OSMANIA UNIVERSITY, HYDERABAD (Esttd. 1917) Accredited with 'A+' by NAAC



FORENSIC SCIENCE

Department of Chemistry Osmania University Hyderabad

FACULTY OF SCIENCE

SYLLABUS OF M.Sc. FORENSIC SCIENCE SEMESTER I & II

(CCE)

(Effective from academic year 2023 -2024)

	(Effective from	academ	ic year 2023 -2	2024)		
	SI	EMESTI	ER – I			
THEORY						
Code	Paper	Hrs/	Internal	Semester	Total	Credits
		week	assessment	Examination		
FS101T(*)	Criminal Justice System &	3	50 marks	50 marks	100 marks	3
	Forensic Science					
FS102T(*)	Instrumental Methods of Analysis	3	50 marks	50 marks	100 marks	3
FS103T(*)	Forensic Biology & Biological	3	50 marks	50 marks	100 marks	3
	Techniques					
FS104T(*)	Forensic Physics, Forensic	3	50 marks	50 marks	100 marks	3
	Photography & Forensic					
	Engineering					
PRACTICALS						
FS151P(*)	Crime Scene Management &	4	-	-	50 marks	2
	Forensic Psychology Lab					
FS152P(*)	Instrumental methods of analysis	4	-	-	50 marks	2
	Lab					
FS153P(*)	Forensic Biology Lab	4	-	-	50 marks	2
FS154P(*)	Forensic Physics, Forensic	4	-	-	50 marks	2
	Photography & Forensic					
	Engineering Lab					
	TOTAL				600 marks	20
SEMESTER – II						
THEORY						
Code	Paper	Hrs/	Internal	Semester	Total	Credits
		week	assessment	Examination		
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	4		_	50 marks	2
152511()	Lab				20 marks	2
FS252P(*)	Forensic Chemistry Lab	4	-	-	50 marks	2
FS253P(*)	Forensic Anthropology & Forensic	4	-	_	50 marks	2
	Medicine Lab					
FS254P(*)	Forensic Ballistics Lab	4	-	-	50 marks	2
	TOTAL				600 marks	20

M. Sc. Forensic Science Syllabus

(*Core = Compulsory papers)

SEMESTER – I (THEORY)

FS101T(*): Criminal Justice System & Forensic Science

Instruction Duration of University Examination University Examination

3 Periods per week 2 Hours 100 Marks / 3 Credits

UNIT I: Introduction to Forensic Science UNIT II: Criminology, Penology and Forensic Psychology UNIT III: Law

Course Objectives:

- 1. Understand the criminal justice system and its components
- 2. Learn and analyze about the role of forensic science in the criminal justice system
- 3. Apply the principles of Sociology, Criminology and Psychology in Forensic Science
- 4. Evaluate the impact of forensic science on criminal justice outcomes and law enforcement
- 5. Develop critical thinking skills in applying forensic science to criminal justice

Learning Outcomes:

Students will be able to

- 1. Describe the components of the criminal justice system and their roles
- 2. Explain the application of forensic science in criminal investigations and trials.
- 3. Analyze case studies and evaluate the strengths and limitations of forensic science in criminal justice
- 4. Apply principles of Sociology, Criminology and Psychology in solving crimes
- 5. Develop a critical thinking approach to applying forensic science in criminal justice

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.

- 1. James, S. H. and Nordby, J. J.: Forensic Science: An Introduction to Scientific and Investigative Techniques, CRC Press, 2003 & 2005
- 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, 28thedn., Wadhwa& Co., 2002.
- 30. Ram Ahuja: Criminology, Rewal Pub. Co., 2000
- 31. Meguire, M., Morgan, R and Reiner, R.: Oxford Hand Book of Criminology, 2ndedn. 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 Duration of University Examination University Examination 3 periods per week 2 Hours 100 Marks / 3 Credits

UNIT I: Atomic and Molecular Spectrometry UNIT II: Chromatographic and Hyphenated techniques UNIT III: Electrochemical and Other instrumental methods

Course Objectives:

1. Understand the principles and theory underlying modern analytical instrumentation

2. Introduce and explain various instrumental techniques including spectroscopy, chromatography, electrochemical, radiochemical and thermal methods

3. Study the principle, working and forensic applications of various instrumental techniques

4. Teach students interpretation and analysis of data obtained from instrumental techniques

5. Improve students' ability to effectively communicate scientific results

Learning Outcomes:

Students will be able to

1. Apply the principles of instrumental techniques in analyzing the forensic samples

2. Apply various instrumental techniques such as UV-Vis spectroscopy, FTIR, NMR, TLC, HPLC, GC for chemical analysis

3. Critically evaluate the advantages and limitations of various instrumental techniques for specific applications

4. Collect, interpret and analyze instrumental data for qualitative and quantitative forensic analysis

5. Prove and disprove the evidences obtained from the crime scene

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 ¹H NMR - ¹³C 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.

