, 2009.
27. Easteal, S. McLeod, N. & Reed, K; DNA Profiling: Principles, Pitfalls and Potential, Harwood Academic Publishers, New Jersey, 1991.
28. Primorac, D.& Schanfield, M; Forensic DNA Applications: An Interdisciplinary Perspective, CRC Press, New York, 2014.
29. Rudin, N. & Inman, K; An Introduction to Forensic DNA Analysis, Second Ed.,CRC press, New York, 2001.
30. Spencer, C; Genetic testimony: a guide to forensic DNA profiling, Pearson, New Delhi, 2004.
31. Eveleth, P.B. & Tanner, J.M; Worldwide Variation in Human Growth, Cambridge University Press, London, 1976.

24-358-0205- DIGITAL AND CYBER EVIDENCE AND LABORATORY

COs	Course Outcome Statements	
CO1	Explain the basics of the architecture of personal computers.	K3
CO2	Explain the basics and tools used in digital forensics.	K3
CO3	Explain the basics of digital networks in communication technology.	K3
CO4	Understand about web browsers and email tracking methodology.	K2
CO5	Understand the basics of smart phones and its forensic examination.	K2
K1– Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate		

Course Outcomes	Programme Specific Outcomes					
	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO1	**0**	**1**	**1**	**2**	**1**	**1**
CO2	**0**	**1**	**1**	**2**	**2**	**3**
CO3	**0**	**2**	**2**	**2**	**2**	**3**
CO4	**0**	**3**	**3**	**3**	**3**	**3**
CO5	**0**	**3**	**3**	**3**	**3**	**3**

Module I: Computer System Architecture **(14 hrs)**

CPU, Multiprocessing, Operating System Components, Memory Types, Virtual Memory, Input and Output Devices, Block diagram of a generic computer. File Systems- Types and components. Computer booting process. Computer memory – Volatile and Non-Volatile Memory. Basic Input and Output System (BIOS), and System Applications. Types of Storage Media – Hard Drive, SSD, Optical Devices.

Module II: Introduction to Network and Communication Technology **(14 hrs)**

Overview of OSI model and TCP/IP protocol. Network Address and NAT, Monitoring Network activities, searching for evidence from the network. Live Packet Capturing and Analysis. Routers and Routing Protocols, Routing Table Poisoning, Denial of Service Attack (DOS), Distributed Denial of Service Attack (DDOS) and Wireless Attacks. Web Browsers, Cookies, Favourites or

Bookmarks, Cache, Session Data and Plugins. Email: Types of Email and Protocols. Analyzing the Header details and tracking the email, Spoofed Emails.

Module III: Digital Forensics (16 hrs)

Principles of Digital Forensics. Collection of Evidence- Single System, Networked System and Remote System. Digital Forensic Software and Hardware tools – Proprietary and Open Source Tools. Imaging and Analysis of Storage Media – Tools and Techniques. Computers facilitated crimes and reasons for attacks. Rules of Digital Forensic, Standard Operating Procedure (SOP) of Digital Crime Scene. Incident response tools and techniques. Search and Seizure of Volatile and Non-Volatile Data. Imaging and Hashing Digital Evidence. Analysing and recovering deleted files and folders.

Module IV: Artificial Intelligence in Forensic Science (14 hrs)

Introduction to Artificial Intelligence in Forensics, Machine Learning Algorithms for Forensic Analysis. Neural Networks in Forensic Investigations, AI-based Image and Video Analysis in Forensics, Natural Language Processing for Forensic Text Analysis, AI for Cybercrime Detection and Prevention, AI Techniques for Fraud Detection and Financial Forensics, Deep Learning for Facial Recognition and Biometric Analysis, AI in Digital Forensics and Data Recovery, Ethical and Legal Considerations of AI in Forensics. Introduction to drone forensics.

Module V: Forensic Analysis of Smartphones (14 hrs)

Types of Smartphones and the Operating Systems. Collection and Preservation of Mobile Phone and PDA. Analyzing mobile phone evidence, Rooting and Jailbreaking. Virtual Machine and Cloud Technology Forensics.

Recommended reading:

1. Miller M.: Absolute Beginner's Guide to Computer Basics (5th Edn.), Que, 2009.
2. Block diagram of a generic computer (Ref: Figure 1-11 of https://www.oreilly.com/library/view/designing-embeddedhardware/0596007558/ch01.html)
3. Bill Nelson, Amelia Phillips; Guide to Computer Forensics and Investigation, ISBN-10: 1435498836, ISBN-13: 978-1435498839.
4. Eric Cole, Network Security Bible, Second Edition ISBN-100470502495 ISBN-13 978-0470502495 [OSI and TCP/IP layers].
5. Harlan Carvey; Windows Forensic Analysis Toolkit, Syngress, 2012.
6. Anthony Reyes, Jack Wiles; The Best Damm Cybercrime and Digital Forensics Book, Syngress, USA, 2007.
7. Aaron Philipp, David Cowen, Chris Davis; Hacking Exposed Computer Forensics Second Edition, McGrawHill, USA, 2010.

8. Cory Altheide, Harlan Carvey; Digital Forensics with Open Source Tools, Syngress, USA, 2011.
9. Andrew Hoog; Android Forensics Investigation, Analysis and Mobile Security for Google Android, Syngress, USA, 2011.
10. Hakima Chaouchi, Maryline Laurent-Maknavicius; Wireless and Mobile Network Security, Wiley, 2007.
11. Dan Kusnetzky; Virtualization: A Manager's Guide, O'Reilly, 2011.
12. Artificial Intelligence and Forensics: Applications in Criminal Justice, Homeland Security, and Cybercrime" by S. Srihari and A. Dua
13. "Machine Learning and AI for Forensic Science" by A. Sammons and A. Singh
14. "Artificial Intelligence and Machine Learning for Business: A No-Nonsense Guide to Data Driven Technologies" by J. Allaire and C. Johnson
15. "Handbook of Forensic Analysis and Artificial Intelligence" edited by S. Anuradha and N. Devarajan
16. Drone Forensics" by S. Baggili and F. Breitinger
17. "Digital Forensics for the Law Enforcement Officer" by A. Jones
18. "Practical Drone Forensics" by T. C. Gourley
19. "Drone Forensics and Investigations" by C. D. Vidas and M. Turk
20. "Handbook of Drone Forensics" edited by K. Martin and M. Slay

LABORATORY

COs	Course Outcome Statements	
CO1	Students will gain knowledge and demonstrate the process of collection and analysis of evidence involved in cybercrimes.	K3
CO2	Demonstrate various forensic tools for cybercrime analysis.	K4
K1– Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate		

Course Outcomes	**Programme Specific Outcomes**					
	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO1	**1**	**3**	**3**	**2**	**2**	**3**
CO2	**0**	**2**	**3**	**2**	**2**	**3**

1. Identification of storage media and its authentication.
2. Collection of digital evidences using different software.
3. Imaging the seized storage media with different imaging formats. [Disk Forensics]
4. Recovering the deleted files and folders. [Disk Forensics]
5. Analysing the image file for hidden files and folders including slack space. [Disk Forensics].
6. Collection and Preservation of Volatile data from the standalone computer.
7. Network data collection and preservation. [Network Forensics].
8. Capture and Analysis the TCP packet from the LAN. [Network Forensics].
9. Collecting Registry, Event logs and Executable files details using Forensic Tools.
10. Analysis the browser details of Internet Explorer and Header details of email.

Reference

1. DFS manual
   Digital Forensics. (2017). Germany: Wiley.

24-358-0206 - LABORATORY - QUESTIONED DOCUMENTS AND FORENSIC PHYSICS

COs	Course Outcome Statements	
CO1	Students will gain knowledge and demonstrate the process of developing fingerprints and footprints.	K3
CO2	Students will gain knowledge and demonstrate the process of collection and examining questioned documents.	K3
CO3	Students will gain knowledge and demonstrate the process of collection and examining ammunition.	K3
CO4	Students will gain knowledge and demonstrate the process of collection and examining fiber, soil, glass, paint and other physical evidence.	K3
CO5	Students will gain knowledge and demonstrate the process of collection packing and analysis of GSR	K4
K1– Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate		

Course Outcomes	Programme Specific Outcomes					
	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO1	**1**	**3**	**3**	**1**	**1**	**3**
CO2	**1**	**3**	**3**	**1**	**1**	**3**
CO3	**2**	**3**	**3**	**1**	**1**	**3**
CO4	**2**	**3**	**3**	**2**	**2**	**3**
CO5	**1**	**3**	**3**	**1**	**1**	**3**

1. To take plain and rolled fingerprints and to identify the patterns.
2. To perform ridge tracing and ridge counting.
3. To identify ridge characteristics.
4. To compare the fingerprints.
5. To develop latent fingerprints with powders, fuming and chemical methods.
6. Preparation of Foot print cast.
7. AFIS (Demo only).
8. Identification of Handwriting-general characteristics, fundamental divergences and individual characteristics.
9. Examination and identification of Signature Forgeries.
10. To study the natural variations in handwriting written in different circumstances.
11. Examination of sequence of intersecting strokes.

12. Examination of additions, alterations, and obliterations in the documents.
13. Examination of mechanical and chemical use of erasers on the documents.
14. Examination of indented handwriting.
15. Examination of writing inks by TLC.
16. Familiarization of VSC (Demo only).
17. Familiarization of ESDA (Demo only).
18. Characteristics of Firearms- Caliber, Choke, Trigger pull, and Proof marks (Demo only).
19. Examination and comparison of fired bullets with reference to caliber, rifling characteristics, and identification of firearms (Demo only).
20. Examination and comparison of fired cartridge case with reference to caliber, firing pin, breech face, chamber indentations, extraction, and ejector marks by comparison microscope (Demo only).
21. Determination of shot numbers from size and weight of shots.
22. Identification of propellants (Demo only).
23. Chemical tests for powder residue and barrel wash (Demo only).
24. Instrumental examination of GSR (Demo only).
25. Examination of broken pieces of glass bangles to determine the source correspondence.
26. Determination of specific gravity of glass pieces.
27. Microscopic and spectrophotometric examination of textile fabrics.
28. Physical matching of Cloth piece and/or rope piece and /or garments.
29. Determination of particle size distribution in soil samples using sieve test.
30. Examination of physical properties of paint evidence.
31. Restoration techniques of tool mark impressions.
32. Restoration of erased identification marks.
33. Determination of refractive indices of glass & liquids.
34. Physico-chemical analysis of paint samples.
35. Comparison of tool marks.
36. Recording of speech samples using tape recorder & digital recorders and measures for keeping it in safe custody.
37. Speaker wise segregation of speech samples of recorded conversation spoken between two speakers.
38. Spectrographic analysis of voice samples of two speakers using voice spectrograph and comparison of their spectrographic features.
39. Video analysis and detection of tampered video files using Video analyzing tool.

Reference

1. DFS manual
2. Ellen, D., Day, S., Davies, C. (2018). Scientific Examination of Documents: Methods and Techniques, Fourth Edition. United States: Taylor & Francis.

24-358-0207- LABORATORY - FORENSIC CHEMISTRY AND BIOLOGY

COs	Course Outcome Statements	
CO1	Students will gain knowledge and demonstrate the process of collection and analysing of substances involved in forensic chemistry.	K3
CO2	Students will gain knowledge and demonstrate the biochemical techniques used for forensic analysis of chemical evidence.	K3
CO3	Students will gain knowledge and demonstrate the process of collection of different body fluids and its forensic examination.	K3
CO4	Students will gain knowledge and demonstrate the instrumental techniques used for the examination of biological evidence in forensic science.	K3
CO5	Application of various analytical methods and biological methods for the detection of explosives, NDPS, body fluids etc.	K4
CO5	Estimation of age, sex, and race using bones	K4
K1– Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate		

Course Outcomes	Programme Specific Outcomes					
	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO1	**2**	**3**	**3**	**1**	**1**	**3**
CO2	**2**	**3**	**3**	**3**	**2**	**3**
CO3	**2**	**3**	**3**	**3**	**2**	**3**
CO4	**2**	**3**	**3**	**2**	**2**	**3**
CO5	**0**	**2**	**2**	**3**	**2**	**3**

1. Detection of low explosives by chemical/ color test and TLC.
2. TLC analysis of explosive residues.
3. HPTLC analysis of explosive residues
4. HPLC analysis of explosive residues.
5. Identification and comparison of explosives by FTIR.
6. GC-MS analysis of explosive residues.
7. Analysis of fire residues by GC.
8. Analysis of phenolphthalein in bribe trap cases.
9. Examinations of petroleum products as per BIS specifications.
10. Identification of NDPS drugs by color test and TLC (Demo only).

11. Identification of acidic and basic drug by UV/ TLC.
12. Identification of alcohol by chemical/ color test.
13. Identification of adulterants in some common food samples by chemical methods/color test (Turmeric, chilli, ghee, honey, pulses, sugar, salt etc.)
14. Analysis of NDPS drugs by instrumental methods (Demo only).
15. Systematic extraction and detection of poisons and drugs from visceral samples by various suitable chemical and instrumental techniques.
16. Detection of metallic poisons from viscera samples and food samples.
17. Identification of plant poisons.
18. Microscopic examination of hairs – identification of species origin.
19. Microscopic examination of diatoms.
20. Different staining procedures for cellular organelles.
21. Physical, biochemical and spectrophotometric examination of blood stains.
22. Examination of seminal stains by crystal tests, biochemical and microscopical analysis.
23. Examination of saliva and its stains.
24. Biochemical and microscopic examination of urine, vomit and sweat.
25. Determination of origin of species from biological fluids.
26. Blood group typing of biological fluid stains by absorption elution, absorption inhibition and mixed agglutination techniques.
27. Experiments on electrophoresis of red cell isoenzymes e.g. PGM, GLO-I, EsD, EAP.
28. Isolation of DNA from blood and its quantification.
29. Collection of body fluids and extraction of DNA using FTA card.
30. Examination of Long bones- Femur, Humerus.
31. Identification of individuals by long bones and stature estimation.
32. Determination of sex and age from skull with mandible.
33. Determination of sex from pelvis and sacrum.
34. Identification of individuals by dental examination.
35. Anthropometry- Identification of individuals (in living).
36. Examination of skeletal remains- long bones- Femur, Humerus.
37. Identification of individuals by long bones and stature estimation
38. Sampling of various evidences related to wildlife crimes for forensic analysis.
39. Microscopic examination of hairs – identification of species origin.
40. Identification of forensically important insects and examining the developmental stages (life cycles) for determination of Post-mortem Interval.
41. Postmortem examination in various Asphyxial deaths (Video demonstration only)
42. Postmortem examination of various homicidal/ accidental injuries (Video demonstration only).

