Proposed syllabus and Scheme of Examination
for
B.Sc. (Honors) Forensic Science

Submitted
to

University Grants Commission
New Delhi

Under

Choice Based Credit System

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B.Sc. (Hons) in Forensic Science

Objectives

The Universal Declaration of Human Rights directs the member nations to create such conditions under which the ideals of free human beings, enjoying civil and political freedom from fear and want, can be achieved. The Constitution of India, through its various articles, strives to ensure security and safety of citizens in accordance with the principles of Universal Declaration of Human Rights. However, crime is a violation of these principles. In a country like India, where majority of population is uneducated, social set up is heterogeneous, public-police relations are not very cordial, poverty is rampant and unemployment widespread, it is not surprising that crime rate is increasing exponentially.

If we have to create conditions conducive to harmonious development, we must mitigate the crime rate. This can best be achieved by relying on the support of forensic science system. Unfortunately, in our country, forensic science is not viewed as a core investigative skill in crime detection. In fact, there is a lack of understanding of the forensic process itself. It is for this reason that less than 10% of the police cases are, at present, being referred for forensic examination. Less than 5% are solved by the application of forensic science. The rest are solved by third degree method – a practice which the human rights organizations will not allow in days to come.

In majority of serious crime cases, hi-tech measures are being adopted by perpetrators of crime. The counter measures have to be more sophisticated to surpass them. This calls for strengthening the foundations of forensic science at national level. It is with this aim that we wish to initiate a B.Sc. (Hons) Course in Forensic Science.

The following are the objectives of this course.

1. To emphasize the importance of scientific methods in crime detection.
2. To disseminate information on the advancements in the field of forensic science.
3. To highlight the importance of forensic science for perseverance of the society.
4. To review the steps necessary for achieving highest excellence in forensic science.
5. To generate talented human resource, commensurating with latest requirements of forensic science.
6. To provide a platform for students and forensic scientists to exchange views, chalk-out collaborative programs and work in a holistic manner for the advancement of forensic science.

OVERVIEW OF CURRICULUM

I. CORE COURSE

Year	Semester	Paper No.	Title of Paper
First	I	FSHT-101	Introduction to Forensic Science
		FSHT-102	Crime and Society
	II	FSHT-201	Criminal Law
		FSHT-202	Forensic Psychology
Second	III	FSHT-301	Forensic Dermatoglyphics
		FSHT-302	Technological Methods in Forensic Science
		FSHT-303	Criminalistics
	IV	FSHT-401	Forensic Chemistry
		FSHT-402	Questioned Documents
		FSHT-403	Forensic Biology
Third	V	FSHT-501	Forensic Ballistics
		FSHT-502	Forensic Toxicology
	VI	FSHT-601	Forensic Anthropology
		FSHT-602	Forensic Medicine

II. ELECTIVE COURSE

A. Discipline Specific	B. Generic Elective/Interdisciplinary
Two each in Semester V and VI. To be chosen from the following. DSE-1: Digital Forensics DSE-2: Economic Offences DSE-3: Forensic Serology DSE-4: Accident Investigations DSE-5: DNA Typing DSE-6: Dissertation/Project Work (in Semester VI only)	One each in Semester I, II, III and IV. To be chosen from the following. GE-1: Physics GE-2: Chemistry GE-3: Botany GE-4: Zoology GE-5: Anthropology GE-6: Computer Science GE-7: Economics GE-8: Psychology

III. ABILITY ENHANCEMENT COURSE

1. Ability Enhancement Compulsory	2. Ability Enhancement Elective (Skill Based)
One each in Semester I and II. AECC-1: Environmental Science AECC-2: English/MIL Communication *The College will have an option to take either of the two papers in a particular Semester (I or II), while the students have to appear in both the papers.*	One each in Semester III and IV. To be chosen from the following. AEEC-1: Introduction to Biometry AEEC-2: Handwriting Identification and Recognition AEEC-3: Forensic Science and Society

I. CORE COURSE

FIRST YEAR

SEMESTER-I

PAPER: FSHT-101

Introduction to Forensic Science **Credits: 4**

Learning Objectives: After studying this paper the students will know –

a. The significance of forensic science to human society.
b. The fundamental principles and functions of forensic science.
c. The divisions in a forensic science laboratory.
d. The working of the forensic establishments in India and abroad.

Unit 1: History of Development of Forensic Science in India

Functions of forensic science. Historical aspects of forensic science.
Definitions and concepts in forensic science. Scope of forensic science. Need of forensic science. Basic principles of forensic science.
Frye case and Daubert standard.

Unit 2: Tools and Techniques in Forensic Science

Branches of forensic science. Forensic science in international perspectives, including set up of INTERPOL and FBI.
Duties of forensic scientists. Code of conduct for forensic scientists. Qualifications of forensic scientists.
Data depiction. Report writing.

Unit 3: Organizational set up of Forensic Science Laboratories in India

Hierarchical set up of Central Forensic Science Laboratories, State Forensic Science Laboratories, Government Examiners of Questioned Documents, Fingerprint Bureaus, National Crime Records Bureau, Police & Detective Training Schools, Bureau of Police Research & Development, Directorate of Forensic Science and Mobile Crime Laboratories. Police Academies. Police dogs. Services of crime laboratories. Basic services and optional services.

Practicals **Credits: 2**

1. To study the history of crime cases from forensic science perspective.
2. To cite examples of crime cases in which apprehensions arose because of Daubert standards.
3. To review the sections of forensic science at INTERPOL and compare with those in Central Forensic Science Laboratories in India. Include suggestions for improvements if any.
4. To study the annual reports of National Crime Records Bureau and depict the data on different type of crime cases by way of smart art/templates.
5. To write report on different type of crime cases.
6. To review how the Central Fingerprint Bureau, New Delhi, coordinates the working of State Fingerprint Bureaus.

7. To examine the hierarchical set up of different forensic science establishments and suggest improvements.
8. To examine the list of projects undertaken by the Bureau of Police Research and Development and suggest the thrust areas of research in Police Science.
9. To compare and contrast the role of a Police Academy and a Police Training School.
10. To compare the code of conduct prescribed by different establishments for forensic scientists.

Suggested Readings

1. B.B. Nanda and R.K. Tiwari, *Forensic Science in India: A Vision for the Twenty First Century*, Select Publishers, New Delhi (2001).
2. M.K. Bhasin and S. Nath, *Role of Forensic Science in the New Millennium*, University of Delhi, Delhi (2002).
3. S.H. James and J.J. Nordby, *Forensic Science: An Introduction to Scientific and Investigative Techniques*, 2nd Edition, CRC Press, Boca Raton (2005).
4. W.G. Eckert and R.K. Wright in *Introduction to Forensic Sciences*, 2nd Edition, W.G. Eckert (ED.), CRC Press, Boca Raton (1997).
5. R. Saferstein, *Criminalistics*, 8th Edition, Prentice Hall, New Jersey (2004).
6. W.J. Tilstone, M.L. Hastrup and C. Hald, *Fisher's Techniques of Crime Scene Investigation*, CRC Press, Boca Raton (2013).

PAPER: FSHT-102

Crime and Society **Credits: 4**

Learning Objectives: After studying this paper the students will know –

a. The importance of criminology.
b. The causes of criminal behavior.
c. The significance of criminal profiling to mitigate crime.
d. The consequences of crime in society.
e. The elements of criminal justice system.

Unit 1: Basics of Criminology

Definition, aims and scope. Theories of criminal behavior – classical, positivist, sociological. Criminal anthropology.
Criminal profiling. Understanding modus operandi. Investigative strategy.
Role of media.

