

OSMANIA UNIVERSITY, HYDERABAD
(Esttd. 1917)
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FORENSIC SCIENCE
Department of Chemistry
Osmania University
Hyderabad

FACULTY OF SCIENCE

SYLLABUS OF

M.Sc. FORENSIC SCIENCE

SEMESTER III & IV

(CCE)

(Effective 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 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 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

UNIT II: Examination of document frauds

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

Course Objectives:

1. Apply principles of forensic document analysis
2. Develop skills in examining and analyzing questioned documents
3. Learn to detect and identify alterations, tampering, and forgery
4. Apply document analysis techniques to real-world forensic scenarios
5. Integrate document analysis with other forensic disciplines

Learning Outcomes:

Students will be able to

1. Examine and analyze handwriting, signatures, and other marks on questioned documents
2. Detect and identify alterations, erasures, and obliterations in documents
3. Identify forgery and tampering in documents, including font and paper analysis
4. Analyze ink, paper, and other physical properties of documents to determine authenticity
5. Apply document analysis techniques to solve crimes and resolve legal issues, including fraud and identity theft cases

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

UNIT II: Clinical toxicology

UNIT III: Forensic Toxicology

Course Objectives:

1. Apply advanced principles of forensic toxicology in practical scenarios
2. Develop skills in analyzing visceral samples for toxic substances
3. Learn to identify and analyze emerging drugs and poisons in toxicological specimens
4. Apply forensic toxicology techniques to real-world scenarios
5. Integrate forensic toxicology with other forensic disciplines to reconstruct crimes

Learning Outcomes:

Students will be able to

1. Explain and classify various types of poisons and poisoning
2. Apply the principles of pharmacokinetics and pharmacodynamics to forensic toxicology
3. Analyze visceral samples for identification and quantification of various drugs and poisons using chemical and instrumental methods
4. Detect and identify poisons like heavy metals, pesticides, and volatile organic compounds in visceral samples
5. Explain the antidotes and their mechanisms and methods used for management of acute poisoning

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, 5th ed., 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

UNIT II: Synthesis and characterization of nanomaterials

UNIT III: Forensic applications of nanotechnology

Course Objectives:

1. Provide students with comprehensive understanding of principles and applications of nanotechnology
2. Familiarize students with techniques and tools used in nanotechnology
3. Highlight the role and significance of nanotechnology in enhancing accuracy, sensitivity and efficiency of forensic analysis
4. Disseminate interdisciplinary knowledge combining principles of chemistry, physics, biology and material science for forensic applications
5. Discuss the legal and ethical issues in application of nanotechnology in forensic science

Learning Outcomes:

Students will be able to

1. Demonstrate understanding of nanomaterials, their properties and classification
2. Differentiate various types of nanomaterials and explain their properties
3. Synthesize nanomaterials using physical, chemical and biological methods
4. Characterize nanomaterials using instrumental techniques such as UV-visible Spectroscopy, FTIR, XRD, SEM-EDX, TEM, etc.
5. Apply the knowledge of nanotechnology in analysis of forensic evidences

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. Angus 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

UNIT II: Basics of Forensic Microbiology

UNIT III: Microbial Forensic Investigation

Course Objectives:

1. Provide understanding of microbial forensics including principles, history, and role of microorganisms in forensic science
2. Introduce students to various techniques used in identification, characterization and analysis of microbial evidence in forensic investigation
3. Highlight the application of microbial forensics in solving crimes, biosecurity and bioterrorism cases
4. Integrate microbiology, genetics and forensic science
5. Discuss the procedural aspects and microbial characterization with identification

Learning Outcomes:

Students will be able to

1. Gain knowledge on classification of microbes, microbial nutrition and microbial growth
2. Apply various microbiological and molecular techniques for collecting, identification and analysis of microbial evidence from crime scenes
3. Interpret forensic microbial data and understand the implications in legal context
4. Apply instrumental methods in microbial forensics
5. Conduct research in the field of microbial forensics and develop new techniques

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 (SWGMP) 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

UNIT II: Statistics in research

UNIT III: Publishing research and Intellectual Property Rights

Course Objectives:

1. Develop and articulate a research plan including problem formulation, hypothesis generation and selection of research methodologies
2. Apply various data collection techniques and utilize analytical tools to interpret research data
3. Understand the fundamental concepts of statistics including descriptive and inferential statistics
4. Develop proficiency in scientific writing and report preparation
5. Demonstrate a comprehensive understanding of the various forms of intellectual property and their significance in innovation and commerce

Learning Outcomes:

Students will be able to

1. Design a research project including defining a research problem, formulating hypothesis, and selecting appropriate techniques for research
2. Use statistical concepts like central tendency, probability and regression for analysing research data
3. Accurately interpret statistical outputs and communicate findings in a meaningful way, understanding the implications for the research question or problem.
4. Develop strategies for effectively managing intellectual property within an organization, including conducting IP audits and developing licensing agreements
5. Apply for and obtain IPR and enforce IPR legally

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

UNIT II: Laboratory Management

UNIT III: Laboratory Safety

Course Objectives:

1. Educate students on various quality standards and regulatory requirements
2. Teach students how to develop, implement and maintain effective quality management systems within an organization
3. Provide an understanding of laboratory operations including resource allocation, workflow optimization and equipment maintenance
4. Teach students to identify potential hazards, conduct risk assessments and implement appropriate control measures
5. Emphasize the importance of regular safety training and awareness programs to ensure all laboratory personnel are knowledgeable about safety protocols and procedures

Learning Outcomes:

Students will be able to

1. Design, implement, and maintain effective quality management systems, integrating tools for process control, quality assurance, and continuous improvement
2. Analyze and ensure compliance with relevant quality standards (e.g., ISO 9000) and regulatory requirements, developing documentation and systems to support these standards
3. Manage laboratory operations efficiently, optimizing resource allocation, workflow, and equipment maintenance to ensure high productivity and quality results
4. Utilize Laboratory Information Management Systems (LIMS) effectively for data management, sample tracking, and reporting, enhancing the accuracy and reliability of laboratory data.
5. Implement laboratory safety protocols, conduct risk assessments and provide regular safety training and education to lab personnel

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

Course Objectives:

1. Provide practical skills to analyze questioned documents including handwriting analysis, ink analysis and paper examination
2. Teach students methods for detecting forgery, alterations, and other forms of document tampering
3. Equip students with the skills to properly collect, preserve, and handle questioned documents to maintain their integrity for forensic analysis
4. Familiarize students with special instruments used in questioned document examination such as microscopes, infrared scanners and chromatographic techniques
5. Understand the security features of security documents such as Indian currency notes, Indian passports and plastic currency

Learning Outcomes:

Students will be able to

1. Identify and compare class and individual characteristics of handwriting of questioned documents with standards
2. Differentiate between genuine and forged signature and identify the type of forgery involved
3. Examine disguised writing, alterations, and erasures in questioned documents
4. Decipher indented writings and secret writing using various light techniques
5. Examine the security features of Indian currency notes, Indian passports and plastic currency

Experiments:

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

Course Objectives

1. Identify the various poisons present in various biological matrices by preliminary test
2. Determine and quantify the ethanol present in various biological matrices by Kozelka & Hine's method and GC
3. Systematic extraction of drugs and pesticides from the biological matrices
4. Identify the drugs and pesticides by colour tests and TLC
5. Determine the drug/pesticide by instrumental techniques like UV spectrometry, GC, HPLC and hyphenated techniques

Learning Outcomes:

Students will be able to

1. Identify the poisons by preliminary test
2. Isolate and determine the amount of alcohol present in the individual and can interpret the data
3. Isolate and identify the poisons and drugs present in the various biological matrices
4. Know of the instrumentation techniques, interpret and report the toxicological data
5. Design and perform experiments in toxicology using instrumental techniques

Experiments:

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

Course Objectives:

1. Learn basics concepts of nanotechnology
2. Study about the various types of nanomaterials and their properties
3. Learn the different synthesis procedures for nanomaterials
4. Characterize the nanoparticles synthesized using instrumental methods
5. Integrate nanotechnology and forensic science in real time practical case work

Learning Outcomes:

Students will be able to

1. Synthesize nanoparticles by chemical, physical and plant extract based methods
2. Characterize nanoparticles by microscopic techniques for identification of size, shape and surface characteristics
3. Characterize nanoparticles by spectroscopic techniques
4. Determine the crystalline nature of nanoparticles using XRD
5. Apply nanoparticles for the development of fingerprints and identification of drugs or poisons

Experiments:

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

Course Objectives:

1. Equip students with hands on experience in sample collection, preparation and analysis in microbial forensic cases
2. Provide training on use of lab equipment and technologies such as microbial culturing
3. Teach students to apply various analytical techniques to identify, classify and compare microbial samples from forensic contexts
4. Develop skills to analyze and interpret microbial data and understanding its importance in forensic investigation
5. Highlight the ethical and legal considerations in microbial forensics, including chain of custody, contamination prevention, and reporting results

Learning Outcomes:

Students will be able to

1. Demonstrate proficiency in handling microbial forensic laboratory techniques
2. Identify and classify microbes using molecular and culture based techniques in forensic contexts
3. Design and execute experiments to address specific forensic questions
4. Analyze and interpret microbial forensic data and making conclusions about origin and relevance of microbial evidence in investigations
5. Communicate findings effectively through written reports and conveying significance of microbial forensic evidence to both scientific and legal audience

Experiments:

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

Course Objectives:

1. Understand descriptive and statistical methods of analysis
2. Instruct students to conduct hypothesis testing using various statistical tests
3. Enable students to create clear and effective data visualizations, such as graphs, charts, and plots, to communicate statistical findings
4. Equip students with the knowledge and skills to prepare and file intellectual property documentation, including patents, trademarks, copyrights, and trade secrets
5. Teach students how to conduct comprehensive searches for existing intellectual property and provide detailed instruction on drafting patent application

Learning Outcomes:

1. Apply qualitative and quantitative research methods to analyze data using appropriate statistical techniques
2. Demonstrate proficiency in using statistical softwares for data analysis and interpretation
3. Conduct hypothesis testing using various statistical tests interpreting the results accurately
4. Prepare and file IPR such as patent and copyright
5. Conduct search for existing IPR

Experiments:

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

Course Objectives:

1. Equip students with the skills to develop and implement quality management systems
2. Teach students how to design a laboratory
3. Provide practical skills in managing daily laboratory operations, including resource allocation, workflow optimization, and equipment maintenance
4. Teach students about safety precautions while working in laboratory
5. Study of protective equipment and first aid procedures in the laboratory

Learning Outcomes:

Students will be able to

1. Apply quality management tools and techniques to solve quality related issues
2. Manage laboratory operations effectively, optimizing resource use, workflow, and equipment maintenance to enhance productivity and efficiency
3. Develop and implement comprehensive laboratory safety protocols and procedures, ensuring a safe working environment for all personnel
4. Conduct thorough risk assessments to identify potential hazards, implementing and managing appropriate control measures to mitigate risks
5. Identify protective equipment and their use in laboratory and apply first aid procedures in case of emergency

Experiments:

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

UNIT II: DNA Fingerprinting

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

Course Objectives:

1. Learn about identification and analysis of body fluids in forensic investigation
2. Understand the scientific basis of DNA fingerprinting
3. Learn various methods of DNA extraction, amplification and analysis
4. Explore how forensic serology and DNA fingerprinting are applied in criminal investigations
5. Develop practical laboratory skills in serology and DNA analysis

Learning Outcomes:

Students will be able to

1. Analyze biological fluids such as blood, semen and saliva using colour tests, crystal tests and instrumental methods
2. Analyze biological fluids using molecular techniques like PCR, DNA sequencing, RFLP analysis and STR analysis
3. Identify and characterize the DNA profiles from crime scene and compare them to known samples
4. Interpret the DNA profiling results and carry out statistical analysis
5. Present expert testimony in the court of law

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., Lubjuhn, T., DNA Profiling & DNA Fingerprinting, Birkhauser Verlag, (1995)
10. Malhotra, K.C., Statistical 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

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

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

Course Objectives:

1. Explain about basics of computers and computer crimes
2. Introduce to students about various branches of Cyber forensics, Ethical hacking and tools
3. Teach students about steps involved in Cyber forensic investigation
4. Learn about Email forensic and computer forensic tools
5. Understand the concepts of network forensics, mobile phone forensics, and social media forensics and cyber law