Reference

1. DFS manual
2. UNODC manual

THIRD SEMESTER

24-358-0301- FORENSIC MEDICINE AND TOXICOLOGY

COs	Course Outcome Statements	
CO1	Understand about Medico-legal investigation of death	K2
CO2	Understanding about application of basics of entomology in death investigation.	K2
CO3	Understand injuries and their forensic applications.	K2
CO4	Understand basics of toxicological methods and their forensic significance	K2
CO5	Understanding toxic effects of plant and animal poisons.	K2, K4
K1– Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate		

Course Outcomes	Programme Specific Outcomes					
	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO1	**0**	**2**	**2**	**1**	**1**	**1**
CO2	**0**	**2**	**3**	**1**	**1**	**3**
CO3	**0**	**2**	**3**	**2**	**2**	**2**
CO4	**1**	**3**	**3**	**1**	**2**	**3**
CO5	**1**	**2**	**3**	**2**	**1**	**3**

Module I: Medicolegal Investigation of death **(14 hrs)**

Objectives of medico legal investigation. Death and its causes, types of death, signs of death. Post mortem changes- classification. Determination of cause of death, manner of death. Estimation of time since death. Post mortem biochemistry of the body fluids- Modern techniques used for the estimation of time since deaths. Exhumation. 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. Crimes against women- Introduction to sexual offences. Natural and unnatural sexual offences, perversions. Child abuses and abuses of old people. Abortion and infanticide. Deaths from starvation. Forensic entomology- identification of specific insects and their developmental stages (life cycles), Medico legal importance.

Module II: Mechanical Injuries **(14 hrs)**

Introduction, Classification, Abrasions, Bruises, Lacerations, Incised wounds, Stab wounds, mechanism of healing and forensic significance. Firearm injuries, Defense injuries, fabricated injuries. Traffic accident injuries: vehicular injuries, railway injuries and aircraft injuries. Thermal injuries: Burn and scalds, Lightning, Electricity, Explosions. Chemical trauma. Injuries- Accidental, self-inflicted, or inflicted by others. Ante -mortem and post-mortem, artificial injuries and aging of injuries. Fractures, Dislocations Secondary causes of death. Regional injuries, Fractures of the skull from direct & indirect impact, injuries of the brain, face, eyes, nose, ears, lip, teeth and alveoli, neck, spine and spinal cord, chest, rib, sternum, ribs, lungs, heart, blood vessels, diaphragm, oesophagus, abdomen, stomach, liver, intestine, pancreas, spleen, kidneys, adrenals urinary bladder, rectum external genitalia, muscles, bones and joints.

Module III: Toxicology **(14 hrs)**

Classification of poisons. Mode of action, signs and symptoms of different types of poisons. Fatal dose, fatal period, Symptoms, some common Antidotes Post-mortem findings, Collection and preservation of viscera and other samples. Isolation and Different methods of extraction of poisons from viscera. Extraction of poisons from blood, urine, stomach washes and vomits, food material and toxicological analysis of decomposed materials. Interpretation of toxicological finding and preparation of reports, limitation of method and trouble shooting in toxicological analysis, disposal of analysis samples.

Module IV: Volatile, non-volatile, Metallic, non-metallic and Food poison **(16 hrs)**

Volatile and non- volatile Poisons: - Nature, use, administrations, symptoms, post-mortem findings, fatal dose, fatal period, isolation, detection, qualitative and quantitative estimation of: Acetone, Ether, Oxalic Acid, Phenols, Camphor, Chloral Hydrate, Chloroform, Acetaldehyde Methyl alcohol, ethyl alcohol, illicit liquor, country-made liquor, etc. Metallic poisons: Nature, use, administrations, symptoms, post-mortem findings, fatal dose, fatal period, isolation, detection, qualitative and quantitative estimation of metallic poisons including: Lead, Copper, Mercury, Arsenic, Barium, Selenium, Magnesium, Aluminium etc. Non-metallic poisons including: chlroine, bromine, iodine, phosphorus etc. Food Poisons: Introduction, Food poisoning due to chemical, bacterial and fungal, Sign and symptoms of food poisoning, collection and preservation of evidence material, extraction and isolation, from food material, Biological material, detection and identification by colour test and instrumental techniques.

Module V: Plant and Animal poison **(14 hrs)**

Plant Poisons: Classification and types (Dhatura, *Abrus precatorious*, Nerium oleander, *Calotropis gigantia*, *Gloriosa superba*, Ergot, Mushroom etc.). Nature, signs and symptoms, Fatal dose, fatal period, post mortem findings, extraction from viscera, blood, vomit etc. Detection (preliminary

and confirmatory tests) and medico legal significance. Animal Poisons: Classification and types (neurotoxin, myotoxin, cantharides, vasculotoxin, spider, snakes, scorpion, etc.). Nature, extraction from viscera, blood, vomit etc. Fatal dose, fatal period, signs and symptoms, post mortem findings, detection (preliminary and confirmatory tests) and medico legal significance.

Recommended reading:

1. B.V.Subrahmanyam; Modi's Medical jurisprudence, Lexis Nexis butterworth, (1988)
2. WDS. Mclay; Clinical forensic medicine, Greenwich medical media, (1990)
3. Nandy; Principles of forensic medicine, New central book agency, (1995)
4. R.Shepherd; Simpson's forensic medicine, Oxford University press,(2003)
5. A.K.Mant; Taylor's principles & practice of medical jurisprudence, Wingking Tong co. Ltd., (2003)
6. D.J.Maio & V.J. Maio; Forensic pathology, CRC press, (1993)
7. C.H.Wecht; Legal medicine annual , ACC Press, (1970)
8. C.H. Polson; Essentials of forensic medicine, Pergamon press, (1973)
9. R. Mortiz & R.C. Morris; Handbook of legal medicine, C.V. Mosby company, (1975)
10. S.K. Lahiri; Elements of medical jurisprudence , Prabasi press, (1973) 11. I.Gordon & H.A.Shapiro; Forensic medicine, Longman group Ltd., (1982)
12. K,S Narayan Reddy; The Essentials of Forensic Medicine and toxicology.
13. Krishan Vij Text Book of Forensic Medicine and Toxicology.
14. Rajesh Bardale; Principles of Forensic Medicine and Toxicology.
15. V. V. Pillay; Text Book of Forensic Medicine and Toxicology

24-358-0302 - LABORATORY - FORENSIC MEDICINE AND TOXICOLOGY

COs	Course Outcome Statements	
CO1	Students will gain knowledge and demonstrate the process of collection of different poisonous plants and its forensic examination.	K3
CO2	Students will gain knowledge and demonstrate the instrumental techniques used for the examination of food poison.	K3
CO3	Analysis by using various analytical methods and biological methods for the detection of toxic principles of plants.	K4
K1– Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate		

Course Outcomes	Programme Specific Outcomes					
	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO1	0	2	3	1	2	3
CO2	0	2	3	2	2	3
CO3	0	3	3	2	1	3

1. Identification and Extraction and color test Analysis of different plant poisons.
2. Identification and Extraction and TLC Analysis of different plant poisons.
3. Determination of alcohol in blood and Urine.
4. Determination of pesticide poisoning using color test.
5. Determination of metallic poisons.
6. Analysis of food materials in the case of food poisoning using chemical and microscopic methods.

Reference

1. DFS manual
2. UNODC manual

24-358-0303- FORENSIC DERMATOGLYPHICS AND GRAPHOLOGY

COs	Course Outcome Statements	
CO1	Understand and demonstrate the development of fingerprints.	K2
CO2	Understand and demonstrate the development of footprint and casting of footwear marks.	K2
CO3	Understand gait pattern analysis cheiloscopy.otoscopy and bite mark analysis as a forensic tool.	K2
CO4	Understand and demonstrate forensic document examination	K2
CO5	Understanding the analytical and instrumental techniques for the analysis of writing material and ink.	K3, K4
K1– Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate		

Course Outcomes	Programme Specific Outcomes					
	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO1	**1**	**2**	**3**	**2**	**2**	**3**
CO2	**1**	**3**	**3**	**2**	**1**	**3**
CO3	**0**	**2**	**3**	**2**	**1**	**3**
CO4	**0**	**3**	**3**	**1**	**2**	**3**
CO5	**1**	**3**	**3**	**2**	**1**	**3**

Module I: Fingerprints and Palm Prints **(12 hrs)**

Classification of Fingerprints: Henry's Classification, Single Digit Classification, Extended Henry's System. Development methods (Powder methods, Fuming methods, Chemical Methods, etc.). Recent techniques (Digital Imaging & Enhancement, Laser & other radiation based techniques, Preservation and photography of fingerprints on various surfaces. Ridge counting, Ridge tracing, Minutiae Identification & Matching. Palm Prints: Nature, Location, Types, Classification, Development, Lifting, Evaluation, Analysis, Forensic Significance.

Module II: Footwear Impression and Gait pattern Analysis **(12 hrs)**

Forms of footwear, impressions-Information from footwear impressions. Location and recovery of footwear impressions. Enhancement methods, Preparation of Exemplars-Case studies. Gait pattern analysis. Footprint metric analysis, comparison and identification. Stature estimation using footprints. Forensic podiatry and its applications.

Module III: Forensic Cheiloscopy, Otoscopy and Bite marks (12 hrs)

Lip Prints-Introduction-History-Scope-Application in crime detection. Ear Prints-Introduction-History-Morphology of ear. Ear prints location-Producing standards from suspects-Identification and comparison. Bite marks-Introduction-Significance-Judicial Acceptance, Description of prototypical bite marks. Evidence collection and analysis. Identification and comparison-Case studies.

Module IV:Handwriting evidence (14 hrs)

General characteristics of handwriting and their estimation. Individual characteristics of handwriting and their estimation. Natural variations in handwriting, disguise in writing. Principle of handwriting identification, comparison of like with like, process of comparison – suitability of standards for comparison. Simon NewComb theory of probability, Examination of vernacular scripts, effect of mother tongue on foreign language, effect of age, illness, posture, emotions and writing instrument on handwriting. Preliminary examination of documents- various points to be considered during examination, examination of alphabets and numerals, case studies. Working and handling of Stereo Zoom Microscopes, Comparison Microscope, Video Spectral Comparator, Electrostatic Detection Apparatus, UV – Vis, TLC.

Module V: Writing material and Ink analysis (14 hrs)

Types of paper and Inks, techniques used in the analysis of paper & inks- raw materials, ingredients, and tagging materials etc. including NAA techniques. Examination of mechanical impressions - examination of indentation marks, secret writings, examination of rubber stamp and seal impressions, embossed impressions. Determination of sequence of intersecting strokes – all types, examination of creases and folds, determination of sequence of writings over creases & folds. Reconstruction and examination of torn documents, stabilization and examination of charred documents, case studies. Historical development- Dating of fountain pen ink, ballpoint and Non ball point ink, Ink analysis and forensic document examination. Ink chemistry- recognition of ink source, chemical composition of Ink. Preliminary method of analysis- Introduction, Pen line microscopy, Ink colour assessment, microscopic specular reflectance, Video spectral analysis, Laser induced fluorescence, Infrared luminescence. Forensic comparison and identification of writing ink by TLC. Instrumental analysis of Ink, Ink dating- aging process, first date of production method, Ink tag method, relative age comparison method, determination of age of ink by statistical analysis of densitometry data.

Recommended reading:

1. Ordway Hilton; Scientific Examination of Questioned Documents. Revised Edition, Elsevier, NY (1982).
2. Albert S. Osborn; Questioned Documents, 2nd Ed., Universal Law Pub., Delhi (1998).
3. Albert S Osborn; The Problem of Proof, 2nd Ed., Universal Law Pub. Delhi (1998).

