OSMANIA UNIVERSITY, HYDERABAD

(Esttd. 1917)

Accredited with 'A+' by NAAC

FORENSIC SCIENCE

Department of Chemistry

Osmania University

Hyderabad

SYLLABUS OF

M.Sc. FORENSIC SCIENCE

(Under CBCS - CCE)

(Effective for students admitted from academic year 2023 -2024)

Grand Total marks (all 4 semesters) = 2400 marks

Total credits (all 4 semesters) = 80 credits

M. Sc. Forensic Science Syllabus

(Effective from academic year 2023 -2024)

SEMESTER – I						
THEORY						
Code	**Paper**	**Hrs/week**	**Internal assessment**	**Semester Examination**	**Total**	**Credits**
FS101T(*)	Criminal Justice System & Forensic Science	3	50 marks	50 marks	100 marks	3
FS102T(*)	Instrumental Methods of Analysis	3	50 marks	50 marks	100 marks	3
FS103T(*)	Forensic Biology & Biological Techniques	3	50 marks	50 marks	100 marks	3
FS104T(*)	Forensic Physics, Forensic Photography & Forensic Engineering	3	50 marks	50 marks	100 marks	3
PRACTICALS						
FS151P(*)	Crime Scene Management & Forensic Psychology Lab	4	-	-	50 marks	2
FS152P(*)	Instrumental methods of analysis Lab	4	-	-	50 marks	2
FS153P(*)	Forensic Biology Lab	4	-	-	50 marks	2
FS154P(*)	Forensic Physics, Forensic Photography & Forensic Engineering Lab	4	-	-	50 marks	2
	TOTAL				**600 marks**	**20**
SEMESTER – II						
THEORY						
Code	**Paper**	**Hrs/week**	**Internal assessment**	**Semester Examination**	**Total**	**Credits**
FS201T(*)	Imprints, Impressions & Biometrics	3	50 marks	50 marks	100 marks	3
FS202T(*)	Forensic Chemistry	3	50 marks	50 marks	100 marks	3
FS203T(*)	Forensic Anthropology & Forensic Medicine	3	50 marks	50 marks	100 marks	3
FS204T(*)	Forensic Ballistics	3	50 marks	50 marks	100 marks	3
PRACTICALS						
FS251P(*)	Imprints, Impressions & Biometrics Lab	4	-	-	50 marks	2
FS252P(*)	Forensic Chemistry Lab	4	-	-	50 marks	2
FS253P(*)	Forensic Anthropology &Forensic Medicine Lab	4	-	-	50 marks	2
FS254P(*)	Forensic Ballistics Lab	4	-	-	50 marks	2
	TOTAL				**600 marks**	**20**

(*Core = Compulsory papers)

M. Sc. Forensic Science Syllabus

(Effective for students admitted from academic year 2023 -2024)

SEMESTER – III						
THEORY						
Code	**Paper**	**Hrs/ week**	**Internal assessment**	**Semester Examination**	**Total**	**Credits**
FS301T(*)	Forensic Examination of Questioned Documents	3	50 marks	50 marks	100 marks	3
FS302T(*)	Forensic Toxicology	3	50 marks	50 marks	100 marks	3
FS303T (Elective)	III A: Forensic Nanotechnology	3	50 marks	50 marks	100 marks	3
	III B: Microbial Forensics					
FS304T (Elective)	IV A: Research Methodology, Statistics & IPR	3	50 marks	50 marks	100 marks	3
	IV B: Quality Management, Laboratory Management & Laboratory Safety					
PRACTICALS						
FS351P(*)	Forensic Examination of Questioned Documents Lab	4	-	50 marks	50 marks	2
FS352P(*)	Forensic Toxicology Lab	4	-	50 marks	50 marks	2
FS353P (Elective)	III A: Forensic Nanotechnology Lab	2	-	25 marks	25 marks	1
	III B: Microbial Forensics Lab					
FS354P (Elective)	IV A: Research Methodology, Statistics & IPR Lab	2	-	25 marks	25 marks	1
	IV B: Quality Management, Laboratory Management & Laboratory Safety Lab					
SMNR	Seminar	2	-	50 marks	50 marks	2
	TOTAL				**600 marks**	**20**
SEMESTER – IV						
THEORY						
Code	**Paper**	**Hrs/ week**	**Internal assessment**	**Semester Examination**	**Total**	**Credits**
FS401T(*)	Forensic Serology & DNA Fingerprinting	3	50 marks	50 marks	100 marks	3
FS402T(*)	Digital Forensics & Incident response	3	50 marks	50 marks	100 marks	3
FS403T (Elective)	III A: Forensic Accounting & Fraud investigation	3	50 marks	50 marks	100 marks	3
	III B: Forensic Linguistics & Multimedia Forensics					
PRACTICALS						
FS451P(*)	Forensic Serology & DNA Fingerprinting Lab	4	-	50 marks	50 marks	2
FS452P(*)	Digital Forensics & Incident response Lab	4	-	50 marks	50 marks	2
FS453P (Elective)	III A: Forensic Accounting & Fraud investigation Lab	2	-	25 marks	25 marks	1
	III B: Forensic Linguistics & Multimedia Forensics Lab					
FS454P	Project	12	50 marks	125 marks	175 marks	6
	TOTAL				**600 marks**	**20**

(*Core = Compulsory papers)

SEMESTER – I (THEORY)

FS101T(*): Criminal Justice System & Forensic Science

Instruction	3 Periods per week
Duration of University Examination	2 Hours
University Examination	100 Marks / 3 Credits

UNIT I: Introduction to Forensic Science

Forensic Science: Introduction, Definition, History, Development and Role of Forensic Science in crime investigation - Principles and Branches of Forensic Science – Organization of Forensic Science laboratories and other allied institutions (FSL, CFSL, GEsQD, FPB, NCRB, CDTS, IB, NCB, CBI, Police academies, BPR&D, DFSS, NCFL, Clues Team, RAW)

Physical Evidence: Classification and probative value of physical evidence - Locard's exchange principle and Chain of custody - Daubert standard and Frye standard of admissibility of evidence

Crime Scene Management: Definition, nature and types of crime scene; Legal considerations at the crime scene – Crime Scene processing (Crime scene safety, securing, searching, recording the crime scene, reconstruction of the scene of crime and investigation of crime) – Collection, preservation, packing and forwarding of physical evidence

Forensic Expert and Ethics in Forensic Profession: Qualification, duties, code of conduct and professional responsibility of Forensic Scientist – Forensic report preparation – Teaching ethical values to Forensic Scientists; Ethical decision making and Ethical dilemmas

Court Testimony: Introduction and Admissibility of expert testimony - Expert and lay witnesses - Giving testimony as an Expert

Unit II: Criminology, Penology and Forensic Psychology

Criminology: Definition, Scope and schools of criminology – Crime: Definition, concept (Mens rea and Actus rea), types (Juvenile delinquency; Crime against women; White collar and blue collar crimes; Alcohol, drugs and crime; Organized crime; serial murders), causes and factors responsible for crime – Definition of criminal, Criminal behaviour, theories of criminal behaviour, Criminal profiling (Objectives, pattern, methodology and paradigms of criminal profiling)

Victimology and Penology: Victimology: Definition, Types of victims and victim protection – Penology: Definition, Elements, theories and types of punishment (Capital punishment) – Prisons and Correctional institutions (Objectives, Administration, functioning and limitations)

Basics of Psychology: Nature, Scope and goals of Psychology, Fields of psychology (Pure and Applied) – Cognitive processes (Sensation, Attention, Perception), Process of learning - Memory (Encoding, Storage, Retrieval), Types of memory (Sensory, STM, LTM), Concepts related to memory (Explicit, Implicit, Eyewitness memory and TOT), Forgetting (Decay theory, Interference theory, Motivated forgetting)

Psychopathology: Causes of Psychopathology - Personality disorders, Substance related disorders - Stress and coping strategies

Forensic Psychology: Scope and importance of Forensic Psychology, Psychological disorders and psychiatric disorders – Deception detection techniques (Forensic hypnosis, Narcoanalysis, Polygraphy, Brain fingerprinting) – Applications of Forensic Psychology in various crimes

Unit III: Law

Justice system in India: Administration of civil justice and criminal justice – Hierarchy of courts – Types and Jurisdiction of courts (Civil and criminal)

Structure of Police Organizations in India: Functions and duties of police – Cognizable and Non- cognizable offences - Powers of police to search, seize and arrest

Investigation of Crimes and Prosecution: Investigation of offences by police – Application of Forensic techniques in investigation (Narcoanalysis; Polygraphy; Brain Fingerprinting) - Scientific methods of investigation - Third degree methods and Human rights –-Role and responsibilities of prosecution

Introduction to Constitution of India: Salient features, Fundamental rights, Directive Principles of State Policy and Fundamental duties - **Indian Penal Code, 1860:**Criminal Conspiracy (Sections 120-A, 120-B), Offences against Decency and Morals (Sections 292, 293), Offences against human body (Sections 299 to 302, 304-A, 304-B, 307 to 309, 359, 362, 375, 376), Offences against property (Sections 378, 390, 415, 420), Offences relating to Documents (Sections 463, 465) **Code of Criminal Procedure, 1973:**Expert Witness (Section 293), Trial of person (Section 300) and **Indian Evidence Act -**Opinion of Third Persons (Sections 45 to 47), Facts which need not be proved (Sections 57, 58), Oral evidence (Section 60), Electronic Evidence (Section 65-B), Documentary Evidence (Section 73) – Examination of Witness (Section 135 to 138, 145, 159)

Special Laws in India: POCSO Act, RTI Act, SC/ST (Prevention of Atrocities) Act, Dowry Prohibition Act, UAPA Act, Environmental Protection Act, Prevention of Corruption Act, The Copyright Act, Consumer Protection Act

The syllabus shall include Seminars and Tutorials on the above topics of the paper.

Suggested Reading:

1. James, S. H. and Nordby, J. J.: Forensic Science: An Introduction to Scientific and Investigative Techniques, CRC Press, 2003 & 2005
2. Saferstein R.: Criminalistics – An Introduction to Forensic Science, 5thedn, Prentice Hall, 1998
3. Siegel, J. A., Sukoo, R. J, and Knupfer, G. C: Encyclopedia of Forensic Science, Vol I, II and III, Academic Press, 2000
4. John Horse well: The Practice for Crime Scene Investigation, CRC Press, 2004
5. Anthony J. Bertino: Forensic Science: Fundamentals and Investigations, Cengage Learning, 2008
6. Brown & Davenport: Forensic Science: Advanced Investigations, Cengage Learning, 2012
7. Barry A. J. Fisher, William J. Tilstone, Catherine Woytowicz: Introduction to Criminalistics: The foundation of Forensic Science, Elsevier 2009
8. Barry A. J. Fisher: Techniques of Crime Scene Investigation: Seventh edition, CRC Press, 2004
9. William G. Eckert: Introduction to Forensic Sciences: Second edition, CRC Press, 1997

10. Allan Jamieson, Andre Moenssens: Encyclopedia of Forensic Science, John Wiley & Sons Ltd., 2009
11. Bhuban Mohan, Chakravarthy: Sociology: Theory, Methodology and Concepts
12. Vidya Bhushan, Sachdeva: An Introduction to Sociology: Sixteenth Edition, KitabMahal, 1986
13. C. N. Shankar Rao: Sociology: Principles of Sociology with an Introduction to Social Thought: Sixth Revised Edition, S. Chand & Company Ltd., 2009
14. Sandra Walklate: Criminology: The basics, Taylor & Francis, 2005
15. Don C. Gibbons: Society, Crime and Criminal Careers: An Introduction to Criminology: Third Edition: Prentice Hall, 1973
16. Rohinton Mehta: Crime & Criminology: A Socio-Legal Analysis of the Phenomenon of Crime: First Edition, 1999
17. Marcus Felson and Mary A. Eckert: Introductory Criminology: The study of risky situations, Routledge, 2018
18. Bruce A. Arrigo, Stacey L. Shipley: Introduction to Forensic Psychology, Second Edition
19. Jadunath Sinha: Elementary Psychology
20. Bruce, A. A: Introduction to Forensic Psychology, Academic Press, 2000
21. Shapiro, D. L.: Forensic Psychology Assessment – An Investigative Approach, Allen & Bacon, 1991
22. Kleiner, M.: Handbook of Polygraph Testing, Academic Press, 2002
23. Turrey, B.: Criminal profiling – An Introduction to Behavioral Evidence Analysis, Academic Press, 1999
24. Vimala Veeraraghavan: Handbook of Forensic Psychology, Selective & Scientific books, 2019
25. Stephanie Scott-Synder: Introduction to Forensic Psychology: Essentials for Law Enforcement, CRC Press, 2017
26. Paddala Rama Reddi: Criminal Major Acts
27. The Indian Evidence Act (1872), Amendment Act (2001): Universal Law Pub., 2002
28. The Code of Criminal Procedure Code (1973) Amendment Act, (2001) Universal Law Pub. Co., 2002
29. Rattan Lal and DhirajLal: The Indian Penal Code, 28th edn.,Wadhwa& Co., 2002.
30. Ram Ahuja: Criminology, Rewal Pub. Co., 2000
31. Meguire, M., Morgan, R and Reiner, R.: Oxford Hand Book of Criminology, 2nd edn. Biddles Ltd., 1997
32. B. R. Sharma: Forensic Science in Criminal Investigations and Trials
33. Dr. R. Thilagaraj: Human Rights and Criminal Justice Administration
34. G. B. Reddy and Baglekar Akash Kumar: Consumer Protection Act: A Commentary, Eastern Book Company, 2021
35. The Copyright Act, 1957, Commercial Law Publishers (India) Pvt. Ltd., 2019
36. G. B. Reddy: Women & the law including law relating to children, Gogia Law Agency, 2021

FS102T(*): Instrumental Methods of Analysis

Instruction	3 periods per week
Duration of University Examination	2 Hours
University Examination	100 Marks / 3 Credits

UNIT I Atomic and Molecular Spectrometry

Basics of Spectroscopic techniques: General properties of Electromagnetic Radiation - Wave and quantum mechanical properties of radiation - Optical Atomic Spectra

Atomic Spectrometry: Principle, instrumentation, techniques and forensic applications of Atomic Absorption and Atomic Emission Spectrometry – Atomic Fluorescence Spectrometry - Atomic Mass Spectrometry and Atomic X-Ray Spectrometry

UV-Visible and Molecular Luminescence Spectrometry: Principle, instrumentation, qualitative and quantitative analysis of samples by UV-Visible spectrometry - Photometric Titrations and Photo acoustic Spectroscopy - Molecular Luminescence Spectrometry: Theory, instrumentation and forensic applications of Fluorescence, Phosphorescence and Chemiluminescence methods