Unit 2: Crime

Elements, nature, causes and consequences of crime. Deviant behavior. Hate crimes, organized crimes and public disorder, domestic violence and workplace violence.
White collar crimes
Victimology. Juvenile delinquency. Social change and crime.
Psychological Disorders and Criminality. Situational crime prevention.

Unit 3: Criminal Justice System

Broad components of criminal justice system. Policing styles and principles. Police's power of investigation.
Filing of criminal charges. Community policing. Policing a heterogeneous society. Correctional measures and rehabilitation of offenders.
Human rights and criminal justice system in India.

Practicals **Credits: 2**

1. To review past criminal cases and elucidate which theory best explains the criminal behavior of the accused.
2. To review crime cases where criminal profiling assisted the police to apprehend the accused.
3. To cite examples of crime cases in which the media acted as a pressure group.
4. To evaluate the post-trauma stress amongst victims of racial discrimination.
5. To correlate deviant behavior of the accused with criminality (take a specific example).
6. To evaluate victimology in a heinous crime.
7. To examine a case of juvenile delinquency and suggest remedial measures.
8. To evaluate how rising standards of living affect crime rate.
9. To review the recommendations on modernization of police stations and evaluate how far these have been carried out in different police stations.
10. To visit a 'Model Police Station' and examine the amenities vis-à-vis conventional police stations.
11. To examine steps being taken for rehabilitation of former convicts and suggest improvements.
12. To prepare a report on interrogation cells and suggest improvements.

Suggested Readings

1. S.H. James and J.J. Nordby, *Forensic Science: An Introduction to Scientific and Investigative Techniques*, 2nd Edition, CRC Press, Boca Raton (2005).
2. D.E. Zulawski and D.E. Wicklander, *Practical Aspects of Interview and Interrogation*, CRC Press, Boca Raton (2002).
3. R. Saferstein, *Criminalistics*, 8th Edition, Prentice Hall, New Jersey (2004).
4. J.L. Jackson and E. Barkley, *Offender Profiling: Theory, Research and Practice*, Wiley, Chichester (1997).
5. R. Gupta, *Sexual Harassment at Workplace,* LexisNexis, Gurgaon (2014).

SEMESTER-II

PAPER: FSHT-201

Criminal Law **Credits: 4**

Learning Objectives: After studying this paper the students will know –

a. Elements of Criminal Procedure Code related to forensic science.
b. Acts and provisions of the Constitution of India related to forensic science.
c. Acts governing socio-economic crimes.
d. Acts governing environmental crimes.

Unit 1: Law to Combat Crime

Classification – civil, criminal cases. Essential elements of criminal law. Constitution and hierarchy of criminal courts.
Criminal Procedure Code. Cognizable and non-cognizable offences.
Bailable and non-bailable offences.
Sentences which the court of Chief Judicial Magistrate may pass.
Summary trials – Section 260(2).
Judgements in abridged forms – Section 355.
Indian Penal Code pertaining to offences against persons – Sections 121A, 299, 300, 302, 304A, 304B, 307, 309, 319, 320, 324, 326, 351, 354, 359, 362.
Sections 375 & 377 and their amendments.
Indian Penal Code pertaining to offences against property Sections – 378, 383, 390, 391, 405, 415, 420, 441, 463, 489A, 497, 499, 503, 511.
Indian Evidence Act – Evidence and rules of relevancy in brief. Expert witness. Cross examination and re-examination of witnesses.
Sections 32, 45, 46, 47, 57, 58, 60, 73, 135, 136, 137, 138, 141.
Section 293 in the code of criminal procedure.

Unit 2: Constitution of India

Preamble, Fundamental Rights, Directive Principles of State Policy. – Articles 14, 15, 20, 21, 22, 51A.

Unit 3: Acts Pertaining to Socio-economic and Environmental Crimes

Narcotic, Drugs and Psychotropic Substances Act. Essential Commodity Act.
Drugs and Cosmetics Act. Explosive Substances Act. Arms Act.
Dowry Prohibition Act.
Prevention of Food Adulteration Act. Prevention of Corruption Act.
Wildlife Protection Act. I.T. Act. Environment Protection Act. Untouchability Offences Act

Practicals **Credits: 2**

1. To prepare a schedule of five cognizable and five non-cognizable offences.
2. To study the powers and limitations of the Court of Judicial Magistrate of First Class.
3. To prepare a schedule of the offences which may be tried under Section 260(2) of Criminal Procedure Code.
4. To study a crime case in which an accused was punished on charge of murder under Section 302.
5. To study a crime case in which an accused was punished on charge of rape under Section 375.

6. To cite example of a case in which the opinion of an expert was called for under Section 45 of the Indian Evidence Act.
7. To cite a case wherein a person was detained under Article 22(5) of the Indian Constitution. Express your views whether the rights of the person as enlisted in this Article were taken care of.
8. To cite a case under Article 14 of the Constitution of India wherein the Right to Equality before Law was allegedly violated.
9. To list the restrictions imposed on Right to Freedom of Worship under the Constitution of India.
10. To prepare a schedule of persons convicted under Narcotics, Drugs and Psychotropic Act statistically analyze the age group to which they belonged.
11. To study a case in which Drugs and Cosmetic Act was invoked.
12. To study a case in which Explosive Substances Act was invoked.
13. To study a case in which Arms Act was invoked.
14. In light of Section 304B of the Indian Penal Code, cite a case involving dowry death.
15. To study a case wherein the Untouchability Offences Act was invoked on the basis of Article 15 of the Constitution of India.

Suggested Readings

1. D.A. Bronstein, *Law for the Expert Witness*, CRC Press, Boca Raton (1999).
2. Vipa P. Sarthi, *Law of Evidence*, 6th Edition, Eastern Book Co., Lucknow (2006).
3. A.S. Pillia, *Criminal Law*, 6th Edition, N.M. Tripathi Pvt Ltd., Mumbai (1983).
4. R.C. Nigam, *Law of Crimes in India*, Volume I, Asia Publishing House, New Delhi (1965).
5. (Chief Justice) M. Monir, *Law of Evidence*, 6th Edition, Universal Law Publishing Co. Pvt. Ltd., New Delhi (2002).

PAPER: FSHT-202

Forensic Psychology **Credits: 4**

Learning Objectives: After studying this paper the students will know –

a. The overview of forensic psychology and its applications.
b. The legal aspects of forensic psychology.
c. The significance of criminal profiling.
d. The importance of psychological assessment in gauging criminal behavior.
e The tools and techniques required for detection of deception.
f. The critical assessment of advanced forensic techniques like polygraphy, narco analysis and brain electrical oscillation signatures.

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Unit 1: Basics of Forensic Psychology

Definition and fundamental concepts of forensic psychology and forensic psychiatry. Psychology and law. Ethical issues in forensic psychology.
Assessment of mental competency. Mental disorders and forensic psychology.
Psychology of evidence – eyewitness testimony, confession evidence. Criminal profiling.
Psychology in the courtroom, with special reference to Section 84 IPC.

Unit 2: Psychology and Criminal Behavior

Psychopathology and personality disorder. Psychological assessment and its importance.
Serial murderers. Psychology of terrorism.
Biological factors and crime – social learning theories, psycho-social factors, abuse.
Juvenile delinquency – theories of offending (social cognition, moral reasoning),
Child abuse (physical, sexual, emotional), juvenile sex offenders, legal controversies.

Unit 3: Detection of Deception

Tools for detection of deception – interviews, non-verbal detection, statement analysis, voice stress analyzer, hypnosis.
Polygraphy – operational and question formulation techniques, ethical and legal aspects, the guilty knowledge test.
Narco analysis and brain electrical oscillation signatures – principle and theory, ethical and legal issues.