4. Charles C. Thomas; I.S.Q.D. Identification System for Questioned Documents, Billy Prior Bates Springfield, Illinois, USA (1971).
5. Wilson R. Harrison; Suspect Documents Their Scientific Examination, Universal Law Pub. Delhi Indian Reprint (2001).
6. Hard less H.R; Disputed Documents. Handwriting and Thumb – Print Identification, profusely illustrated, Law Book, Allahabad (1988).
7. Morris Ron N; Forensic Handwriting Identification, Acad Press, London (2001).
8. Kurtz Sheila; Graphotypes a new Plant on Handwriting Analysis, Crown Pub. Inc., USA (1983).
9. Lerinson Jay; Questioned Documents, Acad Press, London (2001) Vacca John R; Computer Forensics- Computer crime scene Investigation, Firewall Medial, An imprint of Laxmi Pub(2002).
10. Casey Eoghan; Handbook of computer crime Investigation, Forensic Tools & Technology-Academic Press (2002).
11. Ellen Davin; Questioned Documents – Scientific Examination, Taylor & Francis, Washington (1997).
12. Roy A Huber, AM Headrick, Handwriting Identification-Facts & Fundamental, CRC Press (1999).
13. Andrea Mc Nichol, Jeffrey A Nelson; Handwriting Analysis Putting it to work for you, Jaico Books, Delhi (1994).
14. Morris (2000); Forensic Handwriting Identification (fundamental concepts & Principles).
15. Madinger J & Zalopany AR; (1999) -Money Laundering- CRC Press.
16. Manning CA;(1999) -Financial Investigation & Forensic Accounting- CRC Press.
17. Brewster F.; Contested Documents and Forgeries," The Eastern Law House, Kolkata.
18. Quirke AJ; Forged Anonymous & Suspect Documents- 1930, Reorge Rontledge & Sons Ltd, London.
19. Katherine M Kappenhaver, CDE-Forensic Document Examination-Humana Press.
20. Jan Seaman Kelly & Brian S Lindblom-Scientific Examination of Questioned Documents-Taylor Francis Group London and New York.
21. Bridges, B.C; Criminal Investigation, Practical Fingerprinting, Thumb Impression, Handwriting expert Testimony, Opinion Evidence., Univ. Book Agency, Allhabad,2000
22. Mehta, M.K; Indentification of Thumb impression & cross examination of Fingerprints N.M. Tripathi Pub. Bombay, 1980.
23. Chatterjee, S.K; Speculation in Fingerprint Identification, Jantralekha printing Works, Kolkata, 1981.
24. Cowger James F; Friction Ridge Skin- Comparison & Identification of Fingerprints, CRC Press, NY, 1993
25. Cossidy, M.J; Footwear Identification, Royal Canadian, Mounted Police, 1980.
26. Iannavelli, A.V; Ear Identification, Forensic Identification Series, Paramount,1989.
27. Henry, C.L. & Ganesslen, R.E; Advances in Fingerprint Technology, CRC Press, London,1991.
28. John A. DiMaggio,Wesley Vernon; Forensic podiatry principles and methods 2017.

24-358-0304- FORENSIC ACCOUNTING

COs	Course Outcome Statements	
CO1	Understand about Forensic accounting and auditing	K2
CO2	Understand about application forensic instruments in document examination	K2
CO3	Explain and demonstrate the techniques and instrumentations used in fingerprint development	K5
CO4	Understanding the advanced Finger Print development methods	K2, K3
CO5	Understand basics AFIS System	K2
K1– Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate		

Course Outcomes	Programme Specific Outcomes					
	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO1	**0**	**2**	**3**	**2**	**3**	**3**
CO2	**0**	**3**	**3**	**2**	**3**	**3**
CO3	**0**	**3**	**3**	**2**	**3**	**2**
CO4	**0**	**2**	**3**	**2**	**2**	**2**
CO5	**0**	**2**	**3**	**2**	**2**	**2**

Module I: Forensic Accounting and Auditing (14 hrs)

Corporate frauds, forensic accounting and auditing, Use of computers in document examination, Automated Signature verification system, determination of age of documents- relative and absolute age of documents, case studies. Examination of security documents including currency notes, Revenue stamps, travel documents - passports, visas, air - tickets, identity cards, lottery tickets, driving license, Bills, educational and financial documents, etc. Different types of security features and their examination including watermarks, wire marks, security fibre/threads, Ghost/imitated marks/ security printing, optical variable inks, holograms and all other security features.

Module II: Forensic Examination of Digital and other Documents (16 hrs)

Types and working of Photostat machine, fax machine, printers, scanners. Identification & linkage of Photocopies and photocopier, typewriter, fax machine, scanner, Desktop printing including image processing device, their role in counterfeit currency and certificate etc. Holographic marks and their examination, Examination of credit, debit and other plastic cards, examination of photocopies, scanned documents, Fax copies etc., and case studies. Numismatic forgery- Introduction, tool, equipments and other resource, method of forgery- alteration, tooling, embossing, application and plating, Casting: Rubber mold model, wax model from mold, Burn out wax, treatment of casting, Creating dye- Cutting by hand, plating, casting and hubbing. Explosive

impact copying preparation of detail report with reasons and illustrative charts, uses of standard terminology.

Module III: Forgery Examination (14 hrs)

Types of forgery, attributes of assisted hand signatures, disguise, discriminators of device, flag of forgery and characters of genuineness, indicators of illiteracy, sign of senility, symbol of sinistrality, gender discrimination. Scope of questioned document examination. Anachronistic features and their importance, detection and decipherment of alterations and erasures, examination of carbon copies and carbonless copies. Examination of signatures – characteristics of genuine & forged signatures, identification of writer of forged writings/signatures. Importance of tremor in identification of writings and signatures, difference between tremors of fraud and genuine tremor in writings and signatures, hesitations, factors responsible for variations (under threat, while travelling, illness, old age, mental state, etc.).

Module IV: Advanced Fingerprint Development methods (16 hrs)

Powder method: Traditional powder methods , Thermoplastic Powder, Nanotechnology Powder, Anti stroke Powder. Powder suspension technique:-Small particle reagent, Black powder suspension, White powder suspension, fluorescent suspension etc. **Advanced methods:** Radioactive technique, Biological technique, reflected ultraviolet Imaging system, X-ray fluorescence, Chemical imaging. Challenging surface: Thermal Surface- Solvent treatment, amino acid/Protein reagent, Fuming method. Metallic reagent- Gun bleaching method, Oxidation reduction method, Electrochemical/corrosion method, Fuming method. Glows- Deposition and development latent print on glows. Adhesive tape-Tape separation method,Skin- Iodine silver plate transfer, Electronography, Powder method, Cyno-acrylate fuming, Iodine-Napthoflavone etc.. **Chemical methods:** Amino acid reagent, Ninhydrin-Chemistry and reaction Mechanism, Forensic application. Metal salt enhancement, Ninhydrin analogous, first analogous, aryl, alkyl and alkoxy analogous, 1,8-Diazafluoren-9-One and 1,2-Indanedione, miscellaneous amino acid reagent-p-Dimethylaminocinamaldehyde, NBD chloride, Dansyal chloride, o-Phthalaldehyde, Fluorescamine, Genipin**.** Cyanoacrylate fuming, health and safety precaution, Cyanoacrylate pretreatment, atmospheric and vacuum CA fuming, Chemistry of CA dye stains- Ardrox, basic yellow 40, MBD, Rhodamine 6G, MRM 10, RAY, thenoyl europium chelate, gentian violet, sudan black. Iodine fuming, Iodine fixation, Operational uses- vapor method, dusting method, Solution method, miscellaneous fuming methodOsmium/ruthenium Tetroxide, soot method, Disulfur dinitrite, etc. **Metal deposition method:** Silver nitrate, Physical developer- Chemistry and mechanism, Sequencing, regent reliability test, bleach toning, potassium iodide toning, other toning process. Single Metal Deposition, Multi- metal deposition- I, II, III, IV, fluorescent and vacuum metal deposition-reaction mechanism, conventional gold zinc process, sequencing. Lipid Reagent: Sudan black, chemistry and mechanism of Oil red O, nile red, European chelate, etc. Nanoparticles in Fingerprinting. Application of microbiology in fingerprint development.

Module V: Automated Fingerprint Identification System (12 hrs)

Fingerprints and AFIS, History of automated identification system: Early print, single database, growth and development of AFIS system, Transmission standard, ANSI standard, compression standard. NCIC classification system, Henry and American classification system, working of AFIS-Database, processing ten print, latent print processing, latent search. Types of AFIS searches: Ten print to Ten print search, Latent to ten print search, Latent to latent search. AFIS report: Ten print report and latent print report.

Recommended reading:

1. Moenssens: Finger Prints Techniques, 1975, Chitton Book Co., Philadelphia, New York.
2. Mehta, M. K.: Identification of Thumb Impression & Cross Examination of Finger Prints, 1980 N. M. Tripathi (P) Ltd. Bombay.
3. Bridges: Practical Finger Printing, 1942, Funk and Washalls Co. New York.
4. H.C. Lee, R.E. Gaensslen "Advances in Fingerprint Technology", 2nd ed. NY: CRC Press, 2001.
5. S.A. Cole, Suspect Identities: A History of Fingerprint and Criminal Identification. Harvard Univ. Press, May 2001.
6. Cherril, F.R. : The Finger Prints. System at Scotland Yard, 1954; Her Majestuy's office, London.
7. C. Champod and P.A. Margot, ªComputer Assisted Analysis of Minutiae Occurrences on Fingerprints, Proc. Int'l Symp. Finger-print Detection and Identification, J. Almog and E. Spinger.
8. E. Roland Menzel; Fingerprint Detection with Loseres; Second edition; Marcel Dekker, Inc. 1999.
9. Ordway Hilton; Scientific Examination of Questioned Documents. Revised Edition, Elsevier, NY (1982).
10. Albert S. Osborn; Questioned Documents, 2nd Ed., universal Law Pub., Delhi (1998).
11. Albert S Osborn; The Problem of Proof, 2nd Ed., Universal Law Pub. Delhi (1998).
12. Charles C. Thomas; I.S.Q.D. Identification System for Questioned Documents, Billy Prior Bates Springfield, Illinois, USA (1971).
13. Wilson R. Harrison; Suspect Documents Their Scientific Examination, Universal Law Pub. Delhi Indian Reprint (2001).
14. Hard less H.R; Disputed Documents. Handwriting and Thumb – Print Identification, profusely illustrated, Law Book, Allahabad (1988).
15. Morris Ron N; Forensic Handwriting Identification, Acad Press, London (2001).
16. Kurtz Sheila; Graphotypes a new Plant on Handwriting Analysis, Crown Pub. Inc., USA (1983).

17. Lerinson Jay; Questioned Documents, Acad Press, London (2001) Vacca John R; Computer Forensics- Computer crime scene Investigation, Firewall Medial, An imprint of Laxmi Pub(2002).
18. Casey Eoghan; Handbook of computer crime Investigation, Forensic Tools & Technology- Academic Press (2002).
19. Ellen Davin; Questioned Documents – Scientific Examination, Taylor & Francis, Washington (1997).
20. Roy A Huber, AM Headrick, Handwriting Identification-Facts & Fundamental, CRC Press (1999).
21. Andrea Mc Nichol, Jeffrey A Nelson; Handwriting Analysis Putting it to work for you, Jaico Books, Delhi (1994).
22. Morris (2000); Forensic Handwriting Identification (fundamental concepts & Principals).
23. Madinger J & Zalopany AR; (1999) -Money Laundering- CRC Press.
24. Manning CA;(1999) -Financial Investigation & Forensic Accounting- CRC Press.
25. Brewster F.; Contested Documents and Forgeries," The Eastern Law House, Kolkata.
26. Quirke AJ; Forged Anonymous & Suspect Documents- 1930, Reorge Rontledge & Sons Ltd, London.
27. Katherine M Kappenhaver, CDE-Forensic Document Examination-Humana Press.

24-358-0305- ADVANCED FORENSIC EXAMINATION OF PHYSICAL EVIDENCE AND BALLISTICS

COs	Course Outcome Statements	
CO1	Understand the characteristics and analyse fibre, soil, glass, paint and other physical evidences using various instrumental techniques.	K2
CO2	Understand and demonstrate the reconstruction of hit and run cases.	K2
CO3	Identifies the firearm using GSR analysis	K4
CO4	Understand and demonstrate the restoration of erased marks	K2
CO5	Describe the reconstruction of sequence of events involved in firearm cases.	K2, K3
K1– Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate		

Course Outcomes	Programme Specific Outcomes					
	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO1	**1**	**3**	**3**	**2**	**1**	**3**
CO2	**0**	**3**	**3**	**2**	**1**	**2**
CO3	**0**	**3**	**3**	**2**	**1**	**3**
CO4	**1**	**2**	**3**	**2**	**1**	**3**
CO5	**1**	**2**	**3**	**2**	**2**	**3**

Module I: Analysis of Physical Evidences **(14 hrs)**

Types and composition of soil, Physical and microscopic examination. Density gradient analysis, ignition-loss test, elemental analysis, interpretation of soil evidence. Types of paint and their composition, macroscopic and microscopic analysis of paint pigments, pigment distribution, microchemical analysis- solubility test, pyrolysis gas chromatography, TLC, colorimetric analysis, IR spectroscopy and X-ray diffraction, elemental analysis, mass spectrometer, interpretation of paint evidence. Cement: Types of cement and their composition, sampling of cement evidence material, determination of adulterants in cement, bromoform test, fineness test, loss on ignition test of cement; Physical and instrumental methods of cement analysis: determination of compressive strength, setting times, initial and final setting time, standard consistency, chemical methods of cement analysis, x-ray powder diffraction- identification of adulterated cement and adulterants. Cement mortar and Cement concrete: Sampling and methods of analysis. Types of fibres, forensic aspects of fibre examination- fluorescence, optical properties, refractive index, birefringence, dye analysis. Physical fit and chemical testing. TLC, IR-micro spectroscopy, Py-MS. Difference

between natural and man-made fibres. Types of glass and their composition- soda-lime, borosilicate, safety glass, laminated, light-sensitive, tampered/ toughened, wire glass, coloured glass. Matching and comparison. Forensic examinations of glass fractures- rib marks, hackle marks, cone fracture, wavy, backward fragmentation, concentric and radial fractures. Colour, fluorescence, physical measurements, refractive index, density gradient, becke-line, specific gravity examination and elemental analysis of glass evidence.