- 1. Atkins, P. W.: Physical Chemistry, 6thedn., Oxford University Press, 1998.
- 2. Fifield, F. W. and Kealy, D.: Principles and practice of Analytical Chemistry, 5thedn, 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, 7thedn., 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, 5thedn., Freeman, 1999.
- 8. Haswell, S. J.: Atomic Absorption Spectrometry, Elsevier, 1992.
- 9. Christian, G. D.: Analytical Chemistry, 6thedn., John Wiley, 2004
- Silverstein, R. M., and Webster, F. X.: Spectrometric Identification of Organic Compounds, 6thedn., 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, 3rdedn, 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, 6thedn., 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, 5thEdn., Freeman, 2003.

FS103T(*): Forensic Biology & Biological Techniques

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

UNIT I: Forensic Botany UNIT II: Hair examination, Fiber examination and Forensic Entomology UNIT III: Wildlife Forensics and Microscopy

Course Objectives:

1. Understand the principles and concepts of Forensic Biology

2. Introduce students to various types of biological evidences encountered in forensic investigations

3. Explain the methods used for collection, preservation and analysis of biological evidences

4. Apply the principle of hair, fibre examination and entomology in forensic investigation

5. Explain concepts of wildlife forensics and understand microscopy principles

Learning Outcomes:

Students will be able to

1. Demonstrate an understanding of principles of forensic biology

2. Recognize and differentiate various biological evidences found in the crime scene

3. Apply various analytical instruments to analyze forensic biological evidence

4. Interpret and analyze the biological evidences for obtaining forensic relevant reports

5. Develop skills in presenting results including written scientific reports and expert testimony in court

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.

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

UNIT I: Forensic Examination of Physical Evidences UNIT II: Forensic Photography UNIT III: Forensic Engineering

Course Objectives:

- 1. Understand the examination of physical evidences recovered from crime scene
- 2. Learn the characteristics of physical evidences like glass, soil, paint and tool marks
- 3. Analyze the crime scene samples with suspect samples and identify the source of origin
- 4. Understand the importance and need of photography in crime scene investigation
- 5. Apply the principles of engineering in failure investigations

Learning Outcomes:

Students will be able to

1. Identify and classify various physical evidences such as glass, soil, tool marks, paint found at the crime scene

2. Investigate failure analysis, predict the cause of failure of constructions, electrical appliances and installations in various crime scenes

3. Analyze and compare crime scene samples with suspect physical evidences

4. Take various photographs at the crime scene and apply image processing techniques to enhance the effectiveness of photographs to be presented in the courtroom

5. Identify false claims and able to resolve disputes

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.

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

Course Objectives:

- 1. Understand the principles of crime scene management
- 2. Learn to process and document crime scenes, and apply principles to criminal investigations
- 3. Develop skills in collecting and preserving physical evidence
- 4. Apply crime scene management techniques to real-world scenarios
- 5. Understand the psychological tests and apply them in Forensic cases

Learning Outcomes:

Students will be able to

- 1. Secure and search the crime scenes for forensic evidences
- 2. Record the crime scene using note making, sketching, photography and videography
- 3. Collect, pack and forward physical evidences to Forensic laboratory for analysis
- 4. Reconstruct and evaluate the indoor and outdoor crime scenes
- 5. Design and conduct psychological tests on suspects in crime cases

- 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

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

Course Objectives:

1. Provide students with hands on experience in operating and handling instruments such as colorimeter, conductometer and potentiometer

2. Develop technical proficiency in utilizing instrumental methods for chemical analysis

3. Learn sample preparation methods for instrumental methods

4. Develop skills in interpreting and analyzing the instrumental data

5. Learn to perform paper chromatography, TLC, Electrophoresis and UV-Visible Spectroscopy for analysis of various samples

Learning Objectives:

Students will be able to

1. Demonstrate proficiency in operating colorimeter, conductometer and potentiometer and calculate the concentrations of unknown samples

2. Separate and identify compounds from a mixture using chromatographic techniques

3. Separate amino acids and proteins using electrophoretic techniques

4. Estimate and identify the Ibuprofen and Paracetamol by UV spectroscopy

5. Interpret and analyze data obtained from instrumental methods and communicate clear and concise observations and results