Infrared and Raman Spectrometry: Theory, instrumentation, techniques and applications of Mid IR Absorption, Mid IR Reflection and Photo acoustic IR Spectrometry - Near and Far IR Spectrometry, IR Micro spectrometry - Principle, instrumentation, techniques and applications of Raman Spectroscopy

Nuclear Magnetic Resonance Spectrometry: Principle, instrumentation, techniques and applications of ^{1}H NMR - ^{13}C NMR - Magnetic Resonance Imaging

UNIT II Chromatographic and Hyphenated techniques

Basics of Chromatographic Techniques: Introduction and History of Chromatography - Theoretical principles of Chromatography - Classification of Chromatographic Methods

TLC, HPTLC and Super Critical Fluid Chromatography: Principle, instrumentation, techniques and applications of Thin Layer Chromatography - High-Performance Thin Layer Chromatography - Super critical fluid chromatography

Gas Chromatography: Principle, technique, instrumentation and applications of Adsorption, Partition, Gas-Solid, Gas-Liquid - Isothermal Gas chromatography and Linear Temperature Programming – Chiral, Pyrolysis and Derivatization gas chromatography

Liquid Chromatography: Principle, technique, instrumentation and applications of High Performance Liquid Chromatography - Isocratic, Gradient, Adsorption, Partition chromatography - Ion and Derivatization Chromatography

Molecular Mass Spectrometry and Hyphenated techniques: ICP-MS: Principles, Instrumentation, Technique and Applications - Principle, instrumentation, techniques and applications of GC-FTIR, GC-MS - LC-MS, CE-MS - MS-MS

UNIT III Electrochemical and Other instrumental methods

Electrochemical techniques: Introduction and general principles of electrochemical techniques - Principles, instrumentation, techniques and applications of Potentiometry and Coulometry - Polarography and ion selective electrodes

Thermal Methods: Principles, Instrumentation, Techniques and Applications of Thermo gravimetric Methods - Differential Thermal Analysis - Differential Scanning Calorimetry

Radiochemical Methods: Introduction to Radioactive Isotopes - Principles, Instrumentation, Techniques and Application of Neutron Activation Analysis - Isotope Dilution Methods

X-Ray Diffractometry: Introduction and theory of XRD – Principle and instrumentation of XRD - Techniques and applications of XRD

Electrophoretic techniques: Introduction, history of electrophoresis, classification and factors affecting electrophoretic techniques – Principle, instrumentation, technique and applications of Zone electrophoresis and Capillary electrophoresis - Isotachophoresis and isoelectric focusing

The syllabus shall include Seminars and Tutorials on the above topics of the paper.

Suggested Reading:

1. Atkins, P. W.: Physical Chemistry, 6th edn., Oxford University Press, 1998.
2. Fifield, F. W. and Kealy, D.: Principles and practice of Analytical Chemistry, 5th edn, Blackwell Science, 2000.
3. Skoog, D. A., Holler, J. F., and Neiman, T. A.: Principles of Instrumental Analysis, Thomson, 1997.
4. Willard, H. H., Merritt, L.L. Jr., Dean, J. A. and Settle, F. A. Jr.: Instrumental Methods of Analysis, 7th edn., Wadsworth, 1998
5. Kealey, D. and Haines, P. J.: Analytical Chemistry, Bios Scientific / Viva Books, 2002.
6. Settle, F. A.: Hand Book of Instrumental Techniques for Analytical Chemistry, Prentice Hall, 1997.
7. Harris, D. C.: Quantitative Chemical Analysis, 5th edn., Freeman, 1999.
8. Haswell, S. J.: Atomic Absorption Spectrometry, Elsevier, 1992.
9. Christian, G. D.: Analytical Chemistry, 6th edn., John Wiley, 2004
10. Silverstein, R. M., and Webster, F. X.: Spectrometric Identification of Organic Compounds, 6th edn., Wiley, 1997.
11. Svehla, G.: Vogel's Qualitative Inorganic analysis, Longman, 1998
12. Haines, P. J.: Thermal Methods of Analysis – Applications and problems, Blackie, 1995
13. Nad, A. K., Mahapatra, B. and Ghoshal, A.: An Advanced Course in Practical Chemistry, New Central Book Agency, 2000.
14. Chatwal, G. R. and Anand, S.: Instrumental Methods of Chemical Analysis
15. Jeffery, G. H., Bassett, J, Mendham, J, Denny, R. C.: Vogel's Text Book of Quantitative Chemical Analysis,
16. Lajunan, L. H. J.: Spectrochemical Analysis by Atomic Absorption and Emission,
17. Verma, R. M.: Analytical Chemistry, Theory and Practice, 3rd edn, CBS, 1994
18. Sharma, B. K.: Instrumental Methods of Chemical Analysis
19. Alexeyev, V: Quantitative Analysis, Mir / CBS 1994
20. Sane, R. T and Ghadge, J. K:Thermal Analysis, Theory and Applications, Quest Pub., Mumbai, 1997
21. Townsends Allen (ed.) : Encyclopedia of Analytical Science, Academic Press, 1995
22. Gowenlock, A. H.: Practical Clinical Biochemistry, 6th edn., Butterworth / CBS, 1988
23. Sane, R. T and Joshi, A. P: Electroanalytical Instruction
24. Goldsby, R. A., Kindt, T. J., Osborne, B. A and Kuby, J: Immunology, 5th Edn., Freeman,2003.

FS103T(*): Forensic Biology & Biological Techniques

Instruction	3 periods per week
Duration of University Examination	2 Hours
University Examination	100 Marks / 3 Credits

UNIT I Forensic Botany

Forensic Biology: Introduction and Definition of Forensic Biology – Scope of Forensic Biology – Forensic Botany: Definition and scope

Forms of Botanical evidences: Identification and matching of various forms of botanical evidences such as wood - seeds - leaves

Pollen grains, Starch grains and Paper pulp: Study and identification of pollen grains – Identification of starch grains and stains of spices – Paper pulp identification

Poisonous Botanical evidences: Toxic principles of plants and their forensic significance – Identification of poisonous plants in India – Identification of poisonous mushrooms of India

Diatoms: Types and morphology of diatoms – Methods of isolation from tissues and bones – Forensic significance of diatoms in drowning cases

Unit II Hair examination, Fiber examination and Forensic Entomology

Hair Examination: Introduction, Structure, Growth and Chemistry of hair – Identification and comparison of hair by microscopic, chemical, biochemical and instrumental methods – Identification of human hair and animal hair

Personal Identification from Hair: Assessment of age, sex, race, site of hair, analysis of drugs and elements in hair, hair diseases – Hair transfer, persistence and recovery – DNA typing of hair

Fibre Examination: Introduction and Classification of fibres - Identification and comparison of fibres by physical, chemical, microscopic, spectroscopic, chromatographic methods – Persistence and recovery of fibres, Forensic significance of fibre examination

Crime Scene Analysis for Entomological evidence: Definition, divisions and role of forensic entomologist – Analyzing crime scene for entomological evidence – Collection of climatological data and entomological specimen before body removal

Forensic Significance of Entomology: Common arthropods found on the dead body – Determination of time since death – Entomological succession

Unit III Wildlife Forensics and Microscopy

Wildlife Forensics: Introduction, Importance of wildlife, Census of wildlife population – Endangered and extinct species - Wildlife Protection Act and CITES

Wildlife Crime: Types of wildlife crime, Methods of smuggling and poaching of wildlife artifacts – Crime scene search – Wildlife crime investigation

Identification of Evidences in Wildlife crime: Determination of time of death and Sex determination from bones - Identification of teeth, claws, Ivory, Horns, antlers, fur, skin, bite marks, pugmarks - Identification of blood, excreta and bones by biochemical and immunological methods

Basic Microscopy: Basic principles and applications of: Simple and Compound Microscope – Comparison Microscope - Phase Contrast Microscope and Stereo Microscope

Advanced Microscopy: Basic principles and applications of Polarizing Microscope – Fluorescent Microscope, Infra-red Microscope - Scanning Electron Microscope and Transmission Electron Microscope

The syllabus shall include Seminars and Tutorials on the above topics of the paper.

Suggested Reading:

1. Robertson, J., ed: Forensic Examination of Fibres. Chichester, West Sussex, England: Ellis Horwood Ltd., (1992)
2. Saferstein, Richard: Criminalistics. An Introduction to Forensic Science, 5th ed., Prentice Hall, 1998
3. Robertson, J: Forensic Examination of Hair. Taylor and Francis. (1999)
4. Saferstein, R: Handbook of Forensic Science (Vol 1,2,3)
5. Eckert: An Introduction to Forensic Science
6. Kirk, P: Criminal Investigation, Interscience, 1953
7. James, S. H. and Nordby, J. J: Forensic Science: An Introduction to Scientific and Investigative Techniques, CRC Press, 2003 & 2005
8. Siegel, J. A., Sukoo, R. J, and Knupfer, G. C: Encyclopedia of Forensic Science, Vol I, II and III, Academic Press, 2000.
9. Becker, R. F: Criminal Investigation, Aspen Pub., 2000.
10. Lee, H: Physical Evidence, Elsevier, 2000
11. The Wild Life Protection Act, 1972., Universal Law Publishing
12. Pillay, V.V: Handbook of Forensic Medicine and Toxicology, 12 th ed., Paras Publication2001.
13. Smith, D.G.V: A Manual of Forensic Entomology and Death: A Procedural Guide, Joyce's Publications (1990)
14. Byrd, J.H. &Castner, J, L: Forensic Entomology - The Utility of Arthropods in Legal Investigation, CRC Press, (2000)
15. Biology Methods Manual, Metropolitan Police Forensic Science Laboratory, London, (1978)
16. Castner James L (Ed.)., Forensic Entomology, CRC Press (2006)
17. Richard Li, Forensic Biology, CRC Press, 2008
18. Gunn Allen, Essentials of Forensic Biology; Animals, Plants & Microorganisms in Legal Investigations, J. Wiley (2006)
19. Coyle H. M. (Ed.), Forensic Botany – Principles and Applications to Criminal Case Work, CRC Press (2002)

FS104T(*): Forensic Physics, Forensic Photography & Forensic Engineering

Instruction	3 Periods per week
Duration of University Examination	2 Hours
University Examination	100 Marks / 3 Credits

UNIT I Forensic Examination of Physical Evidences

Glass Examination: Definition, Types of glass and their composition - Forensic examination of glass fractures under different conditions, Physical examination and Elemental analysis of glass evidence - Interpretation and discussion on important case studies of glass evidence

Soil Examination: Nature, Distribution and Origin of soil materials in the Forensic comparison of soil - Methods of characterizing and fingerprinting soil for Forensic application - Interpretation of soil evidence and discussion on important case studies of soil evidence

Paint Examination: Definition, Types of paint and their composition - Macroscopic and microscopic studies, Micro-chemical analysis and instrumental analysis of paint evidence - Interpretation of paint evidence and discussion on important case studies of paint evidence

Tool Marks Examination: Definition, Types and characteristics of tool marks – Tracing and lifting of marks - Photographic examination of tool marks

Obliteration and Restoration of Tool Marks: Scope & importance of restoration of tool marks - Methods of obliteration of tool marks - Restoration of tool marks (wood, leather, polymer and metals)

UNIT II Forensic Photography

Basics of Photography: Introduction and scope of photography in forensic investigation - Cardinal rules of crime scene photography - Types of photographs (Parallel, Overall, mid-range and close up)

Photography Equipment: Cameras,lenses, filters, films, exposing, development & printing - Light as a Forensic Photographer's Tool:UV light sources, LASER light sources, IR light sources, crime lights, tuneable light sources, white light sources, close up, transmitted light, side light, trick photography, contact print photography, oblique light photography - Photography using scientific equipment: Peripheral cameras, Object modelling, Multi-spectral imaging camera, High speed imaging and UVC photography

Digital Imaging: Introduction and history of digital imaging - Digital image processing operations (Image cropping, Image resampling (resizing), Image flipping and rotation, Linear scales) - Classes of imaging operations and noise reduction

Digital Photography: Introduction and scope of digital photography - Software for digital photography - Laws relating to digital evidence and its admissibility

Crime Scene Photography: Blood stain photography - Imprint and impressions photography - Photography of shooting incident and fire scene

UNIT III Forensic Engineering

Elements of Forensic Engineering: Definition of forensic engineering, Scope and importance of Forensic engineering - Types of forensic engineering investigations - Duties and responsibilities of forensic engineer

Investigation of Failures and Resolution of Claims: Legal concerns after failure - Engineering investigation of failures - Litigation and dispute resolution

Examination of Building Structural Defects and Failures: Examination of concrete structures - Examination of steel structures - Examination of structural foundations

Examination of Electrical Appliances and Installations: Examination of electrical wires - Causes of electric failures - Cable accessory failure analysis

Investigation of Failure Analysis: Aircraft accident investigation - Vehicular accident investigation - Environmental disaster investigation with case studies

The syllabus shall include Seminars and Tutorials on the above topics of the paper.