Module II: Traffic Accidents and Examination (14 hrs)

Road evidence, road engineering and design, identification and interpretation of road obstructions, defects, marks and damage, tyre marks, skid marks. Vehicle examination: Automobile common component and failure analysis, damage assessment, tyres –types speed and load rating, inflation and failures, brakes –types and brake systems, door lock and speed recording devices, safety restraint system – theory and examination of seat-belt child-seat and air-bag, vehicular fires. Speed analysis: vehicle and road kinematics, coefficient of friction and drag factor, methods of determining drag factor, influence on braking distance. Speed determination: skid marks measurement, speed from vehicle yaw, speed calculation on different road surfaces, falls, flips and vault speeds, special speed problem. Hit and run investigation- examination of suspect vehicle, collection of evidence & control samples, inter-comparison of analytical results of physical evidence. Reconstruction of accident: overview of reconstruction software and techniques, computer aided design techniques, vehicle specification databases, momentum and energy analysis program, collision simulators, photogrammetry software. Motorcycle accident investigation: types of motorcycle, dynamics rake and turning, acceleration and breaks, mechanical consideration and slide to stop speed determination. Forensic analysis of tool marks.

Module III: Identification of Firearms (12 hrs)

Testing of barrel wash, chemical tests for testing of lead/ copper around gun-shot holes in clothes, skin and other objects, use of instrumentation techniques in identification of gun-shot holes. Determination of time elapsed since firing, usefulness, different methods employed and their limitations, attempts based on analysis of residue inside the barrel left after the firing of cartridges loaded with black/smokeless powders, attempts based on analysis of CO, CO2, nitrogen oxides, etc., reasons for not being able to estimate time elapsed since firing. Use of instrumentation techniques for analysis of propellant particles found on hands of shooter, fired cartridge case, barrel and target.

Module IV: Restoration Techniques (12 hrs)

Restoration of erased numbers, methods of marking-cast, punch and engraved, methods used for removal of serial numbers, theory behind number restoration, restorations of marks on cast iron, aluminum, brass, wood, leather etc., chemical methods of restoration (etching), reagents used for various metals, electrolytic methods of restoration-reagents used, ultrasonic cavitation for

restoration, magnetic particle method for restoration, other methods of restoration, laser etched serial numbers and barcodes and their restoration, recording of restored marks. Gun-handling testsIntroduction, Ferrozine test. Ballistics Data Measurement System.

Module V: Reconstruction of Firearm Injury (12 hrs)

Reconstruction of sequence of events involved in a shooting case, theory and practice of shooting reconstruction, scientific method of shooting reconstruction, suicide, murder, accident, self- defence, encounter cases. All considerations during direct investigation of shooting incident or without the benefit of original crime scene investigation- the scene of occurrence, photography of crime scene, sketching of crime scene, medico-legal report, basic ballistic facts, laboratory examination reports, firearms and ammunition, clothes of victim etc. On scene evidence- evaluation and documentation, off –scene evaluation and investigation, limitations of shooting reconstruction, simple mathematics involved in shooting reconstruction. Documentation & evaluation of bullet holes, ricochet marks, pellet patterns, estimation of angle of impact, bullet holes in tires and other plastic materials determination of bullet path-use of lasers, cartridge case ejection pattern. Plotting of gun-shot injuries on body-diagrams, evaluation of gun-shot injuries, to determine wounds of entry/ exit, direction of firing, number of rounds fired etc., reconciliation of bullet holes in clothes with underlying wounds, use of blood spatter in reconstruction. Determination of number of participants/firearms involved, their location, position, orientation at the moment of firing, discussion of some important and complicated cases.

Recommended reading:

1. Sharma, B.R.; Firearms in Criminal Investigation & Trials, Universal Law Publishing Co Pvt Ltd, New Delhi, 4th Edn,(2011).
2. Mathews, J.H; Firearms Identification, Vol I, II and III, Charles C. Thomas, USA, (1977)
3. Hatcher, Jury and Weller; Firearms Investigation, Identification and Evidence, Stackpole Books, Harrisburg, Pa,(1997)
4. Heard, B.J; Handbook of Firearms and Ballistics, John Wiley, England, (1997)
5. Warlow, T.A.; Firearms, The Law and Forensic Ballistics, Taylor and Francis, London,(1996)
6. Jauhari M; Identification of Firearms, Ammunition, & Firearms Injuries, BPR&D, New Delhi.
7. Burrard; The Identification of Firearms and Forensic Ballistics, Herbert Jenkins, London, (1956)
8. Gunther and Gunther; The Identification of Firearms, New York, (1935)
9. Wilber; Ballistic Science for the Law Enforcement Officer, Charles C. Thomas, USA, (1977)
10. Lucas ; Forensic Chemistry and Scientific Criminal Investigation, London, (1945)

11. Williams, Practical Handgun Ballistics, Charles C. Thomas, USA, (1980)
12. Nonte, Jr, Firearms Encyclopedia, Wolfe Publishing Limited, London, (1973)
13. Davis, J.E, An Introduction to Toolmarks, Firearms & the Striagraph, Charles C. Thomas, USA, (1958)
14. Hueske, Practical Analysis and Reconstruction of Shooting Incidence, CRC Press, NY,(2006)
15. Thomas Watters; Traffic Crash Analysis: Court Preparation Manual, Dream Catcher Publishing. (1999).
16. Tony L. Becker; Lamp Examination for Traffic Collision Investigators, Institute of Police Technology and Management. (1995).
17. Caddy, B; Forensic Examination of Glass and Paint Analysis and Interpretation, CRC Press, New York, 2001.
18. Shaw, D; Physics in the Prevention and Detection of Crime, Contem Phys. Vol.17, 1976.
19. Saferstein, R; Forensic Science Handbook. Vol. I,II, (Ed.), Prentice Hall, New Jersey, 1988.
20. Working Procedure Manual; Physics. BPR&D Publication, 2000.
21. Sharma, B.R; Forensic Science in Criminal Investigation and Trials (3rd Ed.), Universal Law Publishing Co., New Delhi, 2001.
22. Working Procedure Manual- Physics, BPR&D Publication. 2000
23. Hess, K.P; Textile Fibers and their Use, 6th Edn, Oxford and IBH Publishing Co., 1974.
24. Robinson, J.W; Atomic Spectroscopy, 2nd Ed. Revised & Expanded, Marcel Dekkar, Inc, New York, 1996.
25. Workman, J; Art Springsteen; Applied Spectroscopy- A compact reference for Practitioners, Academic Press, London, 1997.
26. Subrahmanyam, N. & Lal B; A text Book of Optics, S. Chand & Company, New Delhi, 2004.
27. Willard, H.H. Lynne L. Merrett, J. Dean, A. Frank, A. Settle. J; Instrumental Methods of Analysis, 7th Edn. CBS pub. & Distributors, New Delhi, 1986.
28. Khandpur, R.S; Handbook of Analytical Instruments, Tata McGraw Hill Pub. Co. New Delhi, 2004.
29. Thomson, K.C. & Renolds, R.J; Atomic Absorption Fluorescence & Flame Emission
30. Spectroscopy, A Practical Approach, 2nd Edn. Charles Griffith & Company, New South Wales, 1978.
31. Dudley, H. Williams & Fleming, I; Spectroscopic Methods in Organic Chemistry, 4th Edn, Tata
32. McGraw- Hill Publishing Company, New Delhi, 1994.
33. Kenneth S. Obenski et. al.; Motorcycle Accident Reconstruction and Litigation, Lawyers & Judges Pub. Company. (2011)

34. Lynn B. Fricke.; Traffic Crash Reconstruction, Northwestern University Center for Public Safety. (2010)
35. R. W. Rivers.; Basic Physics: Notes for Traffic Crash Investigators and Reconstructionists: An Introduction for Some, a Review for Others, Charles C. Thomas Pub Ltd (2004).
36. R. W. Rivers; Evidence in Traffic Crash Investigation and Reconstruction: Identification, Interpretation and Analysis of Evidence, and the Traffic Crash Investigation and Reconstruction, Charles C. Thomas Pub Ltd. (2006).
37. R.W. Rivers and Frederick G. Hochgraf; Traffic Accident Investigators' Lamp Analysis Manual, Charles C. Thomas Pub Ltd. (2001).

24-358-0306- FORENSIC AUDIO VIDEO ANALYSIS

COs	Course Outcome Statements	
CO1	Understand about Forensic Phonetics	K2
CO2	Understand about application forensic instruments in document examination	K2
CO3	Explain and demonstrate the techniques and instrumentations used in fingerprint development	K5
CO4	Understand basics AFIS System	K2
CO5	Understand basics of forensic audio and video analysis	K2
K1– Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate		

Course Outcomes	Programme Specific Outcomes					
	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO1	**1**	**2**	**3**	**3**	**3**	**2**
CO2	**0**	**1**	**3**	**3**	**3**	**2**
CO3	**1**	**2**	**3**	**3**	**3**	**2**
CO4	**1**	**2**	**3**	**3**	**3**	**2**
CO5	**2**	**3**	**3**	**3**	**3**	**2**

Module I: Forensic Phonetics **(14 hrs)**

Speech Anatomy, Mechanism of speech Production, Acoustic Properties of Vocal Tract. Uniqueness in person's voice, interspeaker and intraspeaker variation. Articulation- Manner & Place of Articulation, Phonemes, Vowel, Consonant and Glides. Phonetics in Speaker Identification, IPA (The International Phonetic Alphabets), Forensic Phonetics, Effect of context, Supra segmental (Prosodic features). Audio-enhancement, Sound Recording/Playback Devices: Analog Tape recorders, Digital recorder, Microphone types, Digital audio formats. Apex Court Judgments on Speaker Identification. Court presentation of report based on speaker Identification.

Module II: Digital Signal Processing **(16 hrs)**

Digital Signal Processing, A to D Conversion- Sampling, Quantization, Digital Audio Formats, Pulse Code Modulation, Coding and Decoding. Computer Representation of Speech Speaker Recognition: Principles of speaker recognition/identification, Methods on Speaker Recognition. Various approaches in Forensic Speaker Identification, Interpretation of result, Statistical

interpretation of probability scale, Objective/Subjective methods, discriminating tests, closed test, open test, likelihood ratio calculation, Concept of test and error in Speaker Identification. Introduction to Pattern Recognition, Pattern Recognition application in Automatic Speaker Identification and Verification System, Different algorithm of automatic speaker identification.

Module III: Audio Evidence Examination (16 hrs)

Audio Evidence Examination: Handling of audio recording evidences, Procedure for preparation of working copies. Phonetic transcription, Analysis of linguistic & phonetic characteristics, Temporal measurement, Text-dependent and text-independent speaker recognition. Instrumental Analysis of speech sample: Verbatim, Clue words, IPA marking, CSL & Linear predictive coding technique, Fourier transformation, Examination using SPID, Vocal behaviours-alcohol speech relationships. Authentication of recorded audio: Type of alterations, Auditory Examination by Critical Listening. Waveform analysis, Speech Spectrographic analysis, Magnetic developing, Optical Method.

Module IV: Introduction to Video Technology (12 hrs)

Video standards, Recording formats- Analog and Digital, Introduction to video devices, Linear and Non-linear editing, Concept of video film production. Graphics and animation technique. Image perception, Colour space & representation, Storage, Image processing application. Introduction to image enhancement, Image restoration, Concept of digital watermarking, Image compression, Retrieval of video files, Integrity of images, Facial image recognition.

Module V: Forensic Analysis of Audio/Video (14 hrs)

Forensic analysis of audio/video in video recording: Authentication of video recording, Visual examination technique on video frame sequence. Video image analysis- object, costumes, Facial image recognition from video frame image, Video signal analysis. Audio video Examination and Recovery, DFT, Fourier transform for periodic signals, properties of DFT signal sampling, analog to digital conversion, Frequency and time domain functions, LPC and FFT . Speech and video enhancement.

Recommended reading:

1. Arthur R Weeks Jr; Fundamentals of Electronic Image. SPIE Press, (2003)
2. Bengold & Nelson Moryson; Speech and Audio signal processing, John Wiley & Sons, USA (1999)
3. D.B. Fry; The Physics of Speech, Cambridge University Press. (2004)
4. David Cheshire; The Complete Book of Video Techniques Subjects Equipment, Dorling Kindersley, London (1992)
5. Des Lyver & Graham Swainson; Basics of Video Production, 2nd Ed. Focal Press (1999)

6. Dwight Bolinger et. al.; Aspects of Language, Third Edition, Harcourt Brace Jovanovich College Publishers, USA. (1981)
7. Gloria J. Borden et. al. Speech Science Primer (Physiology, Acoustics and perception of Speech), 6th Ed, a Wolters Kluwer Company, USA. (2011)
8. Harry Hollien; Forensic Voice Identification, Academic Press, London. (2001)
9. Harry Hollien; The Acoustics of Crime- The New Science of Forensic Phonetics, Plenum Press, New York and London (1990)
10. Husrev Taha Sencar, Nasir Memon; Digital Image Forensics: There is More to a Picture than Meets the Eye. Springer (2013)
11. John C. Russ; Forensic Uses of Digital Imaging CRC Press, (2001)
12. Martin Uren; BKSTS Illustrated Dictionary of Moving Image Technology, 4th Ed, CRC Press, (2013)
13. Oscar Tosi; Voice Identification-Theory of Legal Applications, University Park Press, Baltimore (1979)
14. O'Shaughnessy, Douglas; Speech Communication, Hyderabad Universities Press (India) Pvt. Ltd. (2001)
15. Patricia Ashby; Speech Sounds, 2nd Ed. Routledge, London and New York (2005)
16. Philip Rose; Forensic Speaker Identification, Taylor and Francis, Forensic Science Series, London (2002)
17. Randy Crane; A Simplified Approach to Image Processing, Prentice Hall. (1996).
18. Simon J. Godsill; Digital Audio Restoration, Springer, (1998)
19. Gary H. Anderson; Video Editing and Post-Production- A Professional Guide, 4th Ed, Focal Press, (1998).
20. Iannavelli, A.V; Ear Identification, Forensic Identification Series, Paramount, (1989).
21. Jain, A.K., Flynn, P & Ross A.A., Handbook of Biometrics, Springer, New York (2008).
22. Fred L. Bookstein. Morphometric tools for landmark data: Geometry and biology. Cambridge University Press, (1991).