Practicals **Credits: 2**

1. To cite a crime case where legal procedures pertaining to psychic behavior had to be invoked.
2. To prepare a report on relationship between mental disorders and forensic psychology.
3. To review a crime case involving serial murders. Comment on the psychological traits of the accused.
4. To cite a crime case involving a juvenile and argue for and against lowering the age for categorizing an individual as juvenile.
5. To study a criminal case in which hypnosis was used as a means to detect deception.
6. To prepare a case report on thematic appreciation test.
7. To prepare a case report on Minnesota multiphasic personality inventory test.
8. To prepare a case report on thematic appreciation test.
9. To prepare a case report on word association test.
10. To prepare a case report on Bhatia's battery of performance test of intelligence.
11. To cite a criminal case in which narco analysis was used as a means to detect deception.

Suggested Readings

1. A.A. Moenssens, J. Starrs, C.E. Henderson and F.E. Inbau, *Scientific Evidence in Civil and Criminal Cases*, 4th Edition, The Foundation Press, Inc., New York (1995).
2. R. Saferstein, *Criminalistics*, 8th Edition, Prentice Hall, New Jersey (2004).
3. J.C. DeLadurantey and D.R. Sullivan, *Criminal Investigation Standards*, Harper & Row, New York (1980).
4. J. Niehaus, *Investigative Forensic Hypnosis*, CRC Press, Boca Raton (1999).
5. E. Elaad in *Encyclopedia of Forensic Science, Volume 2*, J.A. Siegel, P.J. Saukko and G.C. Knupfer (Eds.), Academic Press, London (2000).

SECOND YEAR

SEMESTER-III

PAPER: FSHT-301

Forensic Dermatoglyphics **Credits: 4**

Learning Objectives: After studying this paper the students will know –

a. The fundamental principles on which the science of fingerprinting is based.
b. Fingerprints are the most infallible means of identification.
c. The world's first fingerprint bureau was established in India.
d. The method of classifying criminal record by fingerprints was worked out in India, and by Indians.
e. The physical and chemical techniques of developing fingerprints on crime scene evidence.
f. The significance of foot, palm, ear and lip prints.

Unit 1: Basics of Fingerprinting

Introduction and history, with special reference to India.

Biological basis of fingerprints. Formation of ridges. Fundamental principles of fingerprinting. Types of fingerprints. Fingerprint patterns. Fingerprint characters/minutiae. Plain and rolled fingerprints.

Classification and cataloguing of fingerprint record. Automated Fingerprint Identification System.

Significance of poroscopy and edgeoscopy.

Unit 2: Development of Fingerprints

Latent prints. Constituents of sweat residue.

Latent fingerprints' detection by physical and chemical techniques.

Mechanism of detection of fingerprints by different developing reagents.

Application of light sources in fingerprint detection.

Preservation of developed fingerprints.

Digital imaging for fingerprint enhancement.

Fingerprinting the deceased. Developing fingerprints on gloves.

Unit 3: Other Impressions

Importance of footprints. Casting of foot prints, Electrostatic lifting of latent foot prints. Palm prnts.

Lip prints - Nature, location, collection and examination of lip prints. Ear prints and their significance.

Palm prints and their historical importance.

Practicals **Credits: 2**

1. To record plain and rolled fingerprints.
2. To carry out ten digit classification of fingerprints.
3. To identify different fingerprint patterns.
4. To identify core and delta.
5. To carry out ridge tracing and ridge counting.

6. To investigate physical methods of fingerprint detection.
7. To investigate chemical methods of fingerprint detection.
8. To use different light sources for enhancing developed fingerprints.
9. To prepare cast of foot prints.

Suggested Readings

1. J.E. Cowger, *Friction Ridge Skin*, CRC Press, Boca Raton (1983).
2. D.A. Ashbaugh, *Quantitative-Qualitative Friction Ridge Analysis*, CRC Press, Boca Raton (2000).
3. C. Champod, C. Lennard, P. Margot an M. Stoilovic, *Fingerprints and other Ridge Skin Impressions*, CRC Press, Boca Raton (2004).
4. Lee and Gaensleen's, *Advances in Fingerprint Technology*, 3rd Edition, R.S. Ramotowski (Ed.), CRC Press, Boca Raton (2013).

PAPER: FSHT-302

Technological Methods in Forensic Science **Credits: 4**

Learning Objectives: After studying this paper the students will know –

a. The importance of chromatographic and spectroscopic techniques in processing crime scene evidence.

b. The utility of colorimetry, electrophoresis and neutron activation analysis in identifying chemical and biological materials.

c. The significance of microscopy in visualizing trace evidence and comparing it with control samples.

d. The usefulness of photography and videography for recording the crime scenes.

Unit 1: Instrumentation

Sample preparation for chromatographic and spectroscopic evidence.

Chromatographic methods. Fundamental principles and forensic applications of thin layer chromatography, gas chromatography and liquid chromatography.

Spectroscopic methods. Fundamental principles and forensic applications of Ultraviolet-visible spectroscopy, infrared spectroscopy, atomic absorption spectroscopy, atomic emission spectroscopy and mass spectroscopy. X-ray spectrometry. Colorimetric analysis and Lambert-Beer law.

Electrophoresis – fundamental principles and forensic applications.

Neutron activation analysis – fundamental principles and forensic applications.

Unit 2: Microscopy

Fundamental principles. Different types of microscopes. Electron microscope. Comparison Microscope. Forensic applications of microscopy.

Unit 3: Forensic photography

Basic principles and applications of photography in forensic science.

3D photography. Photographic evidence. Infrared and ultraviolet photography. Digital photography. Videography. Crime scene and laboratory photography.

Practicals **Credits: 2**

1. To determine the concentration of a colored compound by colorimetry analysis.
2. To carry out thin layer chromatography of ink samples.
3. To carry out separation of organic compounds by paper chromatography.
4. To identify drug samples using UV-Visible spectroscopy.
5. To take photographs using different filters.
6. To take photographs of crime scene exhibits at different angles.
7. To record videography of a crime scene.

Suggested Readings

1. D.A. Skoog, D.M. West and F.J. Holler, *Fundamentals of Analytical Chemistry*, 6th Edition, Saunders College Publishing, Fort Worth (1992).
2. W. Kemp, *Organic Spectroscopy*, 3rd Edition, Macmillan, Hampshire (1991).
3. J.W. Robinson, *Undergraduate Instrumental Analysis*, 5th Edition, Marcel Dekker, Inc., New York (1995).
4. D.R. Redsicker, *The Practical Methodology of Forensic Photography*, 2nd Edition, CRC Press, Boca Raton (2000).

PAPER: FSHT-303

Criminalistics **Credits: 4**

Learning Objectives: After studying this paper the students will know –

a. The methods of securing, searching and documenting crime scenes.
b. The art of collecting, packaging and preserving different types of physical and trace evidence at crime scenes.
c. The legal importance of chain of custody.
d. The tools and techniques for analysis of different types of crime scene evidence.

Unit 1: Crime Scene Management

Types of crime scenes – indoor and outdoor. Securing and isolating the crime scene.
Crime scene search methods. Safety measures at crime scenes. Legal considerations at crime scenes.
Documentation of crime scenes – photography, videography, sketching and recording notes.
Duties of first responders at crime scenes. Coordination between police personnel and forensic scientists at crime scenes. The evaluation of 5Ws (who?, what?, when?, where?, why?) and 1H (how?). Crime scene logs.