Suggested Reading:

1. Saferstein, R., Criminalistics. An Introduction to Forensic Science, 5th ed., Prentice Hall, 1998
2. Saferstein, R., Handbook of Forensic Science (Vol. 1,2,3)
3. Kirk, P.: Criminal Investigation, Interscience, 1953
4. James, S. H. and Nordby, J. J.: Forensic Science: An Introduction to Scientific and Investigative Techniques, CRC Press, 2003 & 2005
5. Siegel, J. A., Sukoo, R. J, and Knupfer, G. C: Encyclopedia of Forensic Science, Vol, I, II and III, Academic Press, 2000
6. Hara, C.E.O., &Osterburg, J.W., An Introduction to Criminalistics Indiana University Press, (1972)
7. Working Procedure Manual: Physics, BPR&D Publication (2000)
8. Caddy, B., Forensic Examination of Glass & Paints. Analysis and Interpretation ISBN (2001)
9. Mark Tibbett and David O. Carter., Soil Analysis In Forensic Taphonomy, Chemical And Biological Effects Of Buried Human Remains, CRC press, 2008
10. Barry A. J. Fisher ., Techniques of crime scene investigation. S E V E N T H E D I T I O N, CRC press 2004
11. Mark E. Vecellio and Erick P. Bryant, Pocket Guide to Crime Scene Photography, Taylor & Francis Group, LLC(2018)
12. Christopher D. Duncan, Advanced CRIME SCENE PHOTOGRAPHY, Second edition, Taylor & Francis Group, LLC(2015)
13. Everett Baxter, JR.,Complete Crime Scene Investigation Handbook, Taylor & Francis Group, LLC(2015)
14. Nick Marsh, Forensic Photography A Practitioner's Guide, JohnWiley& Sons, Ltd (2014)
15. Edward M. Robinson, Crime Scene Photography, Third Edition, Elsevier Inc. All (2016)
16. Robert T. Ratay, Forensic Structural Engineering Handbook, The McGraw-Hill Companies, Inc..(2000)
17. Kenneth L. Carper, FORENSIC Engineering, SECOND EDITION, CRC Press LLC (2001)

SEMESTER – I (PRACTICALS)

FS151P(*): Crime Scene Management & Forensic Psychology Lab

Instruction	4 Periods per week
Duration of University Examination	3 hours
University Examination	50 Marks/ 2 credits

1. Sketching of Outdoor crime scene
2. Sketching of Indoor crime scene
3. Photography of crime scene
4. Collection and packing of physical evidence at the crime scene
5. Forwarding of physical evidence
6. Reconstruction and evaluation of outdoor crime scene
7. Reconstruction and evaluation of indoor crime scene
8. Physical evidence and Locard's exchange principle
9. Span of attention
10. Rote learning versus Meaningful learning
11. Recall and recognition
12. Personality test: Rosenberg self-esteem scale
13. Perceived stress scale
14. Thematic apperception test and Rorschach ink blot test (Demonstration only)
15. Polygraphy (Demonstration only)

FS152P(*): Instrumental Methods of Analysis Lab

Instruction	4 Periods per week
Duration of University Examination	3 hours
University Examination	50 Marks/ 2 credits

1. Verification of Beer's law and calculation of molar absorption coefficients for $CuSO_4$
2. Verification of Beer's law and calculation of molar absorption coefficients for $KMnO_4$
3. Estimation of salicylic acid by colorimetry
4. Conductometric titration of strong acid vs. strong base
5. Conductometric titration of weak acid vs. strong base
6. Conductometric titration of mixture of acids vs. strong base
7. Potentiometric titration of strong acid vs. strong base
8. Potentiometric titration of weak acid vs. strong base
9. Potentiometric redox titration of potassium dichromate-ferric ammonium sulphate
10. Potentiometric precipitation titration of Ag^+ vs. KCl
11. Separation of amino acids by Paper Chromatography
12. Separation of alkaloids by Thin Layer Chromatography
13. Paper electrophoresis for separation of amino acids
14. Agarose gel electrophoresis for separation of proteins
15. Simultaneous estimation of Ibuprofen and Paracetamol by UV spectroscopy (Demonstration only)

FS153P(*): Forensic Biology Lab

Instruction	4 Periods per week
Duration of University Examination	3 hours
University Examination	50 Marks/ 2 credits

1. Isolation and identification of diatoms
2. Isolation and identification of pollen grains
3. Identification of starch grains
4. Microscopic and chemical comparison of paper pulp
5. Identification of stains of spices
6. Morphological and microscopic characteristics of Datura
7. Morphological and microscopic characteristics of Cannabis
8. Morphological and microscopic characteristics of Nerium
9. Morphological and microscopic examination of human hair and animal hair
10. Examination of scale patterns of human hair
11. Physicochemical and microscopic examination of natural fibres
12. Physicochemical and microscopic examination of artificial fibres
13. Analysis of dyes of fibres by Thin Layer Chromatography
14. Study of Salient features of Wildlife Protection Act
15. Microscopic examination of botanical evidence by Scanning Electron Microscope (Demonstration only)

FS154P(*): Forensic Physics, Forensic Photography and Forensic Engineering Lab

Instruction	4 Periods per week
Duration of University Examination	3 hours
University Examination	50 Marks/ 2 credits

1. Examination of glass fractures
2. Determination of refractive indices of glass by submersion method
3. Determination of density of glass by densitometer method and density gradient method
4. Elemental analysis of glass and soil evidence by SEM-EDX
5. Physicochemical analysis of soil
6. Soil comparison by ignition method and particle size distribution method
7. Soil comparison by density gradient method
8. Physical examination of paint evidence
9. Examination of paint samples by Microchemical and solubility test
10. Comparison of paint sample by TLC
11. Develop tool marks by various tools and compare them
12. Restoration of erased identification marks from metal surfaces/wood surfaces
13. Determination of adulteration of cement by chemical test
14. Examination of electric wires
15. Identification of cameras from film negatives

SEMESTER – II (THEORY)

FS201T(*): Imprints, Impressions & Biometrics

Instruction	3 Periods per week
Duration of University Examination	2 Hours
University Examination	100 Marks / 3 Credits

UNIT I Imprints

Basic Concepts of Fingerprints: Introduction, History, elements of fingerprints, Classification of Fingerprints (Henry Classification, Patterns & Types) - Identification and comparison of fingerprints - Digital imaging of fingerprints and AFIS

Development and Identification of Fingerprints: Development, lifting and preservation of Latent fingerprints on porous and non-porous surfaces - Development of fingerprints on adhesive surfaces, Development of fingerprints with blood and grease contamination - Development of latent fingerprints on dead body and of the dead body

Lip Prints: Introduction, History, Scope and Classification - Recording, processing and development - Application in crime detection and court of law

Ear Prints: Introduction and History, Morphology and shapes of ear – Location of ear prints, producing standards from suspects - Identification and comparison of ear prints

Palm Prints: Introduction, anatomical areas and major creases of the palm - Interdigital area, Hypothenar area, Thenar area and Finger joints - Palm print comparison

UNIT II Impressions

Foot prints and Footwear Impressions: Introduction and types of foot and footwear impressions - Information from footwear impressions and footprints - Location, recovery, enhancement and comparison of foot and footwear impressions

Tire Impressions: Introduction to tire impressions and types of tires - Tread nomenclature and sidewall information, Tread wear indicators - Tire track evidence recovery and examination process

Bite Mark Impressions: Introduction and Significance of bite marks - Judicial Acceptance of bite marks in courtroom, Evidence collection - Identification and comparison of bite marks

Iris Impressions: Introduction and scope of iris impressions - Morphology of iris, genetics of iris pattern, color and patterns of iris - Iris as means of personal identification

Mechanical and Other Impressions: Rubber stamp impressions, Metallic seal impressions, Embossed impressions - Indentation marks, Cast engraved and punched marks - Methods of restoration

UNIT III Biometrics

Biometrics: Introduction and history of biometrics - Operation of biometric system and characteristics - Applications of biometrics

Finger print and Palm Recognition: Fingerprint image processing - Minutiae determination and fingerprint matching - Palm print classification and datum point determination

Iris Recognition: Introduction, Iris Recognition - Coordinate System - Texture Energy Feature

Face Recognition: Introduction, Detection and Location of Faces, Features - Extraction and Face Recognition - Dual Eigen spaces method for face recognition

Gait Recognition: Introduction to gait recognition - Temporal alignment and shape-based recognition approaches - Silhouette Quality and Gait Recognition

The syllabus shall include Seminars and Tutorials on the above topics of the paper.

Suggested Reading:

1. Hillary Mosses Daluz, Fundamentals of Fingerprint Analysis, CRC Press
2. Henry C.Lee and R.E.Gaensslen, Advances in Fingerprint Technology, Second edition, CRC Press
3. William J.Bodziak, Footwear Impression Evidence, Detection, Recovery and Examination, Second Edition
4. William J.Bodziak, Tire tread and Tire Track Evidence Recovery and Forensic Examination, CRC Press
5. Massimo Tistarelli, Christophe Champod, Handbook of Biometrics for Forensic Science, Springer
6. Mrs.I. Indira Sudha, Biometrics and Fingerprint Analysis, Selective and Scientific Books Publisher
7. Stan Z.Li, Anil K.Jain,Handbook of Face recognition, Second edition, Springer
8. Anil K.Jain, Arun A.Ross, KarthikNandakumar, Introduction to Biometrics, Springer
9. Saferstein, Richard. Criminalistics. An Introduction to Forensic Science, 5th ed., Prentice Hall, 1998
10. Saferstein, R., Handbook of Forensic Science (Vol 1,2,3),
11. Eckert, An Introduction to Forensic Science
12. James, S. H. and Nordby, J. J.: Forensic Science: An Introduction to Scientific and Investigative Techniques, CRC Press, 2003 & 2005
13. Siegel, J. A., Sukoo, R. J, and Knupfer, G. C: Encyclopedia of Forensic Science, Vol I, II and III, Academic Press, 2000.
14. Kirk, P.,: Criminal Investigation, Interscience, 1953
15. Hara, C.E.O., &Osterburg, J.W., An Introduction to Criminalistics Indiana University Press, (1972)

FS202T(*): Forensic Chemistry

Instruction	3 Periods per week
Duration of University Examination	2 Hours
University Examination	100 Marks / 3 Credits

UNIT I Forensic Chemistry

Forensic Chemistry: Introduction, Types of cases / exhibits, Preliminary screening – Presumptive tests (colour and spot tests) - Chemical fertilizers (Nitrogen, Phosphorus, Potassium), Insecticides (Endosulfan, Malathion, Carbaryl)

Chemical evidences: Metallurgical analysis (Fe, Cu, Zn, Au, Ag) – Natural products (tobacco, tea, sugars, rubber) – Industrial chemicals and solvents: Sulphuric, Nitric and Hydrochloric acids, Sodium, Potassium hydroxide, Methanol, Ethanol, Acetone, Chloroform and Ether with reference to forensic work

Examination of petroleum products: Distillation and fractionation; various fractions and their commercial uses - Standard methods of analysis of petroleum products – Analysis of petroleum products for adulteration

Fire arson investigation: Chemistry of fire, Causes of fire - Investigation and evaluation of fires - Analysis of arson residues by conventional and instrumental methods

Trace evidence analysis: Introduction and scope of trace evidence analysis – Methods of collection of trace evidences – Analysis methods of various trace evidences (Trap related evidence materials, Dyes and pigments, Oils and fats, Industrial dusts)

UNIT II NDPS & Alcoholic beverages

Introduction to Narcotic Drugs and Psychotropic Substances: Introduction; Definition of drug and drug abuse - Classification of NDPS (Form and origin; Pharmacological classification) - Drug abuse in sports

Drug profiling and designer drugs: Drug profiling- Designer Drugs (Introduction and classes of designer drugs) - Clandestine laboratories

Forensic Analysis of Opiates, Cannabis and Stimulants: Analysis of Opiates (Morphine; Codeine; Heroin) – Analysis of Cannabis (Introduction; Cannabis forms; Active principle; Tests) – Stimulants (Cocaine; Amphetamines, MDMA)

Analysis of Hallucinogens, Other drugs and Legal aspects of NDPS: Analysis of Hallucinogens (LSD, Psilocybin, Mescaline) – Barbiturates; Benzodiazepines – Disubstituted Quinalozones – Legal aspects of drugs of abuse (Dangerous Drugs Act; Drugs and Cosmetic Act; Excise Act; NDPS Act)

Analysis of Beverages: Common terminology (Beverage; Proof; Extract; Alcoholic beverage; Non-alcoholic beverage) – Manufacture, composition and analysis of alcoholic and non-alcoholic beverages – Country made liquor; Illicit liquor; Common adulterants and toxic substances in alcoholic beverages

UNIT III Explosives

Explosives and Explosion Residues: Introduction, Definition of explosion, explosive, use of explosives - Historical timeline of explosives – Composition and characteristics of explosives

Classification of Explosives and Explosion Process: Classification of explosives, Pyrotechnics, IEDs, Plastic explosives – Explosion process (Burning, deflagration, detonation) – Explosion effects

Explosive Crime Scene Management: Approach to scene of explosion, Post blast explosion residue collection – Reconstruction of sequence of events – Evaluation and assessment of scene of explosion

Systematic Analysis of Explosives and Explosion Residues: Extraction of explosion residues – Chemical tests – Instrumental methods (Analysis of Picric acid; Gun powder; Ammonium nitrate; NG,NC, TNT, PETN, TETRYL, RDX and HMX)

Synthesis and Legal aspects of Explosives: Synthesis of primary explosives, secondary explosives and low explosives - Explosives Act and Explosive Substances Act - Profiling and Tagging of explosives, Interpretation of results

The syllabus shall also include Seminars and Tutorials on topics covered in this paper.

Suggested reading:

1. James, S. H. and Nordby, J. J.: Forensic Science: An Introduction to Scientific and Investigative Techniques, 2003.
2. Saferstein, R: Criminalistics - An Introduction to Forensic Science, Prentice Hall, 1995.
3. Sarkar, S: Fuels and Combustion, Orient Longman, 1990
4. Verma, R. M: Analytical Chemistry – Theory and Practice, CBS Pub., 1994
5. Svehla, G. Ed.: Vogel's Qualitative Inorganic Analysis, Longman, 1998.
6. Bassett: Vogel's Text Book of Quantitative Inorganic Analysis, Longman, 1978
7. Vogel, A. I: Text Book of Practical Organic Chemistry including Qualitative Organic Analysis, ELBS, 1971.
8. Skoog, D. A., West, D. M. and Holler, F. J: Analytical Chemistry: An Introduction,Saunders College, 1994.
9. Siegel, J. A, Saukko, P. J. and Knupfer, G. C: Encyclopedia of Forensic Sciences, Academic Press, 2000.
10. Townsends, A. (Ed): Encyclopedia of Analytical Science, Academic Press, 20005.
11. Beveridge, A: Forensic Investigation of Explosives, Taylor & Francis, 2000.
12. Yallop, H. J: Explosion Investigation, Forensic Science Society & Scottish Academic Press, 1980.
13. Narayanan, T. V: Modern Techniques of Bomb Detection and Disposal, R. A. Security System, 1995.
14. Yinon, J. and Zitrin, S: The Analysis of Explosives, Oxford: Pergamon, 1981
15. Yinon, J. and Zitrin, S: Modern Methods and Applications in Analysis of Explosives, John Wiley, 1993.
16. Moffat, A. C., Osselton, M. D., Widdop, B. and Galichet, L. Y: Clarke's Analysis of Drugs and Poisons in Pharmaceuticals, Body Fluids and Postmortem Material, 3 rd . edn. Pharmaceutical Press, 2004.
17. Almirall, J. R. and Furton, K. G: Analysis and Interpretation of Fire Scene Evidence, CRC Press, 2004.