24-358-0307 – PHARMACOLOGY AND DRUG ANALYSIS

COs	Course Outcome Statements	
CO1	Understand principles of pharmacology	K2
CO2	Understand and demonstrate the analysis of narcotic and psychotropic substances.	K2
CO3	Understand and demonstrate the analysis of common adulterants in drugs.	K2
CO4	Understand and demonstrate the forensic examination of food and petroleum products	K2
CO5	Understand and demonstrate the analysis of common adulterants in alcohol ,petroleum and dairy products.	K4, K3
K1– Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate		

Course Outcomes	Programme Specific Outcomes					
	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO1	**2**	**2**	**1**	**3**	**2**	**2**
CO2	**1**	**2**	**3**	**2**	**2**	**1**
CO3	**1**	**1**	**3**	**2**	**2**	**2**
CO4	**3**	**2**	**2**	**3**	**2**	**3**
CO5	**1**	**3**	**3**	**1**	**2**	**3**

Module I: Basic Principles of Pharmacology (12 hrs)

Drug classification , Forensic Pharmacological studies, Ingestion of drugs, absorption, distribution, metabolism, pathways of drug metabolism, drug metabolism and drug toxicity, excretion of drugs, detection of drugs on the basis of their Metabolic studies. Drug dependency and drug abuse. Solvent Abuse (chlorinated hydrocarbons, Aromatic hydrocarbons, alcohols, glycols, fuel and fuel additives): absorption, distribution, and metabolism, psychological & clinical effects. Analysis: collection of sample, distillation & extraction, Analysis by GC, HPLC. Case studies. Chemotherapeutic drugs, Disinfectants,Antiseptics and Sterilants, Antibacterial,antifungal,antiviral drugs etc.

Module II: Drugs of Abuse and Forensic Analysis (12 hrs)

Solvent Abuse (chlorinated hydrocarbons, Aromatic hydrocarbons, alcohols, glycols, fuel and fuel additives): absorption, distribution, and metabolism, psychological & clinical effects. Analysis: collection of sample, distillation & extraction, Analysis by GC, HPLC. Case studies. Drug of abuse in sports. Anabolic steroids. Analysis: collection of sample, distillation & extraction, Analysis by GC, HPLC. Case studies. Date rape drugs. detection and analysis. Case studies. Forensic analysis of alcohol.

Module III: Analysis of Narcotic drugs and Psychotropic substances (12 hrs)

Classification, metabolism , poisoning , signs and symptoms, cannabis- Bhang Ganja, hashish, charas, Opium derivatives - Alkaloids , morphine, heroin and opioids, Coca derivatives. Sample Preparation, Extraction Techniques- Chemical-color test, Microcrystal techniques and other instrumental techniques involved in analysis. Analysis of designer drugs. Analysis of other narcotic and psychotropic substances- natural and synthetic: depressants,stimulants and hallucinogens'

Module IV: Adulteration of Drugs and Chemicals (14 hrs)

Detection of common adulterants and determination of percentage purity in seized samples. Detection identification, quantization of drugs in pharmaceutical products. Analysis of illicit drugs and search of clandestine laboratories, precursors and their analysis. Estimation of morphine in opium and heroin in smack. Analysis of drugs in biological samples and their importance: Hair, urine, blood, viscera. Methods of extraction of drugs/consultation of drugs. Limitation of chemical analysis of drugs. Report writing and interpretation of drugs. Court testimony in NDPS Act cases. Case studies and ground for acquittal and grant of bail.

Module V: Analysis of adulterants in Food and Petroleum products (14 hrs)

Analysis of Lipids and fats: Physical examination of lipids, Chemical examination of lipids (Acid value, Saponification value, Ester value, Acetyl value, Iodine value). Test for hydrogenated oils and fats, Detection and Determination of rancidity, Analysis of butter and butter fats, Analysis of adulterated and non-adulterated oils. Analysis of dairy products. Analysis of alcoholic and non alcoholic drinks. Paraffins, Iso-olefins, Olefin Hydrocarbons, Naphthenes, Cycloparaffins or Aromatic Hydrocarbons, Sulphur Compounds, Nitrogen Compounds, Oxygen Compounds, Organo-Metallic Hydrocarbons; H/C Ratio of Hydrocarbons. Physical Properties of Petroleum Products : Density, Viscosity, Surface Tension, Color, Fluorescence, Cloud Point, Pour Point, Aniline Point, smoke point, boiling point, Optical Properties, Flash Point, Refractive Index and Calorific Value, Determination of Cetane and Octane number. Analytical Techniques: Quantitative and Qualitative Analysis of Petroleum products.

Recommended reading:

1. Bassett: Vogel's Text Book of Quantitative Inorganic Analysis, Longman, 1978.
2. Vogel, A. I: Text Book of Practical Organic Chemistry including Qualitative Organic Analysis, ELBS, 1971.
3. Skoog, D. A., West, D. M. and Holler, F. J: Analytical Chemistry: An Introduction, Saunders College, 1994.
4. Siegel, J. A, Saukko, P. J. and Knupfer, G. C: Encyclopedia of Forensic Sciences, Academic Press, 2000.
5. Townsends, A. (Ed): Encyclopedia of Analytical Science, Academic Press, 2005.
6. Kinghorn: Introduction to Petrochemicals Sukumar Maiti
7. D.W.Waples : Geochemistry in Petroleum Exploration
8. A.L.Waddams : Petroleum Geochemistry and Geology Chemicals from Petroleum
9. Day & Underwood :Analytical Chemistry.
10. Curry: Analytical Methods in Human Toxicology, Part II, 1986.
11. Curtis Klaassen, Casarett & Doll Toxicology: The Basic Science of poisons, 8th Edtion, Mc Graw Hill,2013
12. Moffat, A.C.: Osselton, D. M. Widdop, B.: Clarke's Analysis of Drugs and Poisons in Pharmaceuticals, body fluids and postmortem material, 3rd ed., Pharmaceutical Press,2004.
13. Holfmann, F.G.: Handbook of Drug and Alcohol Abuse.
14. Sunshine, I: Guidelines for Analytical Toxicology Programme, Vol-I, CRC press, 1950.
15. Sunshine, I: Handbook of Analytical Toxicology, press, 1969.
16. Mule, S. J. et al.: Immunoassays for Drugs subjects to ab, CRC Press, 1974
17. Connors, K.: A text book of Pharmaceuticals analysis, Interscience, New York, 1975
18. Niesink, RJM; Toxicology- Principles and Applications, CRC Press, 1996
19. Jaisingh P Modi, A Textbook of Medical Jurisprudence and Toxicology ,Edited by Justice K Kannan,26th Edition,2019,LexisNexis
20. Morrison R.T and Boyd R. N; Organic Chemistry 6th Ed Prentice Hall, 2003
21. Laboratory procedure Manual, Forensic Toxicology: Directorate of Forensic Science, MHA, Govt. of India, 2005
22. Laboratory Procedure Manual : Petroleum Products, Directorate of Forensic Science, MHA, Govt. of India, 2005
23. Working Procedure Manual on Chemistry ; Directorate of Forensic Science MHA Govt. of India,2005.
24. T. Altug: Introduction of Toxicology and Food, CRC Press, 2012.
25. Clarke's Analytical Forensic Toxocology by A. Negrusz and G. Cooper, 2nd Ed., Pharmaceutical Press, 2013.
26. Spot test in Organic Chemistry by Feigl.
27. M D Cole: The Analysis Of Drugs Of Abuse: An Instruct ion Manual

28. Welcher F; Standard Methods of Chemical Analysis, 6th Ed. Van Nostrand Reinhold, New York,1969
29. Watson C. A; Official and Standardised Methods of Analysis, Royal Society of Chemistry, UK, 1994.
30. Marie P. Kautsky: Steroid analysis by HPLC.

24-358-0308- EXPLOSIVE ANALYSIS AND POST BLAST INVESTIGATION

COs	Course Outcome Statements	
CO1	Understand about the type and chemistry of explosives	K2
CO2	Understand and demonstrate the forensic instruments used in post blast investigation and analysis of explosive residues.	K2
CO3	Explain and demonstrate the techniques and instrumentations used arson case examination	K4
CO4	Understand chemistry behind combustion and analysis of fire patterns	K3.K4
CO5	Reconstruction of fire scenes and analysis of inflammable liquid residues	K3,K4
K1– Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate		

Course Outcomes	Programme Specific Outcomes					
	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO1	**0**	**2**	**2**	**2**	**2**	**3**
CO2	**1**	**3**	**3**	**1**	**2**	**3**
CO3	**1**	**3**	**3**	**2**	**2**	**3**
CO4	**1**	**3**	**3**	**3**	**2**	**3**
CO5	**1**	**3**	**2**	**3**	**2**	**3**

Module I: Explosive Chemistry **(14 hrs)**

Introduction and Chemistry of explosives, Oxygen balance, explosive power index, Temperature of chemical explosion, Force and pressure of explosion. Kinetics of explosive reactions. Types of explosives (primary & secondary explosives). Differentiation between High and Low Explosives. General methods of manufacture of explosives. Types of Explosions: Atomic explosion, Physical explosion, Chemical explosion, Explosion and effects. Type of hazards, Effect of blast wave on structures and human etc. Chemical warfare agents: classification ,physical and biochemical properties ,toxic effects detection by biosensors and various instrumental techniques.

Module II: Type of explosives **(14 hrs)**

Black powder, Nitro Cellulose, Nitro Glycerin, Dynamite, Ammonium nitrate. Commercial explosives (permitted explosives, ANFO and slurry explosives). Military explosives (picric acid, tetryl, TNT, Nitro guanidine, PETN, RDX, HMX and polymer bonded explosives). Bombs, Crude bombs, Home-made bombs, Improvised Explosive Devices (IEDs), Molotov Cocktail. Aircraft

explosive sabotage investigation. Improvised explosive characteristics and detection. Vehicle borne IED, collection packing and analysis.

Module III: Post Blast Investigation and Explosive Residue Analysis (14 hrs)

Disposal of bombs, Explosions effects, Role of Forensic Scientist in Post blast investigation. Collection of samples and methods for extraction of explosive from post blast material/ and debris. Forensic pathology of explosive injury. Evaluation and assessment of explosion site and reconstruction of sequence of events. Equipment used for detection of explosives and explosive devices. Portable explosive detection instruments. Trace detection and identification of organic explosives. Qualitative analysis of explosives and explosion residue by colour tests. TLC, HPTLC, High Performance Liquid Chromatography, FTIR, GC-MS, X- ray diffraction, ICP. Significance of analytical research in explosive investigation. Case studies.

Module IV: Chemistry and Physics of Combustion (14 hrs)

Introduction, national fire protection association. Fire and arson, motives and pathology of arson. Scientific approach to fire investigation, modern fire analysis. Fire and energy, basic chemistry, chemistry and behavior of fire. State of matter and behavior of gases, liquids and solids, stereochemistry and Flammable limits. Introduction, ignition, spontaneous and chemical ignition. Flames and flam abilities, compartmental fire (house fire). Development of fire pattern, fire modeling.

Module V: Fire and Arson Investigation (16 hrs)

Introduction, need and presumption of accidental causes, planning of investigation, survey and documentation, Determination of origin and cause of fire, Reconstruction, inventory, avoiding spoliation. Mythology of arson investigation (sources of error in fire and arson investigation). Eliminating accidental cause, investigating fatal fire and vehicular fire. Origin determination, hypothesis development and testing of hypothesis. Evidence collection, preservation. Reporting procedures and conclusion. Professional practice of fire investigation. Introduction, Evolution of separation and analytical techniques and standard methods. Isolation of the residue, Analysis of ILR (ignitable liquid residue). Criteria for identification 1) Identification of gasoline 2) distillates and other classifiable products. Improving sensitivity and estimation of the degree of evaporation. Reporting procedures, quality assurance and conclusion. Evaluation of ignition sources. Introduction 1) Joint examination of physical evidence appliances and electrical components 2) Testing of ignition scenario, spontaneous ignition tests, conclusion.

Recommended reading:

1. Scientific protocols for fire investigation John J. Lentini CRC press.
2. Practical fire and arson investigation David R. Redsicker, John J.O ‘Connor CRC press.

3. Laboratory Procedure Manual: Petroleum Products, Directorate of Forensic Science, MHA, Govt. of India, 2005
4. Working Procedure Manual on Forensic Chemistry: Directorate of Forensic Science MHA Govt. of India, 2005.
5. Welcher F; Standard Methods of Chemical Analysis, 6th Ed.Van Nostrand Reinhold, New York, 1969.
6. Watson C. A; Official and Standardised Methods of Analysis, Royal Society of Chemistry, 7. UK,1994.
7. Bassett: Vogel's Text Book of Quantitative Inorganic Analysis, Longman, 1978.
8. Vogel, A. I: Text Book of Practical Organic Chemistry including Qualitative Organic Analysis, ELBS, 1971.
9. Skoog, D. A., West, D. M. and Holler, F. J: Analytical Chemistry: An Introduction, Saunders College, 1994.
10. Siegel, J. A, Saukko, P. J. and Knupfer, G. C: Encyclopedia of Forensic Sciences, Academic Press, 2000.