Learning Outcomes:

Students will be able to

1. Identify various hardware devices and work on softwares
2. Demonstrate an understanding of cybercrimes and their types
3. Collect digital evidence; carry out duplication and data analysis
4. Operate various email forensic and computer forensics tools and softwares
5. Investigate cases related to mobile phones, network frauds and social media harassing

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, Blockchain 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 (5th 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

UNIT II: Forensic Accounting in Fraud Investigation

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

Course Objectives:

1. Understand the role of forensic accountants in fraud detection and prevention
2. Teach students to identify and apply various techniques in detecting and investigating financial fraud
3. Equip students with skills for collecting, analyzing, and presenting financial evidence in legal and regulatory contexts
4. Educate students on the roles and responsibilities of forensic accountants in legal proceedings
5. Develop the ability to prepare a forensic accounting report and provide expert testimony in court

Learning Outcomes:

Students will be able to

1. Demonstrate thorough understanding of tools used in fraud detection and investigation
2. Identify signs of frauds by applying various fraud detection techniques
3. Collect, analyze and interpret financial evidence
4. Identify types of frauds and fraud risk indicators
5. Understand laws relevant to forensic accounting

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

UNIT II: Multimedia Forensics

UNIT III: Audio, video and image analysis

Course Objectives:

1. Understand the basics concepts of linguistics and its application in forensic aspect
2. Understand the role of forensic stylistics in forensic applications
3. Teach the concepts of forensic phonetics and speaker identification
4. Educate students about multimedia forensics
5. Equip students with the knowledge of tools used for audio video authentication, forensic image analysis and CCTV forensics

Learning Outcomes:

Student will be able to

1. Relate linguistics and stylistics to forensic cases and help in forensic investigation
2. Apply forensic phonetics for authentication of tape recordings and vocal behaviours
3. Conduct speaker profiling and speaker identification
4. Investigate multimedia forensic cases
5. Investigate audio and video files, images files and CCTV footages using various softwares and tools

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

Course Objectives:

1. Examination and identification of body fluids by colour and crystal tests
2. Determination of origin of species from blood, semen and saliva by gel diffusion method
3. Blood grouping from dried blood stains and other sources by absorption elution technique
4. Determination of secretor status from semen and saliva by absorption inhibition technique
5. Isolate, purify and amplify the DNA from various biological sources

Learning Outcomes:

Students will be able to

1. Extract and identify the blood and body fluids from various sources
2. Identify the cases of sexual assault from examination of spermatozoa
3. Determine the origin of species from the immunological test
4. Identify the suspect/ victim blood group from dried blood sample and secretor status from body fluids
5. Have hands on experience on DNA isolation, amplification and identification of an individual from DNA profile

Experiments

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

Course Objectives:

1. Provide hands on experience with various digital forensic techniques including data acquisition, preservation and analysis of different types of digital devices
2. Teach students procedures and methodology for effective incident response involving detection, managing and mitigating cyber security incidents
3. Equip students with skills in using digital forensics and incident response softwares and tools such as EnCase, FTK and WireShark
4. Train students to handle digital evidence and maintain chain of custody to ensure integrity and admissibility of digital evidence in court
5. Document detailed reports of digital forensic investigation and incident response

Learning Outcomes:

Students will be able to

1. Demonstrate proficiency in conducting digital forensic analysis
2. Recover data, examine and interpret various digital evidences and storage media found in the crime scene
3. Apply forensic techniques to detect, analyze and manage cyber security incidents including malware analysis, network forensics and system recovery
4. Use digital forensic tools to extract, analyze and report digital evidence in real world scenario
5. Maintain integrity of digital evidence, prepare clear reports and communicate findings effectively to both technical and on-technical audience

Experiments

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

Course Objectives:

1. Provide hands on experience in applying forensic techniques to detect and investigate financial fraud
2. Equip students with practical skills for identifying frauds through data analysis and forensic auditing
3. Train students in financial evidence collection, examination and documentation to ensure its integrity and admissibility in legal proceedings
4. Familiarize students with forensic accounting tools and softwares used in fraud investigation
5. Develop skills to prepare forensic accounting reports and provide expert testimony

Learning Outcomes:

Students will be able