18. Bogusz, M. J: Handbook of Analytical Separations : Vol. 2 ,Forensic Science, Elsevier, 2000.
19. Dettean, J. D: Kirk's Fire Investigation, Prentice Hall, 2002.
20. Gough, T. A: The Analysis of Drugs of Abuse, John Wiley, 1991.
21. Saferstein, R: Forensic Science Hand Book, Vol. I, II and III, Prentice Hall
22. N. D. P. S. Act, 1985 with amendments
23. Explosive Act with amendments
24. Explosive Substances Act with amendments
25. Bureau of Indian Standards: Specifications and Methods of Analysis for Alcoholic Beverages.
26. Bureau of Indian Standards: Specifications and Methods of Analysis for Petroleum Products.
27. Working Procedure Manual: Chemistry, Explosives & Narcotics, B.P. R & D, 2000
28. DEA Manual: Analysis of Controlled Substances
29. Wilson and Wilson's Comprehensive Analytical Chemistry Volumes
30. Standard Methods of Chemical Analysis
31. AOAC: Official Methods of Analysis
32. Indian, British & U. S. Pharmacopeias

FS203T(*): Forensic Anthropology & Forensic Medicine

Instruction	3 Periods per week
Duration of University Examination	2 Hours
University Examination	100 Marks / 3 Credits

UNIT I Forensic Anthropology

Human Osteology: Structure of bones - Types and formation of bones – Study of human skeletal system

Anthropology: History, Scope and development of anthropology, Role of forensic anthropologist – Determination of sex and stature from skeletal remains – Determination of age and race from skeletal remains, Bone pathology and forensic significance

Personal Identification from Skeletal Remains: Portrait Parle/Bertillon system, Somatoscopy and Somatometry - Superimposition technique, Facial reconstruction and Video image analysis – Personal identification from skeletal remains in mass disaster cases

Basics of Forensic Odontology: Introduction to Forensic Odontology - Structure and types of teeth, Dentition and dental formula - Dental diseases

Personal Identification with Forensic Odontology:

Determination of age from teeth – Determination of sex and race from teeth - Role of teeth in mass disaster, Forensic significance in personal identification

UNIT II Forensic Medicine - I

Introduction to Forensic Medicine and Personal Identification: Introduction, history and scope of Forensic Medicine - Qualification and role of Forensic Medical Examiner - Personal identification of living and dead

Thanatology: Definition, causes, modes and medico legal aspects of death - Postmortem examination (autopsy), Exhumation - Postmortem changes and their importance in determination of time after death

Traumatology: Definition and types of injuries - Mechanical injuries (Types, causes, and medico legal aspects) - Thermal injuries (Types, causes, and medico legal aspects)

Sexual offences, Pregnancy, Abortion and Delivery: Introduction, types and medico legal aspects of sexual offences, examination of victim and suspect - Introduction and medico legal aspects of pregnancy and delivery - Introduction, types and medico legal aspects of abortion and MTP act

Infanticide: Definition of infanticide, types of infant birth, signs of live birth – Medico legal aspects of infanticide - Battered baby syndrome, sudden infant death syndrome and Munchausen's syndrome

UNIT III Forensic medicine - II

Examination of Human bodies: Examination of decomposed bodies - Examination of mutilated bodies - Examination of burnt bodies

Deaths from Poisoning and Starvation: Definition and types of poisoning - Medico legal aspects of poisoning - Causes and medico legal aspects of starvation

Mechanical Asphyxia and Drowning: Definition and types of mechanical asphyxia - Medico legal aspects of asphyxia - Definition, types and medico legal aspects of drowning

Death due to Lightning and Electrocution: Definition of lightning and electrocution - Types of burns in lightning and electrocution - Medico legal aspects of lightning and electrocution

Deaths Associated with Surgery, Anaesthesia and Blood Transfusion: Introduction, Classification of patients by American Society of Anaesthesiologists - Causes and medico legal aspects of death during surgery, blood transfusion hazards and risks - Immunological and non-immunological reactions, Investigation of transfusion reactions

The syllabus shall include Seminars and Tutorials on the above topics of the paper.

Suggested Reading:

1. Pillay, V.V., Handbook of Forensic Medicine and Toxicology, 12th ed., ParasPublication, 2001.
2. Modi, J. P., Textbook of Medical Jurisprudence & Toxicology , M.M. Tripathi, Publication, (2001)
3. Parikh, C.K. , Textbook of Medical Jurisprudence & Toxicology
4. Reddy Narayn,. M., Textbook of Medical Jurisprudence & Toxicology
5. James, P.J.: Encyclopedia of Forensic and Legal Medicine, Elsevier, 2005
6. Angi M. Christensen, Nicholas V. Passalacqua and Eric J. Bartelink, Forensic Anthropology Current Methods and Practice, Elsevier Inc (2014)
7. Angela Libal, Solving Crimes With Science:Forensics FORENSIC ANTHROPOLOGY, Mason Crest, an imprint of National Highlights, Inc (2014)
8. Bradley J. Adams Forensic Anthropology, Inside Forensic science, Infobase Publishing (2007)
9. LINDA L. KLEPINGER, FUNDAMENTALS OF FORENSIC ANTHROPOLOGY, John Wiley & Sons, Inc. (2006)
10. ROBERT PICKERING and DAVID BACHMAN The use of Forensic Anthropology, 2nd edition, Taylor & Francis Group, LLC (2009)
11. KrishanVij, Textbook of Forensic Medicine and Toxicology Principles and Practice, Fifth Edition, Elsevier(2011)

FS204T(*): Forensic Ballistics

Instruction	3 Periods per week
Duration of University Examination	2 Hours
University Examination	100 Marks / 3 Credits

UNIT I Introduction to Forensic Ballistics

Forensic Ballistics: Introduction, history and scope of forensic ballistics - Classification of fire arms based on various parameters - Role of forensic ballistic examiner, Arms act

Identification of Origin of Firearms: Constructional features of Standard firearms - Improvised firearms, country made firearms - Imitative fire arms

Ammunition and their components: Introduction, types of ammunition, Classification and construction features of different types of cartridges - Types of primers, priming composition, Propellants and their compositions - Types of bullets and compositional aspects

Mechanism of Firearms: Trigger mechanism during firing process - Rifling and its significance in rifled firearms - Choke and its significance in smooth bore shot gun firearms

Handling of Firearms and its Ammunition: Techniques of dismantling / assembling of fire arms - Safety aspects of handling fire arms and ammunitions - Do and don't while handling firearms and its ammunition

Unit II Categories of Gun Ballistics

Internal Ballistics: Definition of internal ballistics - Process of Ignition of propellant - Definition, measurement and factors affecting the recoil velocity

Intermediary Ballistics: Definition of intermediary ballistics - Effects on the motion of projectile and firearm - Muzzle blast, flash and silencers

External Ballistics: Definition of external ballistics - Determination of trajectory of projectiles - Factors affecting the trajectory of projectile

Terminal Ballistics: Definition of terminal ballistics - Effect of projectile on hitting the target and Function of bullet shape - Ricochet and its effects and factors affecting the wound characteristics

Wound Ballistics: Definition of wound ballistics**,** Threshold velocity for penetration of skin, flesh, bones, Nature of wounds - Evaluation of injuries caused due to shot gun, rifle, handguns and country made firearms - Methods of measurement of wound ballistic parameters, ante mortem and postmortem injuries

UNIT III Identification of Firearms and GSR Residue Analysis

Principles and Practice of Identification of Firearms: Principles of firearm identification - Different types of marks produced during firing process on cartridge and on bullet - Techniques for obtaining test material from various types of weapons, Linkage of fired cartridges and bullets with test fired cartridge and bullet

Determination of Various Parameters: Range of fire - Time of firing, Angle of firing - Direction of firing

Automatic Trajectory, Bullet and Cartridge Comparison system: Ballistic Data Acquisition system - Automated management of ballistics data (NIBIN and IBIS), History of establishment - Brass Trax, Bullet Trax & Match Point etc., Limitation, Advantages and Applications

Gunshot Residue Analysis: Mechanism of formation of GSR - Identification of shooter - Collection and analysis (classical and Instrumental methods) of GSR analysis

Management and Reconstruction of Crime Scene: Reconstruction and interpretation of suicide, murder, accidental and self-defense cases - Forensic report writing - Courtroom testimony in shooting incidents

The syllabus shall include Seminars and Tutorials on the above topics of the paper.

Suggested Reading:

1. Saferstein, R., Criminalistics. An Introduction to Forensic Science, 5th ed., Prentice Hall, 1998
2. Saferstein, R., Handbook of Forensic Science (Vol. 1,2,3)
3. Kirk, P.: Criminal Investigation, Interscience, 1953
4. James, S. H. and Nordby, J. J.: Forensic Science: An Introduction to Scientific and Investigative Techniques, CRC Press, 2003 & 2005
5. Siegel, J. A., Sukoo, R. J, and Knupfer, G. C: Encyclopedia of Forensic Science, Vol, I, II and III, Academic Press, 2000
6. Hara, C.E.O., &Osterburg, J.W., An Introduction to Criminalistics Indiana University Press, (1972)
7. Mathews, H.J., & Thomas, C.C., Firearms Identification (Vol1,2,3) , Springfield, (1973)
8. Hatcher, Jury & Weller, Firearms Investigation, Identification and Evidence, Stackpole Books, (1977)
9. Heard, B.J., Handbook of Firearms and Ballistics, John Wiley & Sons, (1997)
10. Warlow, T.A. , Firearms: The Law and Forensic Ballistics, Taylor & Francis , (1996)
11. Johari, M., Identification of Firearms, Ammunition and Firearm Injuries; BPR&D, (1980)
12. Sellier, K.G. et.al., Wound ballistics and The Scientific Background, Elsevier, (1994)
13. Brain J. H., Hand Book of Fire arms and Ballistics, John Wiley
14. Sharma B. R., Fire arms in Criminal Investigation and Trials, 3rdEdn. Universal (2002)
15. Kumar K., Forensic Ballistics in Criminal Justice, Eastern Book Co (1987)

SEMESTER – II (PRACTICALS)

FS251P(*): Imprints, Impressions & Biometrics Lab

Instruction	4 Periods per week
Duration of University Examination	3 hours
University Examination	50 Marks/ 2 credits

1. To develop latent fingerprints using powder methods and tape lifting
2. Development of latent fingerprints with iodine fuming and chemical methods
3. Prepare plain and rolled inked fingerprints on fingerprint slip to perform Henrys classification.
4. Identification of ridge characteristics and classify fingerprints
5. Comparison of fingerprints
6. Lip prints - Photography, lifting and comparison
7. Ear prints - Photography, lifting and comparison
8. Footprint tracing, casting and comparison
9. Identification and comparison of footwear impressions
10. Sole prints lifting from the crime scene and their comparison
11. Bite marks casting and comparison
12. Tire print tracing, casting and comparison
13. Restoration of erased identification marks from metal surfaces
14. To perform gait pattern analysis and study the gait characteristics
15. To study the practical working and handling of Biometric devices & AFIS (Demo)

FS252P(*):Forensic Chemistry Lab

Instruction	4 Periods per week
Duration of University Examination	3 hours
University Examination	50 Marks/ 2 credits

1. Analysis of natural products (Tobacco/Sugars/Tea)
2. Analysis of Corrosive chemicals: Hydrochloric acid, Sulphuric acid, Nitric acid and alkalis
3. Analysis of Phenolphthalein in trap cases
4. Analysis of Dyes and Pigments
5. Forensic analysis of oils and fats
6. Analysis of adulteration of Petroleum products
7. Forensic analysis of arson related evidences
8. Examination of NDPS drugs by colour/spot and microcrystalline test
9. Analysis of NDPS by Thin Layer Chromatography
10. Quantitative drug analysis by UV-Visible spectrophotometry
11. Chemical analysis of liquors
12. Extraction and detection of inorganic explosive / explosion residues by spot/ colour tests
13. Extraction and detection of organic explosive / explosion residues by spot/ colour tests and TLC
14. IR spectroscopy of samples of forensic interest (Demonstration only)
15. Determination of a drug / explosive of forensic interest by HPLC/GC- MS / LC- MS of a drug of forensic interest (Demonstration only)

FS253P(*):Forensic Anthropology & Forensic Medicine Lab

Instruction	4 Periods per week
Duration of University Examination	3 hours
University Examination	50 Marks/ 2 credits

1. Study of human skeletal system
2. Determination of sex from skull
3. Determination of sex from pelvic girdle
4. Determination of sex from mandible
5. Determination of age from skull
6. Determination of age from teeth
7. Estimation of stature from long bones
8. Personal identification by Bertillon system
9. Personal identification by superimposition technique
10. Study of identification methods (Fingerprints, Tattoo marks, Deformities, Hair, mole and scars)
11. Demonstration of Instruments used for conducting autopsy (Dissection Set)
12. Medico legal autopsy of different cases of death – External examination (Demo)
13. Medico legal autopsies of different cases of death – Internal examination (Demo)
14. Study of dead body at autopsy for sign of death, cause of death, manner of death and time since death (Demo)
15. Proformas for demonstration of Post mortem report, Death Certificate, Sexual offence certificate and Summons

FS254P(*): Forensic Ballistics Lab

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	50 Marks / 2 Credits

1. Characteristics of Firearms – Calibre, Choke, Trigger pull, Proof marks etc.
2. Identification of parts and action mechanism of shot gun
3. Identification of parts and action mechanism of rifles (Revolver, Pistol, AK47)
4. Study of Muzzle loaders
5. Study of ammunition of shotgun
6. Study of ammunition of rifled firearms
7. Examination and Comparison of fired bullets – Calibre, rifling characteristics, probable type of firearms
8. Examination and Comparison of fired Cartridges/cases (Calibre, firing pin, breech face, Extractor / Ejector marks etc.)
9. Determination of shot number from size and weight of shots
10. Identification of types of bullets
11. Identification of propellants
12. Determination of range of firing
13. Chemical tests for powder residues (Walker's test) and Barrel wash
14. Determination of bullet entry and exit hole on glass pane
15. Test firing of bullets and its comparison (Demonstration only)

SEMESTER III (THEORY)

FS301T(*): Forensic Examination of Questioned Documents

Instruction	3 Periods per week
Duration of University Examination	2 Hours
University Examination	100 Marks/ 3 Credits

UNIT I: Introduction to questioned documents and handwriting examination

Document and Questioned document: Legal definition of document and classification – Questioned document, Handling and marking, preliminary examination – Nature and problems of questioned document examination

Basics of Handwriting identification: Development of handwriting, principles in handwriting examination - Factors influencing handwriting - Individuality of handwriting, Natural variations

Handwriting characteristics and comparison: Procurement of Admitted/ Specimen writings - Various writing features and their estimation - General and individual characteristics of handwriting

Disguised writing and anonymous letters: Disguised writing, modes of disguise - Anonymous letter; Classification - Identification of the writer

Types of writing instruments: Systematic examination of inks - Types of pens and their specific functioning – Examination of paper

UNIT II: Examination of document frauds

Examination of signature forgeries: Examination of signature - Characteristics of genuine and forged signatures – Forgery, Types of forgeries and their detection

Examination of other document frauds: Examination of alterations, erasures, over writings, additions & obliterations – Decipherment of secret writings – Examination of indented writings & charred documents

Examination of typewritten documents: Class and individual characteristics of typewriting – Identification of typewriter writings and printed matter – Identification of typewriter machine

Examination of computer printouts, xerox copies and fax messages: Identifying features of various printers from computer printouts – Identifying features of photocopier machines – Examination of fax messages

Conventional printing processes: Various types of conventional printing processes and their identifying features – Identification of source of printed material - Examination of built up documents

UNIT III: Security documents, analytical instrumentation and legal aspects of document examination

Examination of security documents: Examination of genuine and counterfeit Indian currency notes – Examination of Indian passports – Counterfeiting passports

Examination of plastic currency: Security features of plastic currency – Plastic currency frauds, prevention and detection – Examination of plastic currency in forensic lab

Determination of age of document, examination of digital signatures and mechanical impressions: Determination of age of document – Digital signature, Cryptography and types -

Determination of sequence of strokes, Examination of rubber stamp, seal impressions and other mechanical impressions

Analytical instrumentation in document examination: Basic tools for forensic document examination – VSC, ESDA and Raman Spectroscopy in document examination – Application of microscopy, chromatography and fluorimetry in document examination

Legal aspects of forensic document examination: Opinion writing, Reasons for opinion, Court testimony – IPC sections relevant to document examination: IPC – 29, 29A, 409, 467, 468, 470, 471, 489 (A to E) – IEA sections relevant to document examination: IEA – Sec 3, 45, 47 and 73

The syllabus shall include Seminars and Tutorials on the above topics of the paper.