24-358-0309- ENVIRONMENTAL BIOTECHNOLOGY AND MICROBIAL FORENSICS

COs	Course Outcome Statements	
CO1	Understand the principles and techniques of recombinant DNA technology and its applications in bioprocess engineering.	K2
CO2	Understanding the concepts and techniques of Animal and Plant biotechnology	K2
CO3	Analyze the production of industrially important primary and secondary metabolites from plants and microbes and their role in biotherapeutics.	K3
CO4	Explain the concepts and methodologies of microbial forensics, including the identification and analysis of microbial agents of forensic importance.	K3
CO5	Apply forensic anthropology and odontology techniques to identify human remains and determine key characteristics such as age, sex, ancestry, and dental records.	K5
K1– Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate		

Course Outcomes	Programme Specific Outcomes					
	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO1	**1**	**2**	**3**	**3**	**3**	**2**
CO2	**0**	**1**	**1**	**3**	**3**	**2**
CO3	**0**	**1**	**3**	**3**	**3**	**2**
CO4	**1**	**2**	**3**	**3**	**3**	**2**
CO5	**1**	**2**	**3**	**3**	**3**	**2**

Module I: Recombinant DNA Technology, Bioprocess and Bio-chemical Engineering (12 hrs)

DNA modifying enzymes, Cloning strategies: Genomic libraries, cDNA libraries, single gene cloning. RAPD, RFLP and AFLP. Vectors: Types of vectors and choice of vectors- Plasmids, cosmids, lamda phage vectors, shuttle vectors, BACs and YACs. Transformation anTransfection.Expression systems in Eukaryotic cells, Yeast, Bacteria, Insect cell lines, Gene screening. Biosafety guidelines and containment strategies. Bioreactor design: Body construction, aeration and agitation, operation and applications. Microbial Growth: measurement, batch and continuous culture and its kinetics. Downstream processing: recovery and purification of products. Strains improvement. Fermentation economics.

Module II: Animal and Plant biotechnology (12 hrs)

Introduction to Animal and Plant biotechnology: Cell lines: Definition, development, maintenance and management, established cell lines and their characteristic features. Transgenic animals-Creating transgenic animals, Example of transgenic animals-Dolly, Insects, Primates, mice.

Somaclonal and gametoclonal variation: applications and limitations. Transgenic Plants: Herbicide

resistant, insect resistant, drought/stress resistant, delayed ripening, Ti Plasmid and T-DNA.

Module III: Bio therapeutics and Industrial Microbiology (12 hrs)

Introduction to industry important recombinant proteins, recombinant protein stability, Improvised recombinant protein secretion, Introduction to industrially important primary and secondary metabolites from plants and microbes. Microbial production: Antibiotics, acetic acid, lactic acid, wine, beer, SCP. Food borne – shigella, salmonella. etc. Forensic aspects of biological toxins. Regulatory affairs and IPR: Basic principles of quality control (QC) and quality assurance (QA). Guidelines for QA and QC: raw materials, products and validation. Introduction to pharmacopoeia. Intellectual Property Rights.Importance of protecting scientific discoveries. IPR policy of Government of India. Patent: Qualification (novel, commercial and non-obvious), jurisdiction of patent laws, Indian and international patent laws, filing procedures.

Module IV: Microbial Forensics (14 hrs)

Defining the microbial forensics program, epidemiology, microbial forensic tools. Dynamics of disease transmission, Outbreak Investigation., Deliberate introduction of a biological agent. Microbes of Forensic Importance: *Bacillus anthracis, Yersinia pestis, Francisella tularensis, Brucella spp., Burkholderia Pseudomallei, Clostridium botulinum, Listeria monocytogenes* and their morphological and biochemical studies. DNA of microbes in soil for crime detection. Fungi of forensic importance: Opportunistic mycoses, *Chytridiomycota zygomycota*, *Aspergillus fumigates*, *Microsporidum*, *Pneumocytosis jiroveci*, *Asp.flavus* & *Candida* sp, epidemiology, Antifungal agents. Biological agents in warfare: Collection, transportation and preservation of microbial forensic samples, Categories of biological weapons. Recent outbreaks of viral diseases. Biosafety and biosecurity, Bio surveillance, documentation, and case studies.

Module V: Anthropology and Odontology (14 hrs)

Introduction to forensic anthropology. Forensic Anthropometry, osteometry. Relative dating techniques, Chronometric dating techniques. Identity of missing person by superimposition techniques. Facial reconstruction method. Portrait parley. Identification through somatometric and somatoscopic observation. Genetic traits of forensic significance. Sexing human skeletal remains. Racial differences in human skeleton. Distinguishing humans from other non- human skeletal remains. Bio-archaeology: Field recovery methods. Laboratory processing, curation and chain of custody. Age at death, sex, ancestry, height and weight, pre-mortem injury and disease, taphonomy, perimortem trauma, postmortem trauma. DNA Kinship and identity. Types of dentitions, basic structure of human teeth. Types of teeth and their morphology. Identification of individuals from teeth, ante-mortem and post-mortem dental records. Ages of eruption and other individual characteristics.Dental anomalies and their role in personal identification.Bite marks: Types and forensic importance. Role of Forensic Odontology in mass disaster victim identification.

Recommended reading:

1. Application areas of anthropology, Anil Mahajan & Surinder Nath Reliance Publishing House.
2. Dental Anthropology, V.Rami Reddy Inter-India Publication,
3. A manual of biological Anthropology, Indra P. Singh & M.K. Bhasin Kamla Raj Enterprises.
4. Anthropology, Fred Plog, Clifford J. Jolly & Danial G. Bates Alfred A. KNOPF NewYork.
5. The use of Forensic Anthropology, Robert Pickering & David Bachman CRC Press.
6. Physical Anthropology, B.R.K. Shukla & Sudha Rastogi Palaka Prakashan.
7. The Forensic Anthropology Laboratory, Michael W. Warren, Heather A.Haney& Laurel E. Freas; CRC Press, (2008).
8. Forensic recovery of human remains: Dopras, Schultz, Whirler, Williams.
9. Advances in Forensic Taphonomy, Method theory and Archaeological perspective.
10. Forensic Dental evidence, Mike Bowers, Elsevier Publ.
11. Practical forensic odontology, DH Clark, Butterworth-Heinemman Publ.
12. Bite Mark Evidence, Robert BJ Dorian, 1st Ed, CRP Press, 2004.
13. Forensic Dentistry, Senn DR and PG Simson, 2nd Ed, CRP Press, 2010.
14. Pharmaceutical Biotechnology: Concepts & Applications – Gary Walsh (Wiley).
15. Modern Industrial Microbiology and Biotechnology – Nduka Okafor (Science Publisher).
16. Biotechnology and Biopharmaceuticals – Rodney J.Y.H.O and Milo Gibaldi (Wiley).
17. Biotechnology in Healthcare – Gavin Brooks (PLP).
18. Gene Therapy: Protocols - Joseph M. Le Doux (Humana Press).
19. Biotehnology – Applying the genetic revolution – David P. Clark and Nanette J. Pazdarnik, Academic Press, ISBN: 978-0121755522.
20. Molecular Biotechnology: Principles and Applications of Recombinant DNA, 4th Edition – Bernard G. Glick, Jack J. Pasternak and Cheryl L. Patten, ASM Press, ISBN: 9781555814984.
21. Plant, Gene and Crop Biotechnology, 2nd Edition – Maarten J. Chrispeels and David E. Sadava, Jones and Bartlett Publishers, ISBN: 978-0763715861.
22. Biotechnology – U. Satyanarayana, Books and Allied (P) Ltd.
23. Plant Tissue Culture by MK Razdan & SS Bhojwani (1996) Elsevier.
24. Freshney, Culture of Animal Cells, 5th Edition, Wiley-Liss, 2005.
25. Ed. John R.W. Masters, Animal Cell Culture - Practical Approach,3rd Edition, Oxford University Press, 2000.
26. Microbial Forensics : Roger G Breeze, Bruce Budowle, Steven E Schutzer.
27. Microbial Forensics : Bruce Budowle, Steven E Schutzer, Roger G Breeze, Paul S Keim, Stephen A Morse.
28. Chemical and Physical Signatures for Microbial Forensics: Cliff, J.B, Kreuzer, H.W, Ehrhardt C.J, Wunschel, D.S.

24-358-0310- WILDLIFE FORENSICS AND ENTOMOLOGY

COs	Course Outcome Statements	
CO1	Understand biogeographic zones, wildlife conservation importance, and species conservation status.	K2
CO2	Analyze wildlife protection laws and evaluate the impact of illegal wildlife trade.	K4
CO3	Apply techniques for securing and processing wildlife crime scenes and collecting physical evidence.	K5
CO4	Examine methods for investigating wildlife crimes and identifying hunting methods and species.	K5
CO5	Utilize DNA analysis for species identification and individual and relatedness analysis in wildlife forensics.	K4
K1– Remember K2 – Understand K3 – Apply K4 –Analyze K5 –Evaluate		

Course Outcomes	Programme Specific Outcomes					
	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO1	**0**	**1**	**2**	**1**	**1**	**2**
CO2	**1**	**1**	**2**	**1**	**1**	**2**
CO3	**2**	**3**	**3**	**2**	**2**	**3**
CO4	**0**	**2**	**3**	**2**	**2**	**3**
CO5	**2**	**3**	**3**	**2**	**2**	**3**

Module I: Introduction to Wildlife Forensics **(14 hrs)**

Biogeographic zones of India- wildlife sanctuaries, national parks, biosphere reserves, world heritage sites, ramsar sites, special focus on Western Ghats. Definition of wildlife, causes of wildlife depletion, economic importance of wildlife, need for wildlife conservation. History of wildlife management and conservation in India. Forensically important wild flora and fauna- rare, endangered, threatened and endemic species of fishes, amphibians, reptiles, birds and mammals in India; India as a mega wildlife diversity country. IUCN revised red list categories, Red Data Book and red listing.

Module II: Type of Wildlife Crimes **(16 hrs)**

Overview of Wildlife (Protection) Act, 1972 and subsequent amendments; Wildlife Crime Control Bureau; The Indian Forest Act 1927 and subsequent amendments; Forest Conservation Act 1980 and Rules; Biodiversity Act 2002; Biodiversity Rules 2004; Plant Varieties Protection and Farmer's Rights Act 2001; Geographical Indications of Goods Act 1999; The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act 2006. Overview of Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), International Tropical Timber Agreement. Types of wildlife crimes- extent and kind of wildlife

trade at national and international levels. Ramification of wildlife trade on in-situ conservation specially related to species demography. Illegal trade in flora and fauna with special reference to turtles, reptiles, birds and mammals and plant trade in India. Identification of species from different parts of reptiles, birds, mammals and plants.

Module III: Crime Scene Processing (14 hrs)

Approaching, defining and securing wildlife crime scene; Scene processing steps, Mapping and sketching the scene. Identification of physical evidence of wildlife crime. Evidence collection, preservation and processing of a wildlife crime scene. Trace evidence associated with fish and reptiles – scales, skin, and fish fillet identification. Trace evidence associated with avian/ mammal species– feathers, hair, bones, horns, nails; elephant teeth and tusk; tiger fur etc. Timber identification- Sandalwood, Teakwood, etc., Medicinal plants (MPs) and its identification.

Module IV: Forensic entomology and wildlife crimes (12 hrs)

Entomology and botany in wildlife forensic investigation. Decomposition analysis. Killing of wildlife animals- evidence of hunting, poisoning, bait bombs, electrocution etc. Differentiation of human and animal blood- field and laboratory analysis. Aspects of wildlife osteology- species identification, carcass identification. Morphometric identification. Live animal examinations, necropsy overview, samples from live and dead animals. Pugmark identification of various animals.

Module V: DNA Analysis (16 hrs)

DNA and its practical applications in wildlife crime scene processing. Collection, preservation and transportation of Blood – Blood stains – Feces (or Scat) – Hair/ Feathers – Horn/ Ivory/ Bone – Meat – Skin – soft tissue for DNA analysis. DNA isolation from fresh blood with sodium per chlorate - soft tissues (meat, cooked meat, flesh, dried meat and skin pieces) - Blood and blood stains - Bone, tusk, teeth and horns – Hair – Feathers. Quantification and quality check of DNA. Species identification technique- Mitochondrial cytochrome b (Cytb), BLAST, NCBI database, Consortium of Barcode of Life (COBOL), genetic markers for plant and animal identification. Microsatellite genotyping for individual identification of animals. Relatedness and paternity analysis, report writing and court room presentation, case studies.

Recommended reading:

1. Berwick, S.H. and Saharia, V.B. 1995. Wildlife Research and Management. OUP, New Delhi.
2. Dasmann, R.F. 1982. Wildlife Biology.
3. Rajesh, G. Fundamentals of Wildlife Management, Justice Home, Allahabad.
4. Sawarkar B. Wildlife Management.

5. Mullineaux, E., & Keeble, E. (2016). *BSAVA manual of wildlife casualties* (No. Ed. 2). British Small Animal Veterinary Association.
6. Practical Crime Scene Processing and Investigation; Ross M. Gardner, 2nd Edition, Taylor & Francis Group, LLC, 2012.
7. Wildlife Forensic Investigation: Principles & Practice; John E. Cooper, Margaret E. Cooper. CRC Press, 2013.
8. UNODC. (2016). Best practice guide for forensic timber identification. *United Nations office on drugs and crime: international consortium on combating wildlife crime*.
9. Bhat, K. V., Balasundaran, M., & Balagopalan, M. (2006). Identification of *Santalum album* and *Osyris lanceolata* through morphological and biochemical characteristics and molecular markers to check adulteration. *Kerala Forest Research Institute, Thrissur, India*.
10. Arun Suma, E. M. Muralidharan, P. Sujanapal, M. Balasundaran. Identification of market adulterants in East Indian sandalwood using DNA barcoding. Annals of Forest Science, Springer Nature (since 2011)/EDP Science (until 2010), 2014, 71 (6), pp.517-522. ff10.1007/s13595-013- 0354-0ff. ffhal01101762.
11. Handbook: Standard Operating Procedures for forensic investigations of suspected illegal killings of Wildlife. Research Institute of Wildlife Ecology (FIWI) of the University of Veterinary Medicine Vienna, Austria /Alpbionet 2030 projectISBN: 978-3-200-06798-1.
12. Negi, S. B. (2013). Wildlife crime investigation a hand book for wildlife crime investigation officers. *New Delhi: Wildlife Crime Control Bureau, Ministry of Environment and Forests Government of India*.
13. Gaur, A., & Reddy, A. (2017). DNA techniques in wildlife forensics (animals): standard operating procedures (SOP). *CSIR Centre for Cellular and Molecular Biology, Hyderabad, 37*.
14. Dormontt, E. E., Boner, M., Braun, B., Breulmann, G., Degen, B., Espinoza, E., ... & Lowe, A. J. (2015). Forensic timber identification: It's time to integrate disciplines to combat illegal logging. *Biological Conservation*, *191*, 790-798.