- 1. Verification of Beer's law and calculation of molar absorption coefficients for CuSO₄
- 2. Verification of Beer's law and calculation of molar absorption coefficients for KMnO₄
- 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 Duration of University Examination University Examination 4 Periods per week 3 hours 50 Marks/ 2 credits

Course Objectives:

- 1. Apply Forensic botany principles in analysis of forensic botanical evidence
- 2. Study the morphology and characteristics of poisonous plants
- 3. Understand the structure of hair and its application in crime investigation
- 4. Identify various types of fibres and application in forensic investigation
- 5. Study the salient features of Wildlife Protection Act

Learning Outcomes:

Students will be able to

1. Conduct microscopic examination for identification of pollen grains, starch grains and paper pulp fibers

2. Isolate diatoms from water and visceral samples and carry out microscopic examination for determining the manner of drowning

- 3. Identify and differentiate human and animal hair
- 4. Identify and classify different types of fibres and their application in crime investigation
- 5. Analyze dyes in fibers using TLC

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

Course Objectives:

- 1. Examination of types of glasses and glass fractures
- 2. Determine the characteristics of physical evidences like glass, soil and paint
- 3. Compare and individualize the source of unknown sample from known samples
- 4. Develop, compare and identify the characteristics of tool marks and restoration
- 5. Examine electrical wires, cameras from film negatives and adulteration in cement

Learning Objectives:

Students will be able to

- 1. Analyze and identify the glasses and glass fractures
- 2. Determine the direction and angle of impact on glass pane
- 3. Collect and identify the class and individual characteristics of physical evidences like soil and paint
- 4. Collect and identify the class and individual characteristics of tool marks and restore them
- 5. Compare electrical wires, cameras and determine adulteration in cement samples

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

UNIT I: Imprints UNIT II: Impressions UNIT III: Biometrics

Course Objectives:

1. Understand the principles of imprints, impressions, and biometrics in forensic science

- 2. Learn to analyze and compare imprints and impressions from crime scenes
- 3. Develop skills in biometric analysis, including fingerprint, facial recognition, and iris scanning
- 4. Apply imprints, impressions, and biometric techniques to real-world scenarios
- 5. Integrate imprints, impressions, and biometrics with other forensic disciplines

Learning Outcomes:

Students will be able to

1. Describe the principles of imprints, impressions, and biometrics and their significance in forensic science

2. Analyze and compare imprints and impressions from crime scenes, including footwear, tire tracks, and tool marks

3. Conduct biometric analysis using various techniques, including fingerprint analysis, facial recognition, and iris scanning

4. Apply imprints, impressions, and biometric techniques to solve crimes and resolve legal issues5. Integrate imprints, impressions, and biometrics with other forensic disciplines to reconstruct crimes and identify perpetrators

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.

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

UNIT I: Forensic Chemistry UNIT II: NDPS & Alcoholic beverages UNIT III: Explosives

Course Objectives:

1. Apply principles of chemistry in solving forensic cases

2. Develop skills in analyzing complex chemical evidence using specialized laboratory techniques

3. Learn to identify and analyze emerging drugs and poisons

4. Apply forensic chemistry techniques to crime cases

5. Integrate forensic chemistry with other forensic disciplines to reconstruct crimes

Learning Outcomes:

Students will be able to

1. Identify and quantify chemical evidences such as insecticides, fertilizers, natural products and other chemicals encountered as evidences in crime scenes

2. Analyze petroleum products, arson residues and trace evidences using various chemical and instrumental methods of analysis

3. Identify and classify drugs of abuse found as evidences using spot tests and instrumental methods

4. Analyze alcoholic beverages and check for adulterated liquor samples

5. Detect explosives and explosion residues using chemical and instrumental methods

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

<u>UNIT III Explosives</u>

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.

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

UNIT I: Forensic Anthropology UNIT II: Forensic Medicine - I UNIT III: Forensic medicine - II

Course Objectives:

1. Understand the principles and concepts of Forensic Biology and Forensic Medicine

2. Introduce students to various types of biological evidences encountered in forensic investigation, their collection, preservation and analysis

3. Introduce students to procedures of medico legal investigation of death and injuries, autopsy procedures and examination of trauma in forensic pathology

4. Identify individual from examination of bones and teeth evidence in crime scene

5. Integrate Forensic anthropology, odontology and medicine with other forensic disciplines for legal purposes

Learning Outcomes:

Students will be able to

1. Conduct forensic analysis of injuries and death to determine cause and manner of death, and identify potential weapons or instruments used

2. Apply forensic medicine techniques to solve crimes and resolve legal issues, analyzing evidence from a mock crime scene to reconstruct events and identify perpetrators

3. Demonstrate expertise in forensic medicine, applying knowledge and skills to real-world scenarios and case studies

4. Assess living individuals in legal context and identify individuals from bones and teeth

5. Interpret and synthesize findings from forensic medical examinations, autopsy reports and anthropological analysis and present expert testimony in court

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.