Suggested reading:

1. Jan Seamen Kelly and Brian S Lindblom, Scientific examination of questioned documents, 2nd edition, CRC Press, 2006
2. Katherine M Koppenhaver, Forensic document examination – Principles and practice, Humana Press, 2007
3. Jane A Lewis, Forensic document examination – Fundamentals and current trends, Academic Press, 2014
4. David Ellen, Scientific examination of documents – Methods and techniques, Third edition, CRC Press, 2005
5. Morris, Ron. Forensic Handwriting Identification Fundamental Concepts and Principles, Academic Press, 2000
6. Huber, Roy, A. and Headrick, A. M. Handwriting Identification: Facts and Fundamentals, CRC Press, 1999
7. Osborn, A. S. The Problem of Proof, 2 nd ed, Universal Law Publishers, 1998
8. Thomas, C.C., Typewriting Identification I.S.Q.D., Billy Prior Bates, 1971
9. Harrison, W.R., Suspect Documents: Their Scientific Examination, Universal Law Publisher, 1997
10. Lerison, J., Questioned Documents, Academic Press, 2000
11. Hilton, O., Scientific Examination of Questioned Documents, Elsevier, 1982
12. Michael Allen, Foundations of forensic document analysis – Theory and Practice, Wiley Blackwell, 2016
13. Suzanne Bell, Fakes and Forgeries, 2009
14. Bhuvan, Examination of disputed documents, 3rd edition, 2022
15. Siegel, J. A., Sukoo, R. J, and Knupfer, G. C: Encyclopedia of Forensic Science, Vol I, II and III, Academic Press, 2000

FS302T(*): Forensic Toxicology

Instruction	3 periods per week
Duration of University Examination	2 Hours
University Examination	100 Marks / 3 Credits

UNIT I: General principles of Toxicology

Toxicology: Introduction, History, Scope and Areas of Toxicology - Role of Forensic Toxicologist - Laws related to Forensic Toxicology

Poisons: Introduction and Classification of poisons – Classification of poisoning; Types of poisoning – Factors affecting intensity of poisoning

Pharmacokinetics: Introduction, Methods of transportation of toxicant - Absorption, Distribution, Storage of toxicants, Redistribution, Metabolism and Other routes of elimination – Toxicokinetics: one and two compartmental model

Toxicodynamics: Spectrum of undesired (toxic) effects - Interaction of chemicals - Tolerance and dose response relationship

Toxicity testing: Introduction, methods of toxicity testing - Mutagenicity and carcinogenicity – Developmental and reproductive toxicity

UNIT II: Clinical toxicology

Emergency hospital toxicology: Introduction, Maintenance of vital functions, Assessment of consciousness of poisoned patient - Clinical evaluation of poisoned patient - Diagnosis of signs and symptoms of poisoning

Management of poisoning: Poison information centre – Measures to enhance elimination of poisons - Removal of unabsorbed poisons

Antidotes: Introduction, Classification of antidotes - Mechanism of action of antidote (cyanide, methanol, arsenic, opiate, carbon monoxide, nitrite, acetaminophen and pesticides) - Recovery and after care of patients

Investigation of poisoning: Examination of poisoned death - Identifying route of administration of poison - Estimation of time and dose after administration of poison

Therapeutic drug monitoring: Introduction - Analytical techniques for therapeutic drug monitoring - Challenges and future directions

UNIT III: Forensic Toxicology

Collection and preservation methods of toxicological samples: Sample collection – Preservation - Storage of toxicological exhibits in fatal and survival cases

Toxicological Analysis: Introduction, Sample preparation - Extraction methods - Isolation and Clean-up procedures in toxicological analysis

Identification and quantitation of volatile inorganic and organic poisons: Volatile poisons – Gases - Miscellaneous poisons

Identification and quantitation of non-volatile inorganic and organic poisons: Metals and anions – Drugs - Pesticides

Toxicological investigation: Interpretation of toxicological data - Courtroom testimony in toxicological cases - Case studies

The syllabus shall also include Seminars and Tutorial on topics covered in this paper.

Suggested Reading:

1. Klaassen, C. D.,:Casarett and Doull's Toxicology: The Basic Science of Poisons, 5thed, McGraw-Hill, 1995
2. 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.
3. Siegel, J.A., Saukko, P. J., Knupfer, G.,: Encyclopedia of Forensic Sciences (Vol3), Academic Press, 2000
4. Rang, P.H., Dale, M.M., Ritter, M.J.: Pharmacology, 4th ed., Harcourt/Churchill Livingstone, 2000
5. Paranjape, H.M., Bothara, G.K., Jain, M.M.: Fundamentals of Pharmacology, 1st ed., Nirali Prakashan,1990
6. Budhiraja, R.D.: Elementary Pharmacology and Toxicology, Popular Prakashan, 2nd ed., 1999
7. Wiseman, H and Henry J.: Management Of Poisoning, A Handbook for Healthcare workers, 1st ed., A.I.T.B.S, 2002
8. Hardman, J. G. and Limbird, L. E.,: Goodman and Gilman's The Pharmacological basis of Therapeutics, 9th edn., McGraw-Hill, 1996
9. Laboratory procedure Manual, Forensic Toxicology: DFS, 2005
10. Sunshine, I ; Methods for Analytical Toxicology, CRC Presss USA (1975)
11. Cravey, R.H; Baselt, R.C.: Introduction to Forensic Toxicology , Biochemical Publications, Davis, C.A. (1981)
12. Stolmen, A.; Progress in Chemical Toxicology: Academic Press, New York (1963)
13. Modi, Jaisingh, P.; Textbook of Medical Jurisprudence& Toxicology, M.M. Tripathi Publication (2001)
14. Eckert; An Introduction to Forensic Science, CRC Press
15. Pillay, V. V.; Handbook of Forensic Medicine and Toxicology, Paras Pub., 2001
16. Curry, A. S: Poison Detection in Human Organs
17. Levine Barry, Principles of Forensic Toxicology, 2nd Edn., (2006)
18. Hodgeon Emeet, A Text Book of Modern Toxicology, 3rd.Edn. (2004)
19. Pillay, V. V.; Comprehensive Medical Toxicology, 3rd edition, Paras Pub., 2018

FS303T(Elective III A): Forensic Nanotechnology

Instruction	3 periods per week
Duration of University Examination	2 Hours
University Examination	100 Marks / 3 Credits

UNIT I: Basics of Nanotechnology

Nanotechnology: Introduction to nanotechnology, Definition of terms: Nanomaterials, Nanoscience and Nanotechnology, Nanoscale and its features - Applications of nanotechnology - Challenges and future scope of nanotechnology, Nanotechnology in India

Societal issues in nanotechnology: Ethical issues in nanotechnology - Economic impact of nanotechnology - Societal acceptance of nanotechnology

Classification of nanomaterials: Based on origin - Based on dimension - Based on structural configuration

Properties of nanomaterials: Mechanical and Structural properties, Melting – Electrical and Optical properties - Magnetic and Chemical properties

Types of nanomaterials and their properties: Clusters, Semiconductor nanoparticles, Metal nanoparticles, Plasmonic materials, Types of Magnetic nanomaterials - Some special nanomaterials: Carbon nanomaterials, Porous material, Aerogels, Zeolites - MOFs, Core-shell particles, Meta materials, Bio-inspired materials

UNIT II: Synthesis and characterization of nanomaterials

Synthesis of nanomaterials and physical methods: Top down approach and Bottom up approach – Physical methods of nanomaterial synthesis: Mechanical methods, Methods based on evaporation – Sputter deposition, Chemical Vapour deposition, Electric arc deposition, Ion implantation, Nanolithography

Synthesis of nanomaterials by chemical methods: Introduction, Colloids, Nucleation and growth of nanoparticles, synthesis of metal and semiconductor nanoparticles by colloidal route – Langmuir Blodgett method, Micro emulsion method, Sol gel method – Hydrothermal synthesis, Sonochemical synthesis, Microwave synthesis, Synthesis using lab-on-chip

Synthesis of nanomaterials by biological methods: Principles of green chemistry, synthesis of nanomaterials using plant extracts and microbial organisms – Synthesis of nanomaterials using proteins, DNA and surface layers of bacterial cell walls - Mechanism of Self-assembly

Characterization of nanomaterials using microscopic techniques: Characterization of nanomaterials using Optical and Confocal microscope - Characterization of nanomaterials using SEM and TEM - Characterization of nanomaterials using STM, AFM, SNOM

Characterization of nanomaterials using various instrumental methods: Characterization of nanomaterials by spectroscopic techniques such as UV-Visible spectroscopy, Photoluminescence spectroscopy and FTIR – Characterization of nanomaterials by X-ray diffraction and dynamic light scattering techniques – Characterization of nanomaterials by thermal methods of analysis and Vibrating Sample Magnetometer

UNIT III: Forensic applications of nanotechnology

Forensic nanotechnology: Introduction to Forensic nanotechnology - Scope and importance – Recent advancements and applications of nanotechnology in Forensic Science

Applications of Nanotechnology in Forensic Chemistry and Forensic Toxicology: Application of nanomaterials in explosive detection – Detection of illicit drugs and poisons - Identification of food adulterants

Application of Nanotechnology in Questioned document examination: Preventive aspect and Investigative aspect – Nanomaterials as formulation of inks, security features and security tags in documents – Application of nanomaterials in analysis of inks, Nano trackers

Application of Nanotechnology in Forensic Serology, DNA analysis and Forensic Medicine: Nanosensors Working and types – Identification of body fluids using nanotechnology, estimation of age of bloodstain, estimation of time since death – Use of nanotechnology for enhancement of PCR efficiency

Applications of Nanotechnology in Forensic Physics and defence: Application of nanotechnology in latent fingerprint development - Detection of trace evidences, GSR – Applications of nanotechnology in detection of biological and chemical threats, weapons and nerve agents

The syllabus shall also include Seminars and Tutorial on topics covered in this paper.

Suggested Reading:

1. Kulkarni, Sulabha K.: Nanotechnology: Principles and Practices 3rd edition, Springer, 2015
2. Ritesh Kumar Shukla and Alok Pandya: Introduction of Forensic Nanotechnology as Future Armour, Nova Science Pub., 2019
3. D. E. Babatunde *et al.*: Environmental and Societal Impact of Nanotechnology, IEEE Access, 2019
4. Augus I Kirkland and John L Hutchison: Nanocharacterisation, RSC Pub., 2007
5. Bharat Bhushan: Springer Handbook of Nanotechnology, Springer, 2004
6. Jeremy Ramsden: Essentials of Nanotechnology, Ventus Publishing APS., 2008
7. Guozhong Cao: Nanostructures & Nanomaterials: Synthesis, Properties & Applications, Imperial College Press, 2004
8. Tilstra, Luanne, and Thomas F. George: The Science of Nanotechnology: An Introductory Text, Nova Science Publishers, 2008
9. Nicolini, Claudio A: Nanobiotechnology & Nanobiosciences, Pan Stanford Pub., distributed by World Scientific Pub., 2009
10. Merkoçi, Arben: Biosensing Using Nanomaterials, 1st ed., Wiley, 2009
11. Rawtani, Deepak, and Chaudhery Mustansar Hussain: Modern Forensic Tools and Devices: Trends in Criminal Investigation, Wiley, 2023
12. Allhoff, Fritz: Nanotechnology & Society: Current and Emerging Ethical Issues, Springer, 2008
13. "Nanotechnology in Forensic Science: Extensive Applications and New Perspective." Indian Journal of Biochemistry and Biophysics, 2022.

14. Bisma Sher Ali: “The Application of Nanotechnology in Criminology and Forensic Sciences: Bisma Sher Ali.” International Journal for Electronic Crime Investigation, Vol. 6(4), 2022, pp. 13–18.
15. “Nano-Forensic: New Perspective and Extensive Applications in Solving Crimes.” Letters in Applied NanoBioScience, Vol. 10(1), 2020, pp. 1792–98
16. Chen, Yung-fou: “Forensic Applications of Nanotechnology.” Journal of the Chinese Chemical Society, Vol. 58(6), 2011, pp. 828–35

FS303T(Elective III B): Microbial Forensics

Instruction	3 periods per week
Duration of University Examination	2 Hours
University Examination	100 Marks / 3 Credits

UNIT I: Basics of Microbiology

Microbiology: Introduction, history of microbiology - Branches of microbiology - Scope and importance of microbiology

Microorganisms: Definition, characteristics of microorganisms – Classification, nomenclature of microorganisms - Role of microorganisms in environment, industry, causing diseases and bioterrorism

Microbial Nutrition: Common nutritional requirements of microbial metabolism - Nutritional types of microorganisms - Transport mechanisms for nutrient absorption

Microbial growth: Culture media - Isolation and preservation of pure cultures - Kinetics and measurement of microbial growth

Control of microorganisms: Kinetics of microbial death - Physical and chemical methods of microbial control - Evaluation of antimicrobial agent effectiveness

UNIT II: Basics of Forensic Microbiology

Forensic Microbiology: Concept of Forensic microbiology - History, introduction to epidemiology - Microbial Forensic program (SWGMGF) and CDC

Microorganisms of forensic importance: Bacteria of forensic importance - Fungi of forensic importance – Virus of forensic importance

Biological toxins of forensic importance: Introduction - Plant and animal toxins – Microbial toxins

Bioterrorism: Introduction to bioterrorism and types of biological agents (Category A, B, C) - Planning and response to bioterrorism - Epidemiology and punishments for Bioterrorism under Prevention of Terrorism Act, 2002

Applications of Forensic Microbiology: Estimation of post-mortem interval (PMI) and cause of death – Microbial outbreak investigation - Other medico legal aspects (sexual assault, medical malpractice, food safety and environmental contamination)

UNIT III: Microbial Forensic Investigation

Collection and preservation of Microbial forensic samples: Sampling and collection methods of microbes - Legal concerns for sample handling and data records - Safety issues and regulations of handling and transportation of microbial evidence

Morphological and physiological characterization and identification of microbes: Introduction - Classical methods of microbial characterization - Microbial culture and its impact on microbial identification and attribution elements

Genetic analysis for microbial characterization: Introduction - PCR (dendrograms and phylogenetic trees) - Molecular genetic techniques for strain typing

Identification of microbes by analysis of fats and lipids: Introduction - Methods for extraction and detection of fatty acids and lipids - Investigative applications of fatty acids and lipids

Instrumental methods for microbial characterization and identification: Introduction - Characterization and identification of microbes by instrumental techniques (SEM- EDX, AFM, Raman spectroscopy, mass spectrometry, nuclear microscopy, ICP-OES, ICP-MS) - Analysis of elemental signatures of microbes.