24-358-0311- CYBER SECURITY AND DIGITAL FORENSICS

COs	Course Outcome Statements	
CO1	Gain a foundational understanding of cyber forensics and security principles.	K3
CO2	Identify and mitigate common web application vulnerabilities and apply secure coding practices.	K3
CO3	Develop skills in network scanning, intrusion detection, perimeter defense, and network incident response.	K3
CO4	Acquire knowledge in mobile device architecture, forensic acquisition, data analysis and mobile application security.	K3
CO5	Develop skills in image forensics and stenography	K3
K1– Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate		

Course Outcomes	Programme Specific Outcomes					
	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO1	**0**	**2**	**2**	**2**	**2**	**2**
CO2	**0**	**2**	**2**	**1**	**2**	**2**
CO3	**0**	**3**	**2**	**2**	**2**	**2**
CO4	**0**	**1**	**2**	**2**	**2**	**3**
CO5	**0**	**3**	**3**	**2**	**2**	**3**

Module 1: Cyber Forensics and Cyber Security **(12 hrs)**

Introduction to Cyber Forensics, Introduction to Cyber Security, Role of Networking in Cyber Forensics and Cyber Security, Evolution and Impact of the Internet, Internet Services and Process, World Wide Web and Web Technologies, Web Hosting and Development, Website Legal Issues, Concept of Cyberspace, Legal Framework for Cyberspace.

Module 2: Web Application Security **(12 hrs)**

Understanding Web Application Vulnerabilities, Client-Side and Server-Side Vulnerabilities, Cross-Site Scripting (XSS) Attacks, SQL Injection Attacks, Cross-Site Request Forgery (CSRF) Attacks, Authentication and Session Management, Secure Web Application Design, Web Application Firewalls, Secure Coding Practices, Web Application Security Testing.

Module 3: Network Security and Forensics **(14 hrs)**

Network Scanning and Enumeration, Network Eavesdropping and Countermeasures, Firewall Technologies and Configuration, Intrusion Detection and Prevention Systems, Network Security Zones and Perimeter Defense, Secure Network Infrastructure Design, Cryptography and Encryption, Computer Network Forensics, Wireless Network Security, Network Incident Response and Recovery.

Module 4: Mobile and Smartphone Forensics **(14 hrs)**

Introduction to Mobile Forensics, Mobile Device Architecture and Operating Systems, Mobile Forensic Acquisition Techniques, Mobile Forensic Data Analysis, Recovering Deleted Data from Mobile Devices, Mobile Application Security, Mobile Device Malware Analysis, Cloud Forensics for Mobile Devices, Forensic Analysis of Messaging Apps, Mobile Device Incident Response.

Module 5: Image Forensics and Steganography **(12 hrs)**

Introduction to Image Forensics, Image Manipulation Detection Techniques, Authenticity Verification of Digital Images, Steganography and Steganalysis, Forgery Detection in Digital Images, Image Metadata Analysis, Multimedia Forensics, Video Forensics and Analysis, Deepfake Detection and Analysis, Emerging Trends in Image Forensics.

Recommended reading:

1. Carrier, B. (2014). File System Forensic Analysis. Addison-Wesley Professional.
2. Casey, E. (2011). Digital Evidence and Computer Crime: Forensic Science, Computers and the Internet. Academic Press.
3. Sammons, J. (2018). The Basics of Digital Forensics: The Primer for Getting Started in Digital Forensics. Syngress.
4. Rehman, R., & Islam, S. (Eds.). (2016). Cyber Security: Analytics, Technology and Automation. Springer.
5. McAfee, R., & Owens, H. (2014). Cyber Forensics: A Field Manual for Collecting, Examining, and Preserving Evidence of Computer Crimes. Apress.
6. Kim, J., & Solomon, M. G. (2015). Web Application Vulnerabilities: Detect, Exploit, Prevent. Syngress.
7. Sommer, P., & Brown, E. (2013). Ethical Hacking and Penetration Testing Guide. Syngress.
8. Doupé, A., et al. (2016). "Why Johnny Can't Pentest: An Analysis of Black-Box Web Vulnerability Scanners." IEEE Symposium on Security and Privacy.
9. Adelstein, F., & Amoroso, E. (2006). The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws. Wiley.

10. Wieser, D., et al. (2015). "Beyond XSS: Towards Interactive Exploitation of Web Vulnerabilities." IEEE Symposium on Security and Privacy.
11. Stallings, W. (2017). Network Security Essentials: Applications and Standards. Pearson.
12. Carvey, H. (2014). Windows Forensic Analysis Toolkit: Advanced Analysis Techniques for Windows 8. Syngress.
13. Ogletree, T., et al. (2013). "Network Forensics: Exploring Network Intrusions and Cybercrime." Communications of the ACM.
14. Raghavan, P., & Krishnan, K. (2016). Cyber Security: Understanding Cyber Crimes, Computer Forensics, and Legal Perspectives. Auerbach Publications.
15. Easttom, C. (2014). Network Defense and Countermeasures: Principles and Practices. Pearson.
16. Baggili, I., et al. (2015). Mobile Forensics: Advanced Investigative Strategies. Syngress.
17. Casey, E., & Aquilina, J. (2012). Malware Forensics: Investigating and Analyzing Malicious Code. Syngress.
18. IPhone Forensics: Recovering Evidence, Personal Data, and Corporate Assets (2008). Syngress.
19. Quick, D., & Choo, K. K. R. (2016). Handbook of Digital Forensics of Multimedia Data and Devices. Wiley.
20. Zhang, R. (2013). Android Application Security: A Semantics and Context-Aware Approach. Springer.
21. Sencar, H. T., & Memon, N. (2006). Digital Image Forensics: There is More to a Picture than Meets the Eye. IEEE Signal Processing Magazine.
22. Fridrich, J., et al. (2012). "Rich Models for Steganalysis of Digital Images." IEEE Transactions on Information Forensics and Security.
23. Khan, A., et al. (2016). "A Comparative Study of Recent Image and Video Forensics Techniques." Journal of Real-Time Image Processing.
24. Hussain, M., et al. (2017). "DeepFake Video Detection Using Recurrent Neural Networks." IEEE International Conference on Multimedia Big Data.
25. Gironi, A., et al. (2020). "Detection of GAN-Based Deepfake Images Using Style Transfer Features." IEEE Access.

24-358-0312- ETHICAL HACKING, RECOVERY, FORENSIC AND DIGITAL IMAGE PROCESSING

COs	Course Outcome Statements	
CO1	Understand the principles and techniques of ethical hacking.	K2
CO2	Explain the protocols and preventive measures for securing digital systems.	K3
CO3	Understand the techniques and methods for data recovery and restoration.	K2
CO4	Understand digital image processing fundamentals and techniques.	K2
CO5	Apply digital image processing techniques for analysis and manipulation.	K5
K1– Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate		

Course Outcomes	Programme Specific Outcomes					
	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO1	**0**	**2**	**3**	**2**	**3**	**3**
CO2	**0**	**3**	**3**	**3**	**3**	**3**
CO3	**0**	**3**	**3**	**2**	**3**	**3**
CO4	**0**	**2**	**3**	**2**	**2**	**3**
CO5	**1**	**3**	**3**	**3**	**2**	**3**

Module I: Ethical Hacking Fundamentals **(14 hrs)**

Introduction to Ethical Hacking, Malicious and Hostile Code, Identification, Authentication, and Authorization, Computer Security and Risk Management, Risk Analysis and Threat Probability, Preventive Measures and Security Breach Analysis.

Module II: Data Recovery and Restoration **(16 hrs)**

Understanding Data Storage Mechanisms, Data Deletion and Recovery Concepts, Recovery Software and Limitations, Partition Recovery and Data Restoration, Recovery from Corrupted/Formatted/Deleted Hard Drives, Backup and Restoration Techniques.

Module III: Digital Image Processing Fundamentals (14 hrs)

Elements of Digital Image Processing, Image Enhancement Techniques, Image Restoration and Compression, Morphological Image Processing, Image Segmentation Techniques, Edge Detection and Boundary Detection

Module IV: Steganography and Steganalysis (14 hrs)

Introduction to Steganography, Information Hiding and Watermarking, Steganography Methods and Techniques, Steganalysis and Detection Algorithms, Digital Watermarking and Security, Content Authentication and Attacks

Module V: Pattern Recognition and Analysis (14 hrs)

Introduction to Pattern Recognition, Bayesian Decision Theory, Principal Component Analysis (PCA), Hidden Markov Models for Sequential Pattern Classification, Nonparametric Methods and Neural Networks, Linear Discriminant Function-based Classifiers

Recommended reading:

1. CEH Certified Ethical Hacker All-in-One Exam Guide by Matt Walker
2. The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws by Dafydd Stuttard and Marcus Pinto
3. Metasploit: The Penetration Tester's Guide by David Kennedy, Jim O'Gorman, Devon Kearns, and Mati Aharoni
4. Hacking: The Art of Exploitation by Jon Erickson
5. The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy by Patrick Engebretson
6. Digital Forensics and Incident Response: Incident Response Techniques and Procedures by Gerard Johansen
7. Digital Evidence and Computer Crime: Forensic Science, Computers, and the Internet by Eoghan Casey
8. File System Forensic Analysis by Brian Carrier
9. Windows Forensic Analysis Toolkit: Advanced Analysis Techniques for Windows 7 by Harlan Carvey
10. Practical Forensic Imaging: Securing Digital Evidence with Linux Tools by Bruce Nikkel
11. Digital Image Processing by Rafael C. Gonzalez and Richard E. Woods
12. Digital Image Processing: An Algorithmic Introduction using Java by Wilhelm Burger and Mark J. Burge
13. Digital Image Processing and Analysis: Human and Computer Vision Applications with CVIPtools by Scott E. Umbaugh

14. Handbook of Medical Imaging: Processing and Analysis Management by Isaac N. Bankman (Editor)
15. Practical Image and Video Processing Using MATLAB by Oge Marques
16. Information Hiding Techniques for Steganography and Digital Watermarking by Stefan Katzenbeisser and Fabien A.P. Petitcolas
17. Steganography Techniques for Digital Images by Jean-Francois Couchot and Frederic Petitcolas
18. Digital Watermarking and Steganography: Fundamentals and Techniques by Frank Y. Shih
19. Applied Cryptography: Protocols, Algorithms, and Source Code in C by Bruce Schneier
20. Handbook of Digital Forensics and Investigation by Eoghan Casey
21. Pattern Recognition and Machine Learning by Christopher M. Bishop
22. Pattern Classification by Richard O. Duda, Peter E. Hart, and David G. Stork
23. Digital Image Processing and Pattern Recognition by Chi-Hau Chen
24. Neural Networks for Pattern Recognition by Christopher M. Bishop
25. Machine Learning: A Probabilistic Perspective by Kevin P. Murphy

24-358-0313 - LABORATORY - FORENSIC DERMATOGLYPHICS AND GRAPHOLOGY

COs	Course Outcome Statements	
CO1	Students will gain knowledge and demonstrate the process of collection and analysis of fingerprint evidence	K3
CO2	Demonstration of various methods of fingerprint development.	K4
CO3	Students will gain knowledge and demonstrate the process of collection and analysis of foot print and footwear impression	K4
CO4	Students will gain knowledge and demonstrate the instrumental techniques used for the forensic examination of documents..	K4
K1– Remember K2 – Understand K3 – Apply K4-Analyze K5 – Evaluate		

Course Outcomes	Programme Specific Outcomes					
	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO1	**1**	**3**	**3**	**2**	**3**	**3**
CO2	**1**	**3**	**3**	**2**	**2**	**3**
CO3	**1**	**3**	**3**	**2**	**2**	**3**
CO4	**1**	**3**	**3**	**2**	**2**	**3**

1. Laboratory Equipments:- Working and handling of Stereo Zoom Microscopes, Comparison.Microscope, Video Spectral Comparator, Electrostatic Detection Apparatus.
2. Forensic identification of class and individual characteristics of handwriting
3. To detect and decipher alterations in a document
4. To decipher secret writings, indentations and charred documents.
5. To study the handwriting of ethnic and population groups.
6. Reconstruction of torn sheets of paper.
7. Examination of creases and folds and determination of sequence of strokes.
8. Examination of Security Documents – Indian Bank Notes under VSC.
9. Examination of Travel Documents – Indian Passports and Visas under VSC.
10. Examination of Stamp Papers and Lottery Tickets.
11. Examination of paper.
12. Analysis of inks by TLC.
13. Identification of normal/ disguised writings.
14. Detection of built-up documents.
15. Examination of anonymous letters.
16. Application of Forensic Stylistics in personal identification.
17. Effect of writing instruments, posture and emotions on handwriting.