Unit 2: Crime Scene Evidence

Classification of crime scene evidence – physical and trace evidence. Locard principle.
Collection, labeling, sealing of evidence. Hazardous evidence. Preservation of evidence.
Chain of custody. Reconstruction of crime scene.

Unit 3: Forensic Physics

Glass evidence – collection, packaging, analysis. Matching of glass samples by mechanical fit and refractive index measurements. Analysis by spectroscopic methods. Fracture analysis and direction of impact.
Paint evidence – collection, packaging and preservation. Analysis by destructive and non-destructive methods. Importance of paint evidence in hit and run cases.
Fibre evidence – artificial and man-made fibres. Collection of fibre evidence. Identification and comparison of fibres.
Soil evidence – importance, location, collection and comparison of soil samples.
Cloth evidence – importance, collection, analysis of adhering material. Matching of pieces.
Toolmark evidence. Classification of toolmarks. Forensic importance of toolmarks. Collection, preservation and matching of toolmarks. Restoration of erased serial numbers and engraved marks.Forensic gemmology.

Practicals **Credits: 2**

1. To prepare a report on evaluation of crime scene.
2. To reconstruct a crime scene (outdoor and indoor).
3. To compare soil samples by density gradient method.
4. To compare paint samples by physical matching method.
5. To compare paint samples by thin layer chromatography method.
6. To compare glass samples by refractive index method.
7. To identify and compare tool marks.
8. To compare cloth samples by physical matching.

Suggested Readings

1. M. Byrd, *Crime Scene Evidence: A Guide to the Recovery and Collection of Physical Evidence*, CRC Press, Boca Raton (2001).
2. T.J. Gardener and T.M. Anderson, *Criminal Evidence*, 4th Ed., Wadsworth, Belmont (2001).
3. S.H. James and J.J. Nordby, *Forensic Science: An Introduction to Scientific and Investigative Techniques*, 2nd Edition, CRC Press, Boca Raton (2005).
4. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's, *Techniques of Crime Scene Investigation*, CRC Press, Boca Raton (2013).

SEMESTER-IV

PAPER: FSHT-401

Forensic Chemistry **Credits: 4**

Learning Objectives: After studying this paper the students will know –

a. The methods of analyzing trace amounts of petroleum products in crime scene evidence.
b. The methods of analyzing contaminants in petroleum products.
c. The method of searching, collecting, preserving and analyzing arson evidence.
d. The classification of explosives, including the synthesis and characterization of representative analogs.
e. The significance of bomb scene management.
f. The techniques of locating hidden explosives.
g. The classification and characteristics of the narcotics, drugs and psychotropic substances.

Unit 1: Petroleum and Petroleum Products

Distillation and fractionation of petroleum. Commercial uses of different petroleum fractions. Analysis of petroleum products.
Analysis of traces of petroleum products in forensic exhibits.
Comparison of petroleum products. Adulteration of petroleum products.

Unit 2: Cases Involving Arson

Chemistry of fire. Conditions for fire. Fire scene patterns. Location of point of ignition. Recognition of type of fire. Searching the fire scene. Collection and preservation of arson evidence.
Analysis of fire debris. Analysis of ignitable liquid residue. Post-flashover burning.
Scientific investigation and evaluation of clue materials. Information from smoke staining.

Unit 3: Explosives

Classification of explosives – low explosives and high explosives. Homemade explosives. Military explosives. Blasting agents.
Synthesis and characteristics of TNT, PETN and RDX. Explosion process. Blast waves.
Bomb scene management.
Searching the scene of explosion. Mechanism of explosion. Post blast residue collection and analysis.
Blast injuries. Detection of hidden explosives.

Practicals **Credits: 2**

1. To carry out analysis of gasoline.
2. To carry out analysis of diesel.
3. To carry out analysis of kerosene oil.
4. To analyze arson accelerators.
5. To prepare a case report on a case involving arson.
6. To carry out analysis of explosive substances.
7. To separate explosive substances using thin layer chromatography.
8. To prepare a case report on bomb scene management.

Suggested Readings

1. J.D. DeHaan, *Kirk's Fire Investigation*, 3rd Edition, Prentice Hall, New Jersey (1991).
2. A.A. Moenssens, J. Starrs, C.E. Henderson and F.E. Inbau, *Scientific Evidence in Civil and Criminal Cases*, 4th Edition, The Foundation Press, Inc., New York (1995).
3. R. Saferstein, *Criminalistics*, 8th Edition, Prentice Hall, New Jersey (2004).
4. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's, *Techniques of Crime Scene Investigation*, CRC Press, Boca Raton (2013).
5. S. Ballou, M. Houck, J.A. Siegel, C.A. Crouse, J.J. Lentini and S. Palenik in *Forensic Science*, D.H. Ubelaker (Ed.), Wiley-Blackwell, Chichester (2013).

PAPER: FSHT-402

Questioned Documents **Credits: 4**

Learning Objectives: After studying this paper the students will know –

a. The importance of examining questioned documents in crime cases.
b. The tools required for examination of questioned documents.
c. The significance of comparing hand writing samples.
d. The importance of detecting frauds and forgeries by analyzing questioned documents.

Unit 1: Nature and Scope of Questioned Documents

Definition of questioned documents. Types of questioned documents. Preliminary examination of documents.

Basic tools needed for forensic documents' examination – ultraviolet, visible, infrared and fluorescence spectroscopy, photomicrography, microphotography, visible spectral comparator, electrostatic detection apparatus.

Determining the age and relative age of documents.

Unit 2: Comparison of Documents

Comparison of handwriting. Development of individuality in handwriting. Natural variations and fundamental divergences in handwritings. Class and individual characterstics.

Merits and demerits of exemplar and non-exemplar samples during comparison of handwriting. Standards for comparison of handwriting.

Comparison of paper, ink, printed documents, typed documents, Xeroxed documents.

Unit 3: Forgeries

Alterations in documents, including erasures, additions, over-writings and obliterations.

Indented and invisible writings. Charred documents.

Examination of counterfeit Indian currency notes, passports, visas and stamp papers.

Disguised writing and anonymous letters.

Practicals **Credits: 2**

1. To identify handwriting characters.
2. To study natural variations in handwriting.
3. To compare handwriting samples.
4. To detect simulated forgery.
5. To detect traced forgery.
6. To study the line quality defects in handwriting samples.
7. To examine the security features of currency notes, passports and plastic money.
8. To study alterations, obliterations and erasures in handwriting samples.
9. To cite a case wherein Section 45 of Indian Evidence Act was invoked, seeking expert opinion for authentication of handwriting and/or signatures.
10. To cite a case wherein Section 489A of the Indian Penal Code was invoked in context of fake currency.

Suggested Readings

1. O. Hilton, *Scientific Examination of Questioned Documents*, CRC Press, Boca Raton (1982).
2. A.A. Moenssens, J. Starrs, C.E. Henderson and F.E. Inbau, *Scientific Evidence in Civil and Criminal Cases*, 4th Edition, Foundation Press, New York (1995).
3. R.N. Morris, *Forensic Handwriting Identification: Fundamental Concepts and Principles*, Academic Press, London (2000).
4. E. David, *The Scientific Examination of Documents – Methods and Techniques*, 2nd Edition, Taylor & Francis, Hants (1997).

PAPER: FSHT-403

Forensic Biology **Credits: 4**

Learning Objectives: After studying this paper the students will know –

a. The significance of biological and serological evidence.
b. The forensic importance of hair evidence.
c. The importance of biological fluids – blood, urine, semen, saliva, sweat and milk – in crime investigations.
d. How wildlife forensics aid in conserving natural resources.
e. How forensic entomology assists in death investigations.