The syllabus shall also include Seminars and Tutorial on topics covered in this paper.

Suggested Reading:

1. Paniker, C. K. Jayaram, and R. Ananthanarayan: Ananthanarayan and Paniker's Textbook of Microbiology. 7th ed. /, Orient Longman, 2005
2. Hogg, Stuart: Essential Microbiology, John Wiley and Sons, 2005
3. Talaro, Kathleen P., and Barry Chess: Foundations in Microbiology, 8th ed, McGraw-Hill, 2012
4. Willey, Joanne M., et al.: Prescott's Microbiology, Twelfth edition, International student edition, McGraw Hill, 2023
5. Trivedi, Pravin Chandra, et al.: Text Book of Microbiology, Aavishkar, 2010
6. Carter, David O., et al.: Forensic Microbiology, Wiley, 2017
7. Cliff, John B., et al.: Chemical and Physical Signatures for Microbial Forensics, Springer New York, 2012
8. Budowle, Bruce: Microbial Forensics, 2nd ed, Elsevier/Academic Press, 2011
9. Roger G. Breeze, Bruce Budowle, and Steven E. Schutzer: Microbial Forensics, Academic Press, 2005

FS304T(Elective IV A): Research methodology, Statistics and IPR

Instruction	3 periods per week
Duration of University Examination	2 Hours
University Examination	100 Marks / 3 Credits

UNIT I: Concept of Research methodology

Introduction to Research: Introduction to research - Types of research and research approaches - Research process, criteria of good research, problems encountered by researchers in India

Research problem, research design and sampling design: Defining research problem – Research design: Meaning, need, types and features of good design - Sample design: Steps involved, selecting sampling procedure, characteristics of good sample design, types

Scaling techniques, data collection, sampling and data processing: Important scaling techniques and scale construction techniques - Collection of primary data and secondary data, case study method – Concept of population, sample, sample size, Types of sampling, determining sample size, data editing and coding

Measures of Central Tendency, dispersion, asymmetry and relationship: Measures of Central tendency: Mean, median and mode – Measures of dispersion and asymmetry: Range, Mean deviation and Standard deviation, Skewness and Kurtosis – Simple and multiple correlation and regression

Concept of probability: Random variable: discrete and continuous – Addition, multiplication and Bayes theorem – Concept of Probability distribution: Binomial, Poisson, Normal distribution

UNIT II: Statistics in research

Testing of hypothesis: Hypothesis and its characteristics – Null hypothesis and alternative hypothesis, Level of significance, Critical region, Type I and II errors – Procedure for hypothesis testing

Analysis of variance: Concept of analysis of variance – Computational procedure for ANOVA one way and two-way classification – Examples

Large samples tests and Chi square test: Large sample test: Test for single mean, Difference of means, Single proportion and difference of proportion with examples - Chi square test for goodness of fit - Test for independence of attributes, examples

T test and F test: Student t-test, t-test for simple mean and difference of means - Fisher's exact test: Analysis of variance and multiple comparison tests - F-test for equality of variance

Application of statistics to Forensic evidences: Statistical approach to DNA fingerprinting, simple case of genotypic and allelic frequencies, Hardy Weinberg equilibrium, Paternity cases and evaluation of blood group frequencies - Clothing fibres, Shoe types, Air weapon projectiles, Height identification from eye witness – Uncertainty in scientific experimentation, Determination of uncertainty

UNIT III: Publishing research and Intellectual Property Rights

Publishing research: Research paper layout, Impact factor of journals, Plagiarism and Self-plagiarism – Academic databases, Methods to search required literature effectively – Reference Management, Paper formatting and plagiarism detection softwares

Intellectual property rights: Meaning, Evolution, Nature and characteristics of IPR - Classification and forms, Rationale for protection of IPRs - Importance of IPRs in the fields of science and technology

Patents: Concept and principles of patenting an invention - Patentable subject matter, Inventions not patentable, Procedure of obtaining patents in India – Infringement of patent rights, Remedies for infringement of patent rights, Case studies, The Patents Act, 1970

Copyright and related rights: Subject matter and need of copyright - Authorship & ownership of copyright, Exclusive copyright rights of owner, Term of Copyright – Copyright registration in India, Copyright infringement, remedies and case studies, Copyright Act, 1957

Other IPRs: Trademark – Industrial design, Geographical indication - Trade secrets, plant varieties and semiconductor integrated circuits layout design and related laws

The syllabus shall include Seminars and Tutorials on the above topics of the paper.

Suggested reading:

1. C.R. Kothari, Research Methodology: Methods and Techniques, New Age International Publishers
2. David Lucy: Introduction to Statistics for Forensic Scientists, Wiley, 2004
3. Colin Aitken & Franco Taroni: Statistics and Evaluation of Evidence for Forensic Scientists (Statics in practice)
4. Wing kam Fung & Yue-Quing Hu: Statistical DNA Forensics, Theory Methods & Computation, Wiley, 2008
5. I. W. Evett & B. S. Wier: Interpreting DNA Evidence – Statistical Genetics for Forensic Scientists, 1998
6. Miller, J. C. and Miller, J. N.: Statistics for Analytical Chemistry, Ellis Horwood, 1988
7. Fisher, R. A.: Statistical Methods for Research Workers, John Wiley, 1954
8. Sokal, R. R. and Rolf, F. J.: Biometry – Principles and Practices of Statistics in Biological Research, Freeman, 1981
9. Meier, P. C. and Zund, R. E.: Statistical Methods in Analytical Chemistry, Wiley, 2000
10. Rao, V. K., Biostatistics – A Manual of Statistical methods for use in Health, Nutrition and Anthropology, Jaypee Medical Pub., 1996
11. Reddy, G.B.: GLA's Intellectual Property Rights and the Law, Gogia Law Agency, 2023

FS304T(Elective IV B): Quality Management, Laboratory Management & Laboratory Safety

Instruction	3 periods per week
Duration of University Examination	2 Hours
University Examination	100 Marks / 3 Credits

UNIT I: Quality Management

Internal quality audit and product evaluation: Quality, Quality system, Quality plan, Inspection and testing of products, Control of inspection, measuring and test equipment, Control of nonconforming product, Corrective and Preventive action – Handling, storage, packaging, preservation and delivery of product, Control of quality records – Internal quality audits, training and product evaluation

Proficiency testing programs: Introduction, Components of Laboratory quality assurance system: Internal quality control, laboratory accreditation, proficiency testing – Proficiency testing programs: types, designing and running of proficiency testing program, Red Carpet Syndrome – Dealing with extremes, Confidentiality, Dividends of participation

Laboratory Accreditation: Introduction, ISO 9000 series of standards - ISO 14000 and 17000 series of standards – NABL Guidelines for laboratory accreditation in India, GMP and GLP

Total Quality Management: Introduction, evolution of TQM – Essentials of TQM, quality costs and quality circles – QC audit, reliability, implementation of TQM and TQM standard

Laboratory quality management: Organization and management of laboratory, Quality system, audit and review - Accommodation and environment, Laboratory equipment and reference material - Calibration and test methods, handling of calibration and test items, records, certificates and reports, sub-contracting of testing, external services, Grievance committee

UNIT II: Laboratory Management

Organization of laboratory: Administration of Laboratories, Geographical location, Types of laboratories – Connection between field work and laboratory, Educational requirements of laboratory personnel – Routine laboratory work, Research and development

Design of laboratory: Lab space, Design of labs, architectural requirements, floor area, furniture design, physical aspects of lab premises and rooms – Design, importance and requirements of preparation room – Arrangement of stores

Day-to-day management of laboratory: Routine inspection and maintenance of lab, equipment, apparatus and furniture, cleanliness in lab – Stock control and purchase procedure - Filing systems, Record management, information about equipment, miscellaneous records

Scientific reporting: Efficient communication (Memoranda, letters, reports) – Writing up an experiment, recording and presentation of results – Information distribution

Laboratory Information Management system (LIMS): Classification of LIMS functions, Sub-division by functional area, Definition of LIMS, Strategic design of LIMS - System development life cycle: Review of the laboratory, Project proposal, Definition of system requirements, Specifications - Evaluation, Purchase, installation, Demonstration, Validation, User training and implementation of commercial or bespoke LIMS

UNIT III: Laboratory Safety

Lab safety plan: Written safety plan, safety policies, Role of head of the institution and lab staff, Code of behaviour for lab staff – Personal protective devices – Check-in and shut down sequences, shifting loads

Disposal of wastes: Disposal of unserviceable non-consumable items and obsolete instruments – Disposal of chemical wastes – Disposal of biological wastes

Laboratory hazards: Radiation and chemical hazards – Biological hazards – Physical hazards, electrical, fire and gas hazards

First aid in laboratory: Need and procedure for accident reporting – Placement and contents of first aid box, General features of first aid – First aid procedure for electric shock, unconscious casualties, chemical accidents, localized injuries, bleeding and shock

Legal aspects of laboratory safety: Case studies of laboratory accidents, Laboratory construction standards set by BIS, Regulations concerning safety and health of workers in industrial labs – Regulations regarding electricity, fire, alcohol purchase and storage, hazardous substances and experiments on animals – Legal liability for laboratory accidents in educational institutions

The syllabus shall also include Seminars and Tutorials on the above topics of the paper.

Suggested Reading:

1. Kanishka Bedi: Quality Management, Oxford University Press, 2006
2. Dux, J. P., Hand Book of Quality Assurance for Analytical Chemistry Laboratory, Van Nostrand, 1986
3. Duncan, W. L.: Total Quality: Key Terms and Concepts, 1995
4. Shah, D. H.: QA Manual, Business Horizons, 2000
5. Kumar, K.: Quality Management, ABD Pub., 2000
6. Ross, J.: Total Quality Management, Vanity Book, Intl., 1995
7. Seiler, J. P., Good Laboratory practice, Springer, 2000
8. Diwan, P.,: Quality in Totality, Manager's Guide to TQM and ISO 9000, Deepti & Deepti Pub., 2000
9. Gyani, G. J.:Training Manual on ISO 9000; 2000 and TQM, Raj Pub., 1999
10. Olson, M. H. and Davis, G. B.: Management Information Systems, McGraw Hill, 1998
11. Specific Guidelines for Accreditation of Forensic Science Laboratories, DST, 1998
12. Guide for Safety in The Chemical Laboratory: Manufacturing Chemist's Association, 1972
13. Steere N. V.(Ed.): Hand Book of Laboratory Safety, CRC, 1967
14. Tilstone, W. J. and Lothridge, K.: Crime Laboratory Management, Taylor and Francis, 2004
15. Clair, J. S: Crime Laboratory Management, Academic Press, 2003

SEMESTER – III (PRACTICALS)

FS351P(*): Forensic Examination of Questioned documents Lab

Instruction	4 Periods per week
Duration of University Examination	3 hours
University Examination	50 Marks/ 2 credits

1. Identification and comparison of general and individual characteristics of handwriting
2. Identification and examination of disguised writing
3. Forensic analysis of ink by TLC/Spectrophotometry
4. Forensic examination and detection of Simulated forgery
5. Forensic examination and detection of Traced forgery
6. Forensic examination and detection of Freehand forgery
7. Examination of alterations, additions, overwriting and obliterations in documents
8. Examination of erasures (mechanical and chemical)
9. Preparation and decipherment of secret writings
10. Decipherment and examination of indented writings
11. Examination of type scripts and computer printouts
12. Examination of rubber stamps and seal impressions
13. Examination and identification of genuine and counterfeit Indian currency notes
14. Examination of security features of Indian Passports
15. Examination of security features of plastic currency

FS352P(*): Forensic Toxicology Lab

Instruction	4 Periods per week
Duration of University Examination	3 hours
University Examination	50 Marks/ 2 credits

1. Preliminary tests on blood / urine / vomitus / tissues for heavy metals and toxic anions
2. Preliminary tests on blood / urine / vomitus / tissues for phenolic compounds and alcohol
3. Detection and determination of ethanol in toxicological samples by Kozelka & Hine method
4. Systematic extraction of basic substances from viscera
5. Identification of basic drugs by preliminary tests and TLC
6. Systematic extraction of acidic substances from viscera
7. Identification of acidic drugs by preliminary tests and TLC
8. Systematic extraction of neutral substances from viscera
9. Identification of plant alkaloids by preliminary tests and TLC
10. Identification of pesticides by TLC
11. Determination of a drug in toxicological specimen by Visible / UV spectrophotometry
12. Identification of heavy metals by TLC
13. Determination of a drug / pesticide in toxicological specimen by HPLC/GC (Demo only)
14. GC-MS / LC-MS of a poison of forensic interest (Demo only)
15. Detection and determination of ethyl alcohol in blood / urine / visceral tissue by gas chromatography (Demo only)

FS353P(Elective III A): Forensic Nanotechnology Lab

Instruction	2 Periods per week
Duration of University Examination	3 hours
University Examination	25 Marks/ 1 credit

1. Synthesis of nanoparticles by chemical method
2. Synthesis of nanoparticles by physical method
3. Green synthesis of nanoparticles using a plant extract
4. Characterization of nanoparticles by microscopic techniques
5. Characterization of nanoparticles by UV-Visible Spectroscopy and FTIR
6. Characterization of nanoparticles by XRD
7. Forensic application of nanoparticles in fingerprint development
8. Forensic application of nanoparticles in identification of drugs/ poisons