18. Examination of rubber stamp impressions and other mechanical impressions.
19. Determination of relative age of the document.
20. Detection of Forgeries including freehand and traced forgery.
21. Detection of simulated forgery.
22. Examination of alterations, additions, obliterations, overwritings and erasures. .
23. To develop latent finger Prints with Powder methods.
24. To develop latent finger Prints with Fuming methods.
25. To develop latent finger Prints with Chemical methods.
26. Development of fingerprint on pen drive.
27. Development of fingerprint on CD/ DVD.
28. Development of fingerprint on hard disk.
29. Development of fingerprint on glass.
30. To obtain class characteristics of fingerprints
31. To obtain individual characteristics of fingerprints
32. Study of pores on friction ridges
33. Sweat Analysis of palmer and plantar surfaces.
34. To perform ridge tracing and ridge counting.
35. Fingerprint classification using Henry system
36. To measure the Gait of Individuals under various circumstances
37. To study various wear and tear characteristics on footwear
38. To examine anatomical difference in footprints of individuals. Under various Circumstances.
39. Casting/Lifting/Evaluation of Footprints/Footwear Impressions
40. Casting/Lifting/Evaluation of Tyre marks/skid marks
41. Casting/Lifting/Evaluation of tool marks on different objects
42. Serial number restoration on various surfaces
43. Classification/Lifting/Analysis of Lip prints
44. Casting/Lifting/Evaluation of Ear prints
45. Casting/Lifting/Evaluation of Bite marks on various surfaces.

Reference

1. DFS manual
2. Daluz, H. M. (2014). Fundamentals of Fingerprint Analysis. United States: Taylor & Francis.

24-358-0314- LABORATORY - PHYSICAL EVIDENCE AND BALLISTICS

COs	Course Outcome Statements	
CO1	Students will gain knowledge and demonstrate the process of collection and examining fiber, soil, glass, paint and other physical evidence.	K3
CO2	Demonstrate the tool for the forensic analysis of vehicle accidents	K4
CO3	Analysis of various components of firearms by dismantling and assembling	K4
CO4	Tool mark analysis And restoration of serial numbers in vehicles	K4
K1– Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate		

Course Outcomes	Programme Specific Outcomes					
	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO1	**1**	**2**	**3**	**2**	**2**	**3**
CO2	**1**	**3**	**3**	**2**	**1**	**3**
CO3	**0**	**2**	**3**	**2**	**1**	**3**
CO4	**0**	**3**	**3**	**1**	**2**	**3**

1. Florescence examination of glass samples and determination of U.V. absorption cut-off of transparent sheet.
2. Studies of hackle and rib marks in radial and concentric fractures in a glass sheet caused by pointed tool at different angle.
3. Determination of number of layers, sequence of layers and their thickness in paint chip.
4. Microscopic and spectroscopic examination of man-made fibre.
5. To detect adulteration in cement samples.
6. To determine the ratio of cement, fine aggregate and course aggregate in cement concrete sample.
7. Comparison of control soil samples with soil sample taken from victim/suspect by density gradient distribution method.
8. Determination of ignition loss and pH of soil samples.
9. Mineralogical study of soil samples.
10. Physical and microscopic studies of affected electric wires, panel boards due to electrical overload and short-circuit.
11. Studies of cut-marks/tear marks characteristic on cloths using different cutting and tearing tools.

12. Studies of cut-marks striations on metallic wire cut-ends using cutting pliers and its linkages with cutting plier tools.
13. Studies of different characteristics hammer impressions of iron metal sheet and their linkage with the hammers used.
14. Studies of cut marks striations using motorized hacksaw blade and hand driven hacksaw tool.
15. Photographic juxtaposition comparison of tool marks striation.
16. Study of microscopic characteristics of fused bulb filaments of vehicle head light.
17. Photography of road signs, road signals, pavements and road markings and its documentations.
18. To separate different components of shotgun cartridges, identify them and record their different measurements.
19. To separate different components of all-metal cartridges, identify them and record their different measurements.
20. To dismantle and assemble various components of firearms.
21. To study the characteristics of firearms-caliber, choke, proof marks etc., to prepare sulphur casts of bore.
22. To study the locks of various firearms, measurement of trigger pull, liability of accidental discharge of firearms.
23. To determine shot number from size and weight of shots
24. Determination of velocity and energy of bullets.
25. Comparison of compression/ striated tool marks - to prepare cast/sample for study of compression and striated tool-marks.
26. To determine whether given ammunition/ components of ammunition are fired or not.
27. TLC/ HPTLC/HPLC/GC of propellants loaded in shotgun, rifle and handgun cartridges.
28. IR spectra of propellants loaded in shotgun, rifle and handgun cartridges
29. FTIR analysis of propellants particles found inside the fired cartridge case, barrel and on the target around gun-shot hole- comparison of results.
30. Preparation of gel block and study of wound ballistic parameters for bullets fired from handguns and .22-rifle – determination of entry, exit and path of the bullet on fired gel block.

Reference

1. DFS manual
2. Heard, B. J. (2011). Handbook of Firearms and Ballistics: Examining and Interpreting Forensic Evidence. Germany: Wiley.

26. Saferstein, R. (2015). Forensic Science: From the Crime Scene to the Crime Lab. United Kingdom: Pearson.

24-358-0315- LABORATORY - PHARMACOLOGY AND DRUG ANALYSIS

COs	Course Outcome Statements	
CO1	Students will gain knowledge and demonstrate the process of collection and examining narcotic drug and psychotropic substances.	K3
CO2	Demonstrate the instrument for the forensic analysis of petroleum products.	K4
CO3	Forensic analysis of food products by instrumentation	K4
CO4	Demonstrate instruments for detection of adulteration.	K4
K1– Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate		

Course Outcomes	Programme Specific Outcomes					
	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO1	**2**	**2**	**2**	**2**	**1**	**2**
CO2	**2**	**2**	**3**	**2**	**1**	**2**
CO3	**2**	**1**	**3**	**1**	**1**	**3**
CO4	**1**	**2**	**2**	**3**	**3**	**2**

1. Systematic extraction, isolation, purification and identification of volatile, acidic, basic and neutral drugs by various analytical techniques.
2. Qualitative and quantitative analysis of Pharmaceuticals by various chemical and instrumental techniques.
    - Presumptive/ screening tests.
    - Microscopic analysis
    - Microcrystalline test
    - UV spectroscopy
    - HPLC, LC-MS, GC, GC-MS, GC-IR
3. Separation of alkaloids, glycosides, tryptamines by TLC.
4. Separation of Psychotropic substance by TLC.
5. Separation of Cannabis/Opium by TLC.
6. Separation of lipids by TLC.
7. Extraction of caffeine from tea leaves, characterization by IR.
8. Estimation of protein in food samples.
9. Analysis of calcium and magnesium in milk.
10. Analysis of fire residues by GC.

11. Analysis of adulterated and non-adulterated oil by chemical/Color Test and TLC method.
12. Analysis of dye in petrol and kerosene by UV spectrophotometry and TLC.
13. Estimation of nitrite/nitrate in water samples.
14. Separation of amino acids by thin layer chromatography.
15. Analysis of petroleum products- instrumental techniques

Reference

1. DFS manual
2. UNODC manual

24-358-0316 - LABORATORY - ENVIRONMENTAL BIOTECHNOLOGY AND MICROBIAL FORENSICS

COs	Course Outcome Statements	
CO1	Students will gain knowledge and demonstrate the process of collection and examining various DNA samples	K3
CO2	The determination of age race and sex with forensic anthropometric techniques	K4
CO3	Demonstrate the forensic odontology techniques'	K4
K1– Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate		

Course Outcomes	Programme Specific Outcomes					
	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO1	**1**	**3**	**3**	**2**	**1**	**3**
CO2	**0**	**2**	**2**	**2**	**1**	**2**
CO3	**0**	**1**	**2**	**1**	**2**	**2**

1. Extraction of proteins from various biological samples.
2. Protein estimation by different techniques.
3. SDS-PAGE for protein analysis.
4. DNA extraction from various forensic samples.
5. Polymerase chain reaction.
6. STR Genotyping and interpretation.
7. Sequence comparison using BLAST.
8. Construction of Phylogenetic tree from nucleotide and protein sequences.
9. Analysis of protein structure using RASMOL.
10. Validation of various instruments.
11. Isolation of bacteria by different methods.
12. Genomic and Plasmid DNA Isolation from bacteria.
13. Restriction digestion of DNA.
14. RAPD/AFLP for GMO detection.
15. Agarose gel electrophoresis.
16. Western Blotting.

17. Preparation of the competent cells for transformation.
18. Selection of the transformed cells.
19. Growth curve of *E. Coli* and determination of growth rate and generation time.
20. Microbial production of citric acid.
21. Examination of skeletal remains- long bones- Femur, Humerus.
22. Identification of individuals by long bones and stature estimation
23. Determination of sex and age from Skull with mandible.
24. Determination of sex from pelvis and sacrum.
25. Identification of individuals by dental examination.

Reference

1. DFS manual
2. Jain, S. K. (2004). Textbook of Biotechnology: Fundamentals of Molecular Biology. India: CBS Publishers & Distributors.
3. Willey, J., Sherwood, L., Woolverton, C. (2011). Prescott's Microbiology. Italy: McGraw-Hill Education.

24-358-0317 - LABORATORY - CYBER SECURITY AND DIGITAL FORENSICS

COs	Course Outcome Statements	
CO1	Students will gain knowledge and demonstrate the process of analysing the image file for hidden files and folders including slack space.	K3
CO2	Demonstrate the Implementing Web Data Extractor and Web site watcher.	K4
CO3	Auditing Authentication, Authorization, accounting and logging configuration	K4
K1– Remember K2 – Understand K3 – Apply K4 – Analyse K5 – Evaluate		

Course Outcomes	Programme Specific Outcomes					
	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO1	**0**	**2**	**2**	**3**	**2**	**3**
CO2	**0**	**2**	**2**	**3**	**2**	**2**
CO3	**0**	**3**	**3**	**2**	**1**	**3**

1. Encrypting and Decrypting the partition using Bitlocker
2. Analysing the image file for hidden files and folders including slack space.
3. Wireless Network attacks, Bluetooth attacks
4. Drive and partition carving process
5. Malware – Keylogger, Trojans, Keylogger countermeasures
6. Understanding Data Packet Sniffers
7. Understanding the buffer overflow and format string attacks
8. Using NMAP for ports monitoring
9. Working with Trojans, Backdoors and sniffer for monitoring network communication
10. Implementing Web Data Extractor and Web site watcher.
11. Using IP TABLES on Linux and setting the filtering rules
12. Configuring S/MIME for e-mail communication
13. Lan Scanner using look@LAN, wireshark.
14. Advance firewall auditing
15. Auditing with and without network traffic
16. Auditing Authentication, Authorization, accounting and logging configuration
17. Intrusion detection and prevention configuration.

18. Firewalls Intrusion Detection and Honeypots
19. Malware – Keylogger, Trojans, Keylogger countermeasures
20. Password guessing and Password Cracking.
21. Windows Hacking – NT LAN Manager, Secure 1 password recovery
22. Penetration Testing and justification of penetration testing through risk analysis
23. Windows Hacking – NT LAN Manager, Secure 1 password recovery
24. Denial of Service and Session Hijacking using Tear Drop, DDOS attack.
25. Understanding DoS Attack Tools- Jolt2, Bubonic, Land and LaTierra, Targa, Nemesy, Blast, Panther2, Crazy Pinger, Sometrouble, UDP Flood, FSMax.
26. Email header and URL analysis
27. Scanning for vulnerabilities using (Angry IP, HPing2, IPScanner, Global Network
28. Inventory Scanner, Net Tools Suite Pack.)
29. NetBIOS Enumeration Using NetView Tool, Nbtstat Enumeration Tool (Open Source). 30. How to Detect Trojans by using – Netstat, fPort, TCPView, CurrPorts Tool, Process Viewer.
31. Understanding SQL Injection
32. Steganography using tools: Tool: Merge Streams, Image Hide, Stealth Files, Blindside, STools, Steghide, Steganos, Pretty Good Envelop.

Reference

1. DFS manual
2. Casey, E. (2009). Handbook of Digital Forensics and Investigation. Netherlands: Elsevier Science.

FOURTH SEMESTER

24-358-0401-PROJECT

The teacher who gives guidance to project work can select any topic from the syllabi related to the core/ preferably to the elective course. The topic shall be assigned to each student. The research work on this topic shall be carried out by each student under the supervision of the teacher. The report of the research work shall be submitted by each student in the form of a project which shall be attested by the Head of the Department and shall be submitted for the evaluation. A declaration by the student to the effect that the dissertation submitted by him/ her has not previously been formed the basis for the award of any degree or diploma and a certificate by the supervising teacher to the effect that the dissertation is an authentic record of work carried out by the student under his/her supervision are to be furnished in the dissertation.

As part of the project/ dissertation may be done in collaboration (association) with CFSL/ FSL/ RFSL/ FPB/ Chemical Examiner's Laboratory/ Police Academy/ Any other State or Central Institutions of Forensic importance

Abstract & introduction	:	50
Review	:	50
Report Submission	:	50
Viva-Voce & Presentation	:	50
Total	:	**200**

24-358-0402- MOOC

Students shall compulsorily register at least one MOOC (minimum 2 credit) program at the beginning of the first semester and a proof of satisfactory completion and marks/grade issued by the authority who conducted the course must be submitted to the Head of the Department. The credit of such a course will be added to the transcript of the fourth semester. MOOC must be approved by the department council.

24-358-0403- INTERNSHIP

Students shall undergo 3 months compulsory internship at SFSL/FSL/CEL/CFSL by availing summer vacation. The duration of internship will be from May to July and classes of the month of July will be conducted through online mode which includes special lectures of experts from forensic allied fields and would be calculated to student's attendance. The evaluation of internship would be done by the supervisor at the Institute/Organizations of internship followed by post internship report presentation by students at the parent department based on an assessment proforma issued by the Centre for Integrated Studies. Combined marks would be considered for credits.