Unit 1: Biological Evidence

Nature and importance of biological evidence.

Significance of hair evidence. Transfer, persistence and recovery of hair evidence. Structure of human hair. Comparison of hair samples. Morphology and biochemistry of human hair. Comparison of human and animal hair.

Types and identification of microbial organisms of forensic significance.

Identification of wood, leaves, pollens and juices as botanical evidence. Diatoms and their forensic significance.

Unit 2: Wildlife Forensics

Fundamentals of wildlife forensic. Significance of wildlife forensic. Protected and endangered species of animals and plants. Illegal trading in wildlife items, such as skin, fur, bone, horn, teeth, flowers and plants. Identification of physical evidence pertaining to wildlife forensics. Identification of pug marks of various animals.

Unit 3: Forensic Entomology

Basics of forensic entomology. Insects of forensic importance. Collection of entomological evidence during death investigations.

Practicals **Credits: 2**

1. To examine hair morphology and determine the species to which the hair belongs.
2. To prepare slides of scale pattern of human hair.
3. To examine human hair for cortex and medulla.
4. To carry out microscopic examination of pollen grains.
5. To carry out microscopic examination of diatoms.
6. To cite a crime case in which diatoms have served as forensic evidence.
7. To prepare a case report on forensic entomology.
8. To prepare a case report on problems of wildlife forensics.

Suggested Readings

1. L. Stryer, *Biochemistry*, 3rd Edition, W.H. Freeman and Company, New York (1988).
2. R.K. Murray, D.K. Granner, P.A. Mayes and V.W. Rodwell, *Harper's Biochemistry*, APPLETON & Lange, Norwalk (1993).
3. S. Chowdhuri, *Forensic Biology*, BPRD, New Delhi (1971).
4. R. Saferstein, *Forensic Science Handbook*, Vol. III, Prentice Hall, New Jersey (1993).
5. G.T. Duncan and M.I. Tracey, Serology and DNA typing in, *Introduction to Forensic Sciences*, 2nd Edition, W.G. Eckert (Ed.), CRC Press, Boca Raton (1997).

SEMESTER-V

PAPER: FSHT-501

Forensic Ballistics **Credits: 4**

Learning Objectives: After studying this paper the students will know –

a. The classification of firearms and their firing mechanisms.
b. The methods of identifying firearms.
c. The characteristics of ammunition.
d. The importance of firearm evidence.
e. The nature of firearm injuries.
f. The methods for characterization of gunshot residue.

Unit 1: Firearms

History and development of firearms. Classification of firearms. Weapon types and their operation. Firing mechanisms of different firearms.

Internal ballistics – Definition, ignition of propellants, shape and size of propellants, manner of burning, and various factors affecting the internal ballistics: lock time, ignition time, barrel time, erosion, corrosion and gas cutting.

External Ballistics – Vacuum trajectory, effect of air resistance on trajectory, base drag, drop, drift, yaw, shape of projectile and stability, trajectory computation, ballistics coefficient and limiting velocity, Measurements of trajectory parameters, introduction to automated system of trajectory computation and automated management of ballistic data.

Terminal Ballistics – Effect of projectile on hitting the target: function of bullet shape, striking velocity, striking angle and nature of target, tumbling of bullets, effect of instability of bullet, effect of intermediate targets, influence of range. Ricochet and its effects, stopping power.

Unit 2: Ammunition

Types of ammunition. Constructional features and characteristics of different types of cartridges and bullets. Primers and priming compounds. Projectiles. Headstamp markings on ammunitions. Different types of marks produced during firing process on cartridge – firing pin marks, breech face marks, chamber marks, extractor and ejector marks.

Unit 3: Firearm Evidence

Matching of bullets and cartridge cases in regular firearms. Identification of bullets, pellets and wads fired from improvised, country made firearms. Automated method of bullet and cartridge case comparison. Determination of range of fire and time of fire.

Mechanisms of formation of gunshot residues. Methods of analysis of gunshot residues from shooting hands and targets, with special reference to clothings.

Identification and nature of firearms injuries. Reconstruction with respect to accident, suicide, murder and self defence.

Practicals **Credits: 2**

1. To describe, with the aid of diagrams, the firing mechanisms of different types of firearms.
2. To correlate the velocity of bullet with the impact it produces on the target.
3. To correlate the striking angle of the bullet with the impact on the target.
4. To estimate the range of fired bullets.

5. To carry out the comparison of fired bullets.
6. To carry out the comparison of fired cartridge cases.
7. To identify gunshot residue.
8. To correlate the nature of injuries with distance from which the bullet was fired.
9. To differentiate, with the aid of diagram, contact wounds, close range wounds and distant wounds.

Suggested Readings

1. B.J. Heard, *Handbook of Firearms and Ballistics*, Wiley and Sons, Chichester (1997).
2. W.F. Rowe, Firearms identification, *Forensic Science Handbook*, Vol. 2, R. Saferstein (Ed.), Prentice Hall, New Jersey (1988).
3. A.J. Schwoeble and D.L. Exline, *Current Methods in Forensic Gunshot Residue Analysis*, CRC Press, Boca Raton (2000).
4. E. Elaad in *Encyclopedia of Forensic Science, Volume 2*, J.A. Siegel, P.J. Saukko and G.C. Knupfer (Eds.), Academic Press, London (2000).

PAPER: FSHT-502

Forensic Toxicology **Credits: 2**

Learning Objectives: After studying this paper the students will know –

a. The significance of toxicological studies in forensic science.
b. The classification of poisons and their modes of actions.
c. The absorption of poisons in body fluids.
d. The forensic identification of illicit liquors.
e. The classification and characteristics of the narcotics, drugs and psychotropic substances.
f. The menace of designer drugs.
g. The methods of identifying and purifying narcotics, drugs and psychotropic substances.

Unit 1: Basics of Toxicology

Significance of toxicological findings. Techniques used in toxicology. Toxicological analysis and chemical intoxication tests.
Postmortem Toxicology. Human performance toxicology.
Dose-response relationship. Lethal dose 50 and effective dose 50.

Unit 2: Poisons

Classification of poisons. Physico-chemical characteristics and mode of action of poisons. Accidental, suicidal and homicidal poisonings.
Signs and symptoms of common poisoning and their antidotes. Collection and preservation of viscera, blood and urine for various poison cases.
Identification of biocides and metal salts in body fluids. Metabolism and excretion of poisons. Application of immunoassays in forensic work.
Animal poisons. Snake venom. Mode of action. Carbon monoxide poisoning.
Vegetable poisons. Poisonous seeds, fruits, roots and mushrooms.
Beverages. Alcoholic and non-alcoholic illicit liquors. Analysis and identification of ethyl alcohol. Estimation of ethyl alcohol in blood and urine. Proof spirit.
Crime scene management in illicit liquor cases.

Unit 3: Narcotics, Drugs and Psychotropic Substances

Definition of narcotics, drugs and psychotropic substances. Broad classification – Narcotics, stimulants, depressants and hallucinogens. General characteristics and common example of each classification. Natural, synthetic and semi-synthetic narcotics, drugs and psychotropic substances.
Designer drugs. Tolerance, addiction and withdrawal symptoms of narcotics, drugs and psychotropic substances
Crime scene search for narcotics, drugs and psychotropic substances – searching a suspect, searching a dwelling, searching a vehicle.
Clandestine drug laboratories. Collection and preservation of drug evidence. Testing of narcotics, drugs and psychotropic substances.
Isolation techniques for purifying narcotics, drugs and psychotropic substances – thin layer chromatography, gas-liquid chromatography and high performance liquid chromatography. Presumptive and screening tests for narcotics, drugs and psychotropic substances. Microcrystalline testing of drugs of abuse.