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

UNIT I: Introduction to Forensic Ballistics UNIT II: Categories of Gun Ballistics UNIT III: Identification of Firearms and GSR Residue Analysis

Course Objectives:

- 1. Understand the parts and firing mechanisms of different firearms and ammunition
- 2. Understand the various categories of gun ballistics
- 3. Learn and understand the evaluation of firearm injuries
- 4. Learn about GSR analysis and identification of shooter
- 5. Obtain knowledge about the functions, limitations and applications of various automated bullet and cartridge identification systems

Learning Outcomes:

Students will be able to

- 1. Identify various firearms and ammunition and explain their firing mechanisms
- 2. Distinguish the standard firearms from non-standard firearms
- 3. Apply external, internal, wound and terminal ballistics in forensic cases
- 4. Conduct GSR analysis and identify the shooter
- 5. Reconstruct the shooting incident and stand as an expert witness in court room

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.

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

Course Objectives:

- 1. Apply practical skills in fingerprint analysis, impression evidence, and biometrics
- 2. Develop expertise in collecting, processing, and analyzing fingerprints, impressions, and Biometric evidence
- 3. Learn biometric analysis techniques
- 4. Learn to apply techniques in real-world forensic scenarios
- 5. Integrate practical skills with theoretical knowledge in forensic science

Learning Outcomes:

Students will be able to

- 1. Collect and process fingerprint evidence from crime scenes and analyze
- 2. Collect and analyze footwear impressions to identify make, model, and size
- 3. Compare and identify tire track impressions to determine vehicle type and direction
- 4. Apply facial recognition techniques to identify individuals in surveillance footage
- 5. Analyze biometric data to determine identity and reconstruct crime scenes

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

Course Objectives:

- 1. Understand the analysis of natural products, corrosive chemicals, dyes, pigments, oils and fats
- 2. Extract and identify the inorganic and organic explosives by colour test and TLC
- 3. Identification and classification of NDPS drugs by various methods
- 4. Identify the trap related evidences
- 5. Learn to analyze petroleum products for adulteration and analysis of arson residues

Learning Outcomes:

Students will be able to

1. Analyze and assess chemical evidences like natural products, corrosive chemicals, dyes, pigments, oils and fats using various chemical methods

- 2. Isolate and identify the explosives from the explosive residues
- 3. Detect the NDPS drugs using spot tests, crystalline tests and instrumental methods
- 4. Identify the trap related evidences and prove the evidence in bribe trap cases
- 5. Analyze petroleum products for adulteration and analysis of arson residues

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

Course Objectives:

- 1. Apply forensic anthropology and medicine principles in practical scenarios
- 2. Develop skills in analyzing human remains and injuries
- 3. Learn to estimate age, sex, ancestry, and stature from skeletal remains
- 4. Apply forensic techniques to real-world scenarios
- 5. Integrate forensic anthropology and medicine with other forensic disciplines

Learning Outcomes:

Students will be able to

1. Analyze human skeletal remains to estimate age, sex, ancestry, and stature, and identify trauma and disease

2. Conduct forensic analysis of injuries and death to determine cause and manner of death, and identify potential weapons or instruments

3. Identify and analyze human remains using forensic anthropology techniques, including osteology and odontology

4. Study dead body during autopsy for forensic information

5. Reconstruct crime scenes and identify perpetrators using forensic anthropology and medicine techniques

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

Course Objectives:

- 1. Understand the parts and action mechanisms of various firearms
- 2. Learn about the components of ammunition

3. Apply ballistic principles in firearm identification, bullet trajectory analysis and reconstruction of shooting crime scene

- 4. Examination of rifling patterns, firing pin marks, breech face marks and GSR
- 5. Develop skills in reporting and presenting the forensic ballistic reports in courtroom as expert

Learning Outcomes:

Students will be able to

- 1. Identify different types of firearms and explain their action mechanisms
- 2. Differentiate between Shotgun and rifled firearms
- 3. Identify the ammunition based on its components

4. Conduct examination and comparison of various markings on the cartridge and cartridge case for identification of the crime weapon

5. Conduct chemical tests for identification of GSR and present expert testimony in court

- 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)