FS353P(Elective III B): Microbial Forensics Lab

Instruction	2 Periods per week
Duration of University Examination	3 hours
University Examination	25 Marks/ 1 credit

1. Principles of Microscopy
2. Sterilization of microorganisms by physical methods
3. Sterilization of microorganisms by chemical methods
4. Preparation of culture media and isolation of pure cultures
5. Isolation of microorganisms from various sources
6. Measurement of bacterial growth
7. Characterization of microorganisms
8. Identification of microorganisms from databases

FS354P(Elective IV A): Research methodology, Statistics & IPR Lab

Instruction	2 Periods per week
Duration of University Examination	3 hours
University Examination	25 Marks/ 1 credit

1. Calculation of measures of central tendency and dispersion for the given data
2. Problems based on probability
3. Calculation of correlation coefficient & fitting the linear regression equation on given data
4. Test of significant difference between means using t-test
5. Test of goodness of fit of distribution and association between two attributes using Chi-square test
6. Data analysis using MS Excel and SPSS
7. Study of process for filing a patent in India and abroad
8. Study of procedure for applying for copyright for literary work

FS354P(Elective IV B): Quality Management, Laboratory Management and Laboratory Safety Lab

Instruction	2 Periods per week
Duration of University Examination	3 hours
University Examination	25 Marks/ 1 credit

1. Study of salient features of ISO 9000, 14000, 17000 series of standards and guidelines of NABL accreditation
2. Study of design and features of a laboratory
3. Study of purchase procedure, stock verification procedure and maintenance of apparatus
4. Study of fire safety measures and handling of hazardous chemicals
5. Sterilization of glassware
6. Disposal of unserviceable, obsolete items and chemical wastes
7. First aid procedures in laboratory
8. Study of protective equipment used in laboratory

SEMESTER IV (THEORY)

FS401T(*): Forensic Serology & DNA Fingerprinting

Instruction	3 Periods per week
Duration of University Examination	2 Hours
University Examination	100 Marks / 3 Credits

UNIT I: Forensic Serology

Introduction to Forensic Serology and Blood as evidence: Introduction to Forensic Serology, Role of Forensic Serologist, types of cases encountered, Collection and preservation of biological fluids encountered as crime scene evidence - Nature of blood, Bloodstain pattern interpretation and forensic significance – Age of bloodstain

Identification of body fluids by chemical, biochemical, crystal, chromatographic and spectroscopic methods: Identification of blood and semen – Identification of saliva, urine, faeces and human breast milk samples – Identification of menstrual blood, amniotic fluid and parturition stains

Serological tests for grouping biological stains: Determination of origin of species by immunological methods - Determination of secretor and non-secretor status – Methods used for grouping biological stains

Blood groups, serum and cellular proteins: Introduction of blood groups, History, Biochemistry and genetics of ABO, MN, Rh, Lewis, Lutheran, Kidd, Duffy and P systems - Serum proteins (Km, Gm, Hp, Gc, Transferrin, LDH, PCE) - Cellular proteins (PGM, AK, ADA, PepA, EsD, GLO, GPT, G6PD)

Haemoglobin variants and HLA typing: Haemoglobin variants (Hbf, Hbs, Hbc, HbA) - Determination of sex and race from blood - White blood group system HLA and its forensic significance

UNIT II: DNA Fingerprinting

Introduction to DNA Typing, human genetics and DNA: Introduction, Forensic significance, History - Introduction to human genetics: Physical basis of heredity, Alleles, Population genetics – Molecular biology of DNA, Variation, and enzymes

Isolation and determination of quality and quantity of DNA: Collection and Preservation of physical evidence for DNA typing – Isolation of DNA – Determination of quality and quantity of DNA

DNA Fingerprinting techniques: RFLP analysis: Introduction, steps in RFLP analysis and interpretation of RFLP profiles – PCR analysis: Introduction and steps in PCR cycle – Types of PCR

Analysis of PCR product: Sequence polymorphism: HLA DQA1, Polymarker Amplitype PM6 – Mitochondrial DNA analysis – Length Polymorphism: STR analysis (Instrumentation for STR typing and STR Genotyping), Gender identification, D1S80

DNA separation and detection: DNA separation: Slab gel electrophoresis (Agarose gel electrophoresis and PAGE) – Capillary Electrophoresis – DNA detection: Fluorescent dye staining and silver staining

UNIT III: Interpretation of DNA typing results, applications, future technologies & legal aspects

Interpretation of DNA Typing results: Introduction to complicating factors (Multiple contributors, Degradation, Extraneous substance) – System specific interpretational issues of RFLP based systems (Multi banded patterns and single banded patterns) – System specific interpretational issues of PCR based systems

Evaluation of DNA typing results: Determination of genetic concordance, evaluation of results - Bayes theorem, Hardy Weinberg law – Frequency estimate calculations, Population sub structure and Likelihood ratios

Automation and future technologies: Automated analysis systems – DNA chips – SNPs and DNA Cloning

Applications and legal aspects: Applications of DNA profiling in various fields of science – Forensic applications of DNA profiling – Legal standards for admissibility of DNA profiling

Introduction to related fields: Introduction to Bioinformatics, Genomics and Proteomics – DNA databank and database – Certification of expert and accreditation of lab, Validity of DNA analysis reports

The syllabus shall include Seminars and Tutorials on the above topics of the paper.

Suggested reading:

1. Saferstein, Richard. Criminalistics. An Introduction to Forensic Science, 5 th ed., Prentice Hall, 1998
2. Saferstein, R., Handbook of Forensic Science (Vol 1,2,3)
3. Kirk, P.,: Criminal Investigation, Interscience, 1953
4. James, S. H. and Nordby, J. J.: Forensic Science: An Introduction to Scientific and Investigative Techniques, CRC Press, 2003 & 2005
5. Siegel, J. A., Sukoo, R. J, and Knupfer, G. C: Encyclopedia of Forensic Science, Vol I, II and III, Academic Press, 2000.
6. Rudin, N., Inman. K. An Introduction to Forensic DNA Analysis, 2 nd ed., CRC Press (2002)
7. Gardner, E.J., Human Heredity, John Wiley & Sons (1983)
8. Krawczak, M. & Schmidtke, J., DNA Fingerprinting, BioScientific (1994)
9. Epplen J.T., Lubjuhin, T., DNA Profiling & DNA Fingerprinting, Birkhauser Verlag, (1995)
10. Malhotra, K.C., Satistical Methods in Human Population Genetics, ISI, (1988)
11. Kirby, L.T. , DNA Fingerprinting, An Introduction, W.H. Freeman& Co., (1990)
12. Simon, E., DNA Profiling, Principles, Pitfalls and Potential, Harwood Academic Publishers, (1993)
13. Burns, G.V., The Science of Genetics: An Introduction to Heredity, Macmillan, (1980)
14. Clifford, B.J., The Examination and Typing of Bloodstains in the Crime Laboratory, US Court Printing Press (1971)
15. Gaensslen, R.E., Sourcebook in Forensic Serology, Immunology and Biochemistry, US Govt. Printing Press, (1983)
16. Turner, P.C., Mclennan, A.G., Bates, A.D.& White, M.R.H., Instant notes in Molecular Biology, 2 nd ed, Viva Books Pvt. Ltd., (2001)

17. Winter, P.C., Hickey,G.I.,& Fletcher, H.L., Instant Notes in Genetics, Viva Books Pvt. Ltd. (1999)
18. Rashidi, H.H.& Buehler, L.K. Bioinformatics Basics: Applications in Biological Sciences and Medicine, CRC Press, (2000)
19. Jambeck, P.& Gibas,C., An Introduction to Software Tools for Biological Applications
20. Gibas, and Jambeck, P: Developing Bioinformatics Computer Skills, 1 st ed, (O Reilly) Shroff Publishers, (2001)
21. Misner, S and Krawetz, S. A: Bioinformatics – Methods and Protocols, Humana Press, 2000.
22. Butler John M: Forensic DNA Typing, 2 nd Edn.

FS402T(*): DIGITAL FORENSICS & INCIDENT RESPONSE

Instruction	3 Periods per week
Duration of University Examination	2 Hours
University Examination	100 Marks / 3 Credits

UNIT I: Introduction to Computers, Computer crimes and Cyber Forensics

Introduction to computers: Introduction to computers, Historical Perspective and Generations of Computers – Computer hardware (CPU, Computer memory, Input and output devices, Auxiliary storage devices) – Computer software (Operating systems and application software)

Introduction to computer crimes: Introduction to cybercrime, Categories of cybercrime (Cybercrimes against person, property and Government), Worms and Viruses - Types of cybercrimes (Hacking, DoS attacks, Trojan attacks, credit card frauds, cyber pornography, online betting, software piracy, Email spoofing, phishing, cyber terrorism, salami attacks, cyber stalking) – Role of computers in crimes, Prevention of cybercrime

Cyber Forensics: Introduction to Windows, Linux and MAC Forensics, Mobile device Forensics, Network Forensics - Malware Forensics, IoT Forensics, Cloud Forensics, Blockchian Forensics, ICS Forensics – Social Media and OSINT, CCTV Forensics, Drone Forensics, Vehicle Forensics, Multimedia Forensics

Digital Forensics and Digital Evidence: Introduction, Definition, history and rules of digital forensics, Digital Forensic Investigation: Goals and various DFI models, Ethical issues in digital forensics - Definition, Rules of digital evidence, Characteristics of digital evidence - Procedures and challenges in digital evidence handling, Volatile evidence, Legal principles of digital evidence, metadata

Ethical hacking methodology and tools: Introduction to hacking, types of hackers, Reason and impact of hacking, Steps performed by hackers, Prevention from hackers – Ethical hacking: ethical issues, process, working – Types of ethical hacks, Ethical hacking tools

UNIT II: Cyber Forensic investigation, E-Mail Forensics and Computer Forensic Tools

Incident response and data collection: Six stages of incident response, Incident response methodology – Activities in initial response, Phases after detection of an incident – People involved in data collection, live data collection

Forensic Duplication and data analysis: Introduction, rules, need and admissibility of forensic duplication, important terms in forensic duplicate – Requirements of forensic duplicate tools, creating forensic duplicate of a hard drive, creating a boot disk, creating a qualified forensic duplicate with SafeBack and EnCase – Preparation steps for forensic analysis, Investigating Windows systems & UNIX systems

Report writing: Goals of report, Layout of an investigative report - Guidelines for writing a report - Incident response report

E-Mail Forensics: Importance of E-Mail as evidence, working of an email, steps in E-mail communication, E-Mail service protocols - Internet frauds, securing an E-mail account, IP Tracking - E-Mail recovery, E-Mail Forensics analysis steps, E-mail Forensic Tools

Computer Forensic Tools: Introduction, Need and types of Computer Forensic tools (Hardware and Software tools), Tasks performed by Computer Forensics tools, tool comparison - Computer Forensics Software tools, Computer Forensics Hardware tools - Various Computer Forensic tools

UNIT III: Network Forensics, Mobile Phone Forensics, Social Media Forensics, Cyber security and Cyber Law

Introduction to concept of Networks and Mobile phones: Introduction, types and topologies of computer networks - Overview of TCP/IP protocol and OSI Model - Introduction to Mobile Technologies **(**ATM, WAP), Cellular technologies (AMPS, i-Mode, TDMA, CDMA, GSM) and relative strengths (SIM, IMEI), Understanding of the mobile phone operating systems: Android, iOS, Windows

Network Forensics: Introduction to intrusion detection system, types, advantages and disadvantages of intrusion detection systems, understanding network intrusions and attacks – Recognizing pre-intrusion activities, port scans, address spoofing, attack with Trojan, viruses and worms, understanding password cracking, understanding technical exploits, collecting network based evidence, investigating routers

Mobile Phone Forensics: Seizure and Preservation of mobile phones and PDA: Types of evidence present in mobile phones, files present in SIM card, external memory dump and evidences in memory card - Mobile phone evidence extraction process: Data acquisition methods (Physical, File System, Logical and Manual Acquisition) - Mobile Forensic Investigation Toolkit, Tracking of mobile phone location

Social Media Forensics: Types of crimes of social media: Cyber bullying, Online Grooming, Cyber stalking - Sources for social media evidence: Types of data available on social networking sites, different evidence collection methods from social networking sites - Tools and techniques for intelligence gathering from social media: indirect method, direct method with login, direct method without login

Cyber security and cyber law: Concept of cyber security, Issues and challenges of cyber security**,** National cyber security policy and strategy - Reporting of cybercrimes, Remedial and mitigation measures, Legal perspective of cybercrime, IT Act, 2000, its amendments and limitations, Cybercrime and punishments - Cyber Laws and Legal and ethical aspects related to new technologies: AI/ML, IoT, Blockchain, Dark net and Social media, Cyber Laws of other countries, Case Studies

The syllabus shall include Seminars and Tutorials on the above topics of the paper.