Analysis of narcotics, drugs and psychotropic substances in breast milk, saliva, urine, hair and antemortem blood.
Drugs and driving. Dope tests.
Analysis of narcotics, drugs and psychotropic substances in postmortem blood. Postmortem changes affecting the analysis of narcotics, drugs and psychotropic substances.

Practicals **Credits: 2**

1. To identify biocides.
2. To identify metallic poisons.
3. To identify organic poisons.
4. To identify ethyl alcohol.
5. To identify methyl alcohol.
6. To carry out quantitative estimation of ethyl alcohol.
7. To prepare iodoform.
8. To identify drugs of abuse by spot tests.
9. To perform color tests for barbiturates.
10. To separate drugs of abuse by thin layer chromatography.

Suggested Readings

1. R. Saferstein, *Criminalistics*, 8th Edition, Prentice Hall, New Jersey (2004).
2. F.G. Hofmann, *A Handbook on Drug and Alcohol Abuse*, 2nd Edition, Oxford University Press, New York (1983).
3. S.B. Karch, *The Pathology of Drug Abuse*, CRC Press, Boca Raton (1996).
4. A. Poklis, Forensic toxicology in, *Introduction to Forensic Sciences*, 2nd Edition, W.G. Eckert (Ed.), CRC Press, Boca Raton (1997).
5. A.W. Jones, Enforcement of drink-driving laws by use of per se legal alcohol limits: Blood and/or breath concentration as evidence of impairment, *Alcohol, Drug and Driving*, **4**, 99 (1988).
6. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's, *Techniques of Crime Scene Investigation*, CRC Press, Boca Raton (2013).

SEMESTER-VI

PAPER: FSHT-601

Forensic Anthropology **Credits: 4**

Learning Objectives: After studying this paper the students will know –

a. Importance of forensic anthropology in identification of persons.
b. Different techniques of facial reconstruction and their forensic importance.
c. Significance of somatoscopy and somatometry.

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Unit 1: Significance of Forensic Anthropology

Scope of forensic anthropology. Study of human skeleton. Nature, formation, and identification of human bones. Determination of age, sex, stature from skeletal material.

Unit 2: Personal Identification – Somatoscopy and Somatometry

Somatoscopy – observation of hair on head, forehead, eyes, root of nose, nasal bridge, nasal tip, chin, Darwin's tubercle, ear lobes, supra-orbital ridges, physiognomic ear breadth, circumference of head. Scar marks and occupational marks.

Somatometry – measurements of head, face, nose, cheek, ear, hand and foot, body weight, height. Indices - cephalic index, nasal index, cranial index, upper facial index.

Unit 3: Facial Reconstruction

Portrait Parle/ Bertillon system. Photofit/identi kit. Facial superimposition techniques.

Cranio facial super imposition techniques – photographic super imposition, videosuperimposition, Roentgenographic superimposition. Use of somatoscopic and craniometric methods in reconstruction. Importance of tissue depth in facial reconstruction.

Genetic and congenital anomalies – causes, types, identification and their forensic significance.

Practicals **Credits: 2**

1. To *determine of age from skull and teeth.*
2. To determine of sex from skull.
3. To determine sex from pelvis.
4. To study identification and description of bones and their measurements.
5. To investigate the differences between animal and human bones.
6. To perform somatometric measurements on living subjects.
7. To carry out craniometric measurements of human skull.
8. To estimate stature from long bone length.
9. To conduct portrait parley using photofit identification kit.

Suggested Readings

1. M.Y. Iscan and S.R. Loth, The scope of forensic anthropology in, *Introduction to Forensic Sciences*, 2nd Ed., W.G. Eckert (Ed.), CRC Press, Boca Raton (1997).
2. D. Ubelaker and H. Scammell, *Bones*, M. Evans & Co., New York (2000).
3. S.Rhine, *Bone Voyage: A Journey in Forensic Anthropology*, University of Mexico Press, Mexico (1998).

PAPER: FSHT-602

Forensic Medicine **Credits: 4**

Learning Objectives: After studying this paper the students will know –

a. The duties of the first responding officer who receives a call on homicide or suicide case.
b. The steps involved in processing the death scene.
c. The importance of ascertaining whether the crime was staged to appear as suicide or accident.
d. The importance of bloodstain patterns in reconstructing the crime scene.
e. The importance of autopsy.
f. The importance of forensic odontology

Unit 1: Death Investigations

Fundamental aspects and scope of forensic medicine.
Approaching the crime scene of death. Obtaining first hand information from the caller.
Rendering medical assistance to the victim, if alive. Protecting life. Recording dying declaration.
Identifying witnesses and, if possible, suspect. Interviewing onlookers and segregating possible witnesses.
Suspect in custody – initial interrogation and searching for evidence. Miranda warning card.
Assessing the crime scene. Request for forensic team. Importance of command post and log book. Management of crowd and media.
Importance of taking notes. Items to be a part of noting.
Documenting the death scene. Processing evidence. Evaluation of injuries. Importance of canvass form. Indexing the death investigation.
Handling buried body cases – search for buried bodies, methods of exhumation.
Suicide cases – evaluating the type of injuries, gauging the psychological state of victim, suicide notes.

Unit 2: Autopsy

Forensic pathology. Medico-legal aspects of death. Causes of death. Determination of time since death. Investigation of sexual offences. Death by drowning.
Injuries. Types and classification of injuries. Antemortem and post mortem injuries. Aging of injuries. Artificial injuries.

Unit 3: Forensic Odontology

Development, scope and role of forensic odontology in mass disaster and anthropology. Types of teeth and their comparative anatomy.
Bite marks. Forensic significance of bite marks. Collection, preservation and photography of bite marks evidence. Legal aspects of bite marks. Estimation of age from teeth.

Practicals **Credits: 2**

1. To design a questionnaire for the first responder to the death scene.
2. To design a protocol to deal with the media at the crime scene.
3. To design a checklist for the forensic scientists at the death scene.
4. To design a canvass form giving description of an unidentified victim.
5. To analyze and preserve bite marks.

Suggested Readings

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

II. ELECTIVE COURSE (DISCIPLINE SPECIFIC)

DSE-1: Digital Forensics **Credits: 4**

Learning Objectives: After studying this paper the students will know –

a. The basics of digital forensics.
b. The cases which fall under the purview of digital crimes.
c. The types of digital crimes.
d. The elements involved in investigation of digital crimes.

Unit 1: Fundamentals and Concepts

Fundamentals of computers Hardware and accessories – development of hard disk, physical construction, CHS and LBA addressing, encoding methods and formats.
Memory and processor. Methods of storing data. Operating system. Software.
Introduction to network, LAN, WAN and MAN.

Unit 2: Computer Crimes

Definition and types of computer crimes. Distinction between computer crimes and conventional crimes. Reasons for commission of computer crimes. Breaching security and operation of digital systems.
Computer virus, and computer worm – Trojan horse, trap door, super zapping, logic bombs.
Types of computer crimes – computer stalking, pornography, hacking, crimes related to intellectual property rights, computer terrorism, hate speech, private and national security in cyber space.
An overview of hacking, spamming, phishing and stalking.

Unit 3: Computer Forensics Investigations

Seizure of suspected computer. Preparation required prior to seizure.
Protocol to be taken at the scene. Extraction of information from the hard disk.
Treatment of exhibits. Creating bitstream of the original media. Collection and seizure of magnetic media. Legal and privacy issues. Examining forensically sterile media. Restoration of deleted files. Password cracking and E-mail tracking. Encryption and decryption methods. Tracking users.

Practicals **Credits: 2**

1. To identify, seize and preserve digital evidence from crime scenes.
2. To detect deletions, obliterations and modifications of files using encase software.
3. To trace routes followed by e-mails and chats.
4. To identify the IP address of the sender of e-mails.
5. To demonstrate concealment techniques using cryptographic PGP.
6. To identify encrypted files.
7. To identify hidden files.
8. To use digital signatures for securing e-mail and online transactions.
9. To acquire data from PCs/laptops/HDDs/USBs, pen drives, memory cards and SIM cards.
10. To use symmetric and asymmetric keys for protection of digital record.
11. To carry out imaging of hard disks.

Suggested Readings

1. R.K. Tiwari, P.K. Sastry and K.V. Ravikumar, *Computer Crimes and Computer Forensics*, Select Publishers, New Delhi (2003).
2. C.B. Leshin, *Internet Investigations in Criminal Justice*, Prentice Hall, New Jersey (1997).
3. R. Saferstein, *Criminalistics*, 8th Edition, Prentice Hall, New Jersey (2004).
4. E. Casey, *Digital Evidence and Computer Crime*, Academic Press, London (2000).

DSE-2: Economic Offences **Credits: 4**

Learning Objectives: After studying this paper the students will know –

a. Basic economic and financial terminology.
b. Economic crimes in India are linked to several other crimes.
c. Economic crimes often have a bearing on national security.
d. Types of common economic offences and their consequences.
e. Steps involved in mitigating economic crimes.

Unit 1: Taxonomy of Economic Offences/Criminogenic Factors

Fundamentals of economics in economic offences.

Tax evasion. Excise duty evasion. Fraudulent bankruptcy. White collar crime. Economic exclusion. Black money.

Corruption and bribery of public servants. Money laundering and hawala transactions.

Insurance frauds. Corporate frauds. Bank frauds. Ponzi scheme. Pyramid scheme.

Illicit trafficking in contraband goods. Illicit trafficking in arms. Illicit trafficking in explosives. Illicit drug trafficking. Trafficking in human organs. Cultural objects trafficking.

Racketeering in employment. Racketeering in false travel documents.

Unit 2: Applied Economics in Processing Evidence

Forensic accountancy and forensic auditing.

Valuation of economic losses. Violation of Intellectual Property Rights.

Unit 3: Prevention of Economic Offences

Legislations to deal with different forms of economic offences. RBI Act. SEBI Act. Competition Commission of India Act.

Credit card frauds.

Enforcement agencies to deal with different forms of economic offences.

International perspectives – measures adopted by FBI and INTERPOL.

Case histories of economic offences.

Practicals **Credits: 2**

1. To prepare a draft on fraudulent bankruptcy.
2. To cite a case of money laundering and hawala transactions in India and prepare a note on it.
3. To cite a case involving bank fraud and suggest measures to prevent such crimes.
4. To study a case involving illicit drug trafficking and trace the route by which the item was being smuggled.
5. To prepare a report on trafficking of heritage artefacts, including religious deities in India.
6. To study the applications of accounting software.
7. To study the applications of TELLY software.
8. To review the legislative measures to deal with a particular economic offence, identifying the loopholes and suggesting ways to plug the loopholes.
9. To prepare a schedule of national agencies involved in curbing economic offences. Outline their specific duties.

Suggested Readings

1. R.V. Clarke, *Situational Crime Prevention: Successful Case Studies*, 2nd Edition, Criminal Justice Press, New York (1997).
2. S.P. Green, *Lying, Cheating and Stealing: A Moral Theory of White Collar Crime*, Oxford University Press, Oxford (2006).
3. G. Geis, R. Meier, L. Salinger (Eds.), *White-Collar Crime: Classic & Contemporary Views*, Free Press, New York (1995).
4. J. Reiman, *The Rich get Richer and the Poor get Prison*, Allyn & Bacon, Boston (1998).
5. Indian Audit and Accounts department, *Audit of Fraud, Fraud Detection and Forensic Audit*, 2007.
6. State Crime Branch, Haryana, *Investigation of Economic Offences*.

DSE-3: Forensic Serology **Credits: 4**

Learning Objectives: After studying this paper the students will know –

a. The significance of serological evidence.
b. The importance of biological fluids – blood, urine, semen, saliva, sweat and milk – in crime investigations.
c. The usefulness of genetic markers in forensic investigations.
d. The forensic importance of bloodstain patterns

Unit 1: Forensic Importance of Body fluids

Common body fluids. Composition and functions of blood. Collection and preservation of blood evidence. Distinction between human and non-human blood. Determination of blood groups. Antigens and antibodies.

Forensic characterization of bloodstains. Typing of dried stains. Blood enzymes and proteins.

Semen. Forensic significance of semen. Composition, functions and morphology of spermatozoa. Collection, evaluation and tests for identification of semen. Individualization on the basis of semen examination.

Composition, functions and forensic significance of saliva, sweat, milk and urine. Tests for their identifications.

Unit 2: Genetic Marker Analysis

Cellular antigens. ABO blood groups.

Extracellular proteins and intracellular enzymes.

Significance of genetic marker typing data. Sexual assault investigations.

Unit 3: Bloodstain Pattern Analysis

Bloodstain characteristics. Impact bloodstain patterns. Cast-off bloodstain patterns. Projected bloodstain patterns. Contact bloodstain patterns. Blood trails. Bloodstain drying times. Documentation of bloodstain pattern evidence. Crime scene reconstruction with the aid of bloodstain pattern analysis.

Practicals **Credits: 2**

1. To determine blood group from fresh blood samples.
2. To determine blood group from dried blood sample.
3. To carry out the crystal test on a blood sample.
4. To identify blood samples by chemical tests.
5. To identify the given stain as sliva.
6. To identify the given stain as urine.
7. To carry out cross-over electrophoresis.
8. To study the correlation between impact angle and shape of bloodstain.
9. To identify the point of convergence from the bloodstain patterns.

Suggested Readings

1. W.G. Eckert and S.H. James, *Interpretation of Bloodstain Evidence at Crime Scenes*, CRC Press, Boca Raton (1989).
2. G.T. Duncan and M.I. Tracey in *Introduction to Forensic Sciences*, 2nd Edition, W.G. Eckert (Ed.), CRC Press, Boca Raton (1997).
3. R. Saferstein, *Criminalistics*, 8th Edition, Prentice Hall, New Jersey (2004).
4. T. Bevel and R.M. Gardner, *Bloodstain Pattern Analysis*, 3rd Edition, CRC Press, Boca Raton (2008).

DSE-4: Accident Investigations **Credits: 4**

Unit 1: Motor Vehicle Accidents

Accident scene. Sources of forensic information. Eyewitness accounts. Extent of vehicle damage. Visibility conditions. Photographs of accident site. Estimation of speed. Tire marks, skid marks, scuff marks. Maintenance of vehicles. Abandoned vehicles. Importance of air bags. Railway accidents.

Unit 2: Accident Analysis

Pre-crash movement. Post-crash movement. Collision model. Gauging driver's reaction. Occupants's kinematics. Types of injuries resulting from accident. Biomechanics of injuries. Hit and run investigations. Trace evidence at accident sites.

Unit 3: Tachographs

Forensic significance of tachograph data. Tachograph charts. Principles of chart analysis. Accuracy of speed record. Tire slip effects. Falsification and diagnostic signals. Route tracing.