Suggested reading:

1. Thomas A. Johnson: Forensic Computer crime Investigation, CRC Press, 2005
2. Miller M.,: Absolute Beginner's Guide to Computer basics (5^{th} Edn.), Que, 2009
3. Miller M.,: Easy Computer Basics, Windows Vista Edition, Que (2008)
4. Jain, Atul: Cyber Crime – Issues, Threats and Management (Vol.1&2), Isha book Publishers, (2005)
5. Clark.F & Dileberto, K.,: Investigating Computer Crime , Boca Raton , CRC Press, 1996

6. Tewari, R.K., Sastry, P. K., & Ravikumar, K.V.: Computer Crime & Computer Forensic (2003)
7. Eoghan C.: Computer Crime Investigation, Academic Press (2002)
8. John, R. V.: Computer Forensics, Firewall Media, (2002)
9. John R. Vacca., Computer Forensics – Computer Crime Scene Investigation, 2nd Edn., Charles River Media (Thomson), (2005)
10. Stephenson P,: Investigating Computer – Related crime, CRC Press (2000)
11. James, S.H., & Nordby, J.J.: Forensic Science: An Introduction to Scientific & Investigative Techniques, 3rd Edn, (2009)
12. Jennifer Bayuk: Cyber Forensics: Understanding Information Security Investigations, Springer, 2010
13. Nilakshi Jain & Dhananjay R. Kalbande- Digital Forensic: The Fascinating world of digital evidences, John Wiley, 2017
14. Ndatinya, V., Xiao, Z., Manepalli, V. R., Meng, K., & Xiao, Y. (2015). Network forensics analysis using Wireshark. International Journal of Security and Networks, 10(2), 91-106
15. Meghanathan, N., Allam, S. R., & Moore, L. A. (2010). Tools and techniques for network forensics. arXiv preprint arXiv:1004.0570
16. Davidoff, S., & Ham, J. (2012). Network forensics: tracking hackers through cyberspace (Vol. 2014). Upper Saddle River: Prentice Hall
17. Social Media & Network Forensics, CDAC
18. Mike Sheward, Hands-on Incident Response & Digital Forensics, The Chartered Institute for IT
19. Gerard Johansen, Digital Forensics & Incident Response, 2nd edition, Packt publishing, 2020
20. Andre Arnes, Digital Forensics, John Wiley, 2018
21. Nihad A. Hassan, Digital Forensics Basics: A practical guide using Windows OS, 2019
22. Eoghan C., Handbook of Digital Forensics & Investigation, Elsevier Inc., 2010
23. Thomas J. Holt, Adam M. Bossler & Kathryn C. Seigfried-Spellar, Cybercrime and Digital Forensics: An Introduction, Routledge, 2022

FS403T(Elective III A): Forensic Accounting & Fraud Investigation

Instruction	3 Periods per week
Duration of University Examination	2 Hours
University Examination	100 Marks / 3 Credits

UNIT I: Concept of Forensic Accounting and fraud vulnerabilities

Introduction to Forensic Accounting: Introduction, concept of Forensic Accounting – Definitions of Forensic accounting - Applications of Forensic Accounting

Forensic auditing: Definition and Classification of forensic audit, Evolution of Forensic audit in the world and in India – Principles of fraud auditing - Difference between forensic audit and other audits, Uses of Forensic auditing

Forensic accountant and auditor: Principal duties of a forensic auditor; Specific Assistance in Investigative Accounting and Litigation Support – Competencies of forensic accountant; Approach of Forensic auditor to forensic investigation – Advantages of engaging forensic auditors

Basic concept of fraud: Various definitions of fraud; Elements of fraud; Different types of fraudsters – Major corporate frauds (Satyam computers, Kingfisher airlines, PNB fraud, Jet airways, Enron) – Fraud origin and accounting cycles

Fraud vulnerabilities: Fraud triangle, Fraud diamond, Fraud pentagon – Fraud scale, Fraud circle, Hollinger Clark theory – Motivation for fraud, social consequences of economic crime

UNIT II: Forensic Accounting in Fraud Investigation

Types of frauds: Internal, external and mixed fraud – Bank frauds, corporate frauds, fraud tree classification – Insurance frauds, cyber frauds, securities frauds, consumer frauds

Occupational frauds: Definition – Types of occupational frauds (Corruption, Asset misappropriation, fraudulent financial statements) – Money laundering, financial crimes in cross border transactions

Fraud risk indicators: Detecting red flags, classification of red flags (Financial Performance flags, accounting system flags, Operational flags, Behavioural flags, Structural flags and Personnel red flags) – Some red flags (Lack of corporate governance, questionable accounting activities, sudden losses, TGTBT syndrome, generation of orphan funds, disaster situations, missing documentation, chaotic conditions, behavioural issues, complaints) – Yellow flags and green flags

Process of Forensic Accounting: Initialization, develop plan, Obtain relevant evidence - Perform analysis, Reporting, Court proceedings – Forensic audit report

Interviewing skills & techniques of Anti-fraud professionals: Interview process (Data collection, interview purpose, Setting time and place, preparation for interview, recording of interview, interview, types of questions and sequence, Note taking during interview, Concluding and documenting interview) – Identifying deception and techniques used to assess, Admission seeking interview – Barriers and safety considerations for an effective interview

UNIT III: Forensic Audit techniques, Fraud prevention systems and Legal aspects

Forensic Audit techniques: Seven investigative tools used by fraud examiners, general audit techniques (Testing defences), Statistical and mathematical techniques (Trend analysis, ratio analysis) – Technology based/ Digital forensic techniques, Computer Assisted Auditing Techniques (CAATs), generalized audit software and other software related tools – Data mining techniques, laboratory analysis of physical and electronic evidence

Fraud schemes: Fraudulent financial reporting schemes – Improper revenue recognitions – Other financial reporting schemes

Fraud detection methods: IT tools for fraud detection – Categorization of fraud detection methods – Supervised and unsupervised methods

Fraud prevention systems: Effective internal controls, audit interaction – Systems security audits – Methods for performing security audits

Legal aspects of Forensic Accounting: Organization to combat fraud in India and abroad – Applicable laws in India – Applicable laws abroad

The syllabus shall include Seminars and Tutorials on the above topics of the paper.

Suggested reading:

1. Handbook on Forensic accounting & fraud prevention, Global Forensic Audit & Investigation
2. Stephen Pedneault, Frank Rudewicz, Michael Sheetz, Howard Silverstone, Forensic Accounting and Fraud Investigation, 3rd edition, Wiley, (2012)
3. Forensic Accounting – Fraud investigations, American Institute of Certified Public Accountants, (2014)
4. Study on Forensic Accounting and Fraud detection, The Institute of Chartered Accountants of India, (2017)
5. Abdul Rafay, Concepts, Cases, and Regulations in Financial Fraud and Corruption, Published by IG Global, (2023)
6. Arvind Kumar Gupta, Serious Fraud Investigation Office (Law & Practice), (2021)
7. Sandeep Baldava & Deepa Agarwal, Forensic Investigations and Fraud Reporting in India - Practical insights to Predict, Prevent, Detect and Investigate Frauds, Bloomsbury, 2021
8. Jyot Baxi & T N Manoharan, Bharat's New Era of Forensic Accounting, Agarwal Law House, (2021)
9. CA. Jyot Baxi, New Era of Forensic Accounting, Bharat Law House Pvt. Ltd., (2021)
10. Virendra Pamecha, How to Detect & Investigate Financial Frauds & Accounting Gimmicks, Xcess Infostore Private Limited, (2021)
11. David Debenham, The Law of Fraud and the Forensic Investigator, Carswell, (2019)

FS403T(Elective III B): Forensic Linguistics & Multimedia Forensics

Instruction	3 Periods per week
Duration of University Examination	2 Hours
University Examination	100 Marks / 3 Credits

UNIT I: Forensic linguistics

Linguistics: Introduction, evolution and concept of linguistics – Linguistics and its branches, Role of linguistics in understanding human communication - Application of linguistic theories in various fields, crucial role of linguistic analysis in legal settings

Forensic linguistics: Introduction, concept, origin, development and significance of Forensic Linguistics, Language as legal evidence, interdisciplinary nature of Forensic Linguistics – Scrutinizing linguistic features within legal texts and documents, Authorship analysis, Discourse analysis, Threat and deception analysis and language profiling - Current trends, emerging areas, challenges, ethical considerations and case studies in Forensic Linguistics

Forensic stylistics: Introduction to Stylistics and Forensic stylistics, Role of Forensic stylistics - Forensic stylistics analysis – Forensic applications and limitations of Forensic Stylistics

Forensic Phonetics: Introduction, history and branches of phonetics - Human voice (Nature of voice and production of speech, Perception of voice and speech) - Authentication of tape recordings, transcripts and Vocal behaviours (Stress, Alcohol speech relationships)

Speaker identification: Speaker recognition types, procedure, methods, feature extraction and comparison, classification – Speaker recognition by listening, Speaker recognition by visual comparison of spectrograms (Kersta method), Automatic Speaker recognition , Interpretation of results – Speaker profiling, Intelligibility Enhancement of audio recording, Transcription and analysis of disputed utterances, authenticity and integrity examination of audio recordings

UNIT II: Multimedia Forensics

Introduction to Multimedia Forensics: Introduction and scope of Multimedia Forensics - Need of Multimedia Forensics - Multimedia tools and their applications

Forensic investigation of Multimedia files: Multimedia devices for image and video capture - Handling and preservation of multimedia files - Detection of forgeries in media files

Legal Aspects of digital multimedia evidence: Recovery of audio, video and image files, copyright infringement - Plagiarism and related laws – Admissibility of multimedia evidence in the court of law

Digital Signal Processing - Origin and integrity of multimedia files - Digital watermarking, LPC, DFT and FFT - Multimedia file formats, tools for analysis

Multimedia security (Forensic Watermarking): Introduction – Incorporation and working of watermarks - Forensic importance of digital watermarks in digital photography and video

UNIT III: Audio, video and image analysis

Forensic audio analysis: Introduction and scope, fundamentals of audio signals and systems, Analog to digital conversion, history of audio forensics, Acoustic parameters of sound – Forensic audio analysis: handling of forensic evidence and authenticity assessment, audio signal

assessment and analysis, methods of tampering digital audio, forensic authentication of digital audio – Microphone forensics, enhancement of digital audio

Forensic Image Analysis: Introduction, scope, recovery of evidence - Evidence enhancement of images, Analysis and authentication of images, image source identification and image forgery detection - Metadata analysis, error level analysis (ELA), Noise analysis, Clone detection

Video forensics: Introduction, scope, standards for video transmission, Active and passive video forensics, blind and non-blind image video forensics - Technologies that support Video Forensics: Blurred license plate image recognition, Rotation object recognition, Translation object recognition, Scaling - invariant object recognition, Trajectory analysis on moving objects, Video inpainting - Techniques that promote Video Forensics (People counting in videos and recognizing video objects using features extracted from a video shot/clip), Frame rate analysis, Video quality analysis, Motion analysis, Steganalysis

Introduction to CCTV: Introduction - Role and functioning of CCTV cameras – Categories and types of CCTVs

CCTV Forensics: Handling, preservation and transport of CCTV footages, Retrieving evidence from CCTV system - Video Management system and CCTV surveillance, Features of video analysis tools, Comparing hash values - Intelligent video analytics and related case studies

The syllabus shall include Seminars and Tutorials on the above topics of the paper.

Suggested reading:

1. Coulthard, M. & Johnson, A., The Routledge Handbook of Forensic Linguistics, London: Routledge, 2013
2. Coulthard, M., Johnson, A. & Wright, D., An Introduction to Forensic Linguistics: Language in Evidence, London: Routledge (2nd edition), 2016
3. Gibbons, J., Forensic Linguistics: An Introduction to Language in the Justice System, Oxford: Blackwell, 2003
4. McMenamin, G., Forensic Linguistics: Advances in Forensic Stylistics. Boca Raton, Fla.: CRC Press, 2002
5. Eades, D., Sociolinguistics and the Legal Process, Clevedon: Multilingual Matters, 2010
6. Siegel, J. A, Saukko, P. J and Knupfer, G. C (Eds.): Encyclopedia of Forensic Sciences, Academic Press, 2000
7. K. Lee Lerner and Brenda Wilmoth Lerner: World of Forensic Science, Thomson Gale, 2006
8. Allan Jamieson, Andre Moenssens, Wiley Encyclopedia of Forensic Science, John Wiley & Sons Ltd, 2009
9. Gerald R. McMenamin, Forensic Linguistics - Advances in Forensic Stylistics, CRC Press LLC, 2002
10. Philip Rose, Forensic Speaker Identification, Taylor & Francis, 2002
11. Homayoon Beigi, Fundamentals of Speaker Recognition, Springer, 2011
12. Anthony T S Ho, Shujun Li, Handbook of Digital Forensics of Multimedia Data and Devices, Wiley-IEEE Press, 2015
13. Aboul Ella Hassanien et. al, Multimedia Forensics and Security: Foundations, Innovations and applications, Springer, 2017

14. Jonas Lindh, Forensic Comparison of Voice, Speech and Speakers, 2017
15. Frank Y. Shih, Multimedia Security: Watermarking, Steganography and Forensics, CRC Press, 2013
16. Aniket Roy, Rahul Dixit, Ruchira Naskar and Rajat Subhra Chakraborty, Digital Image Forensics: Theory and implementation, Springer, 2020

SEMESTER – IV (PRACTICALS)

FS451P(*): Forensic Serology & DNA Fingerprinting Lab

Instruction	4 Periods per week
Duration of University Examination	3 hours
University Examination	50 Marks/ 2 credits

1. Identification of blood and its stains by chemical and crystal tests
2. Identification of semen and its stains by chemical and crystal tests
3. Identification of saliva and its stains by chemical and crystal tests
4. Identification of urine and its stains by chemical and crystal tests
5. Microscopic identification of spermatozoa
6. Determination of origin of species of blood, semen and saliva by agar gel diffusion method
7. Grouping of dried stain of blood, semen, saliva and hair by absorption elution technique
8. Determination of secretor status from semen and saliva stains by absorption inhibition technique
9. Isolation of DNA from blood
10. PCR amplification of DNA (Demonstration only)
11. Quantitative estimation of DNA by spectrophotometry
12. Agarose gel electrophoresis of proteins
13. Quantitative estimation of proteins
14. Assay of amylase
15. Assay of urease

FS452P(*): Digital Forensics & Incident Response Lab

Instruction	4 Periods per week
Duration of University Examination	3 hours
University Examination	50 Marks/ 2 credits

1. RAM capture and RAM analysis
2. Disk imaging and Content based imaging
3. Registry Analysis and Event log analysis
4. Proof of execution
5. Basic checklist, privacy and security settings for popular social media platforms
6. Reporting and redressal mechanism for violations and misuse of social media platforms
7. Platforms for reporting cybercrimes and checklist for reporting cybercrimes online
8. Preparation of password policy for computer and mobile device
9. Demonstration of FTK imager
10. Demonstration of Autopsy software
11. Demonstration of calculation of MD5 and SHA1 hashes
12. Packet Capture using WireShark
13. OSINT using MALTEGO and OSINT Framework
14. PCAP File analysis
15. Managing application permissions in mobile phone

FS453P(Elective III A): Forensic Accounting & fraud investigation Lab

Instruction 2 Periods per week
Duration of University Examination 3 hours
University Examination 25 Marks/ 1 credit

1. Case study of bank fraud
2. Case study of corporate fraud
3. Case study of insurance fraud
4. Case study of occupational fraud
5. Case study of securities fraud
6. Case study of consumer fraud
7. Study of forensic audit techniques and use of AI and machine learning in fraud investigation
8. Study of salient features of laws pertaining to Forensic Accounting applicable in India

FS453P(Elective III B): Forensic Linguistics & Multimedia Forensics Lab

Instruction 2 Periods per week
Duration of University Examination 3 hours
University Examination 25 Marks/ 1 credit

1. Forensic text analysis
2. Case studies: Role of language in legal outcomes
3. Multimedia sample collection
4. Audacity based segregation of voice
5. Image analysis using open source software
6. Voice analysis using open source software
7. Video analysis using open source software
8. Forensic video enhancement in CCTV footage

FS454P: PROJECT 12 Hours per week

MARKS DISTRIBUTION FOR PROJECT ASSESSMENT		
Internal Assessment		
Research Design Seminar	1 credit	25 marks
Progress Seminar	1 credit	25 marks
Semester End Assessment		
Dissertation	1 credit	50 marks
Final presentation	2 credits	50 marks
Viva voce during final presentation	1 credit	25 marks
TOTAL	**6 credits**	**175 marks**