Practicals **Credits: 2**

1. To lift tire marks.
2. To study the pattern of skid marks.
3. To study the pattern of scuff marks.
4. To estimate the speed of the vehicle from skid marks.
5. To prepare a report on a major road accident.
6. To prepare a report on a major train accident.

Suggested Readings

1. T.S. Ferry, *Modern Accident Investigation and Analysis*, Wiley, New York (1988).
2. D. Lowe, *The Tachograph*, 2nd Edition, Kogan Page, London (1989).
3. T.L. Bohan and A.C. Damask, *Forensic Accident Investigation: Motor Vehicles*, Michie Butterworth, Charlottesville (1995).
4. S.C. Batterman and S.D. Batterman in *Encyclopedia of Forensic Sciences*, Volume 1, J.A. Siegel, P.J. Saukko and G.C. Knupfer (Eds.), Academic Press, London (2000).

DSE-5: DNA Forensics **Credits: 4**

Learning Objectives: After studying this paper the students will know –

a. The basic principle of DNA analysis.
b. The forensic significance of DNA typing.
c. The importance of short tandem repeats and restriction fragment length polymorphism in DNA technique.
d. Role of DNA typing in parentage testing.

Unit 1: Basic Principles

DNA as biological blueprint of life. Extraction of DNA for analysis.
Quantitation of DNA – yield gel quantitation and slot blot quantitation.
Mitochondrial DNA – sequence analysis.

Unit 2: Forensic DNA Typing

Collection of specimens. Polymerase chain reaction – historical perspective, sequence polymorphisms, individualization of evidence.
Short tandem repeats (STR) – role of fluorescent dyes, nature of STR loci.
Restriction fragment length polymorphism (RFLP) – genetic markers used in RFLP, typing procedure and interpretation of results.
Touch DNA.

Unit 3: Parentage Testing

Principles of heredity. Genetics of paternity. DNA testing in disputed paternity. Mendelian laws of parentage testing. Mathematical basis of parentage identification.
Missing body cases. Reference populations and databases.
Report Writing: *Role of DNA typing in identifying unrecognizable bodies.*
Allele frequency determination. Hardy-Weinberg law. Probability determination in a population database.

Practicals **Credits: 2**

1. To carry out the separation of amino acids by thin layer chromatography.
2. To carry out *extraction of DNA from body fluids.*
3. To preparation of gel plates for electrophoresis.
4. To carry out electrophoresis for separation of enzymes.
5. To prepare a report on the role of DNA typing in solving paternity disputes.

Suggested Readings

1. J.M. Butler, *Forensic DNA Typing*, Elsevier, Burlington (2005).
2. K. Inman and N. Rudin, *An Introduction to Forensic DNA Analysis*, CRC Press, Boca Raton (1997).
3. H. Coleman and E. Swenson, *DNA in the Courtroom: A Trial Watcher's Guide*, GeneLex Corporation, Washington (1994).
4. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's, *Techniques of Crime Scene Investigation*, CRC Press, Boca Raton (2013).

DSE-6: Dissertation/Project Work **Credits: 6**

The dissertation/Project Work will be based on a research topic in Forensic Science/Criminology. The topic will be assigned in consultation with police and forensic science establishments, giving due consideration to the problem areas faced by these institutions or by the teachers. The students will be expected to undertake extensive field work/library work, in collaboration with mobile police laboratories (if available) or teachers concerned.

III. ABILITY ENHANCEMENT ELECTIVE COURSE

AEEC-1: Introduction to Biometry **Credits: 2**

Learning Objectives: After studying this paper the students will know –

a. The basis of biometry.
b. The classification of biometric processes.
c. The importance of behavioral biometry.

Unit 1: Fundamental Aspects

Definition, characteristics and operation of biometric system. Classification of biometric systems – physiological and behavioral. Strength and weakness of physiological and behavioral biometrics. Multimodal biometrics. Key biometric processes – enrollment, identification and verification. Positive and negative identification. Performance measures used in biometric systems – FAR, FRR, GAR, FTA, FTE and ATV. Biometric versus traditional technologies.

Unit 2: Physiological Biometrics

Fingerprints, palm prints, iris, retina, geometry of hand and face.

Unit 3: Behavioral Biometrics

Handwriting, signatures, keystrokes, gait and voice.

Suggested Readings

1. S. Nanavati, M. Thieme and R. Nanavati, *Biometrics*, Wiley India Pvt. Ltd. (2002).
2. P. Reid, *Biometrics for Network Security*, New Delhi (2004).
3. Jain, A. K., Flynn, P., & Ross, A. A. *Handbook of biometrics*. Springer Science & Business Media (2007).
4. J.R. Vacca, *Biometric Technologies and Verification Systems*, Butterworth-Heinemann, Oxford (2007).

AEEC-2: Handwriting Identification and Recognition **Credits: 2**

Learning Objectives: After studying this paper the students will know –

a. Important features in handwriting identification.
b. Basis of handwriting characteristics.
c. Significance of forensic documentation.

Unit 1: Handwriting Identification

Basis of handwriting identification. Characteristics of handwriting – scope and application. Class and individual characteristics. Arrangement, alignment, margin, slant, speed, pressure, spacing, line quality, embellishments, movement and pen lifts. Factors influencing handwriting – physical, mechanical, genetic and physiological.

Unit 2: Handwriting Examination

Basis of handwriting comparison. Collection of handwriting samples. Forgery detection. Counterfeiting. Examination of altered and erased documents. Tools used in handwriting examination.

Unit 3: Handwriting Recognition

Basis of handwriting recognition. Off-line and on-line handwriting recognition. Steps involved in handwriting recognition – pre-processing, feature extraction and classification. Applications of handwriting recognition.

Suggested Readings

1. O. Hilton, *Scientific Examination of Questioned Documents*, CRC Press, Boca Raton (1982).
2. A.A. Moenssens, J. Starrs, C.E. Henderson and F.E. Inbau, *Scientific Evidence in Civil and Criminal Cases*, 4th Edition, Foundation Press, New York (1995).
3. R.N. Morris, *Forensic Handwriting Identification: Fundamental Concepts and Principles*, Academic Press, London (2000).
4. E. David, *The Scientific Examination of Documents – Methods and Techniques*, 2nd Edition, Taylor & Francis, Hants (1997).
5. Liu, Z. Q., Cai, J. H., & Buse, R. *Handwriting recognition: soft computing and probabilistic approaches* (Vol. 133). Springer Science & Business Media (2003).

AEEC-3: Forensic Science and Society **Credits: 2**

Learning Objectives: After studying this paper the students will know –

a. Importance of forensic engineering.
b. Importance of forensic archeology.
c. Importance of forensic intelligence.

Unit 1: Forensic Engineering

Role of mechanical, electronics and computer engineers in forensic science. Accident investigations. Failure of signaling and control systems. Ergonomics. Applications of animations, simulations and digital imaging in solving crime cases. Episodes involving fire engineering.

Unit 2: Forensic Archeology

Role of forensic archeology. Searching the archeological site. Methods of digging the burial site. Recovery of remains. Documenting the recovered material. Preservation of remains.

Unit 3: Forensic Intelligence

Role of forensic intelligence in crime analysis. Methods of crime analysis. Databases in forensic intelligence. Management of serial crimes by application of forensic intelligence.

Suggested Readings

1. J.F. Brown and K.S. Obenski, *Forensic Engineering – Reconstruction of Accidents*, C.C. Thomas, Springfield (1990).
2. E.W. Killam, *The Detection of Human Remains*, C.C. Thomas, Springfield (1990).
3. R.K. Noon, *Introduction to Forensic Engineering*, CRC Press, Boca Raton (1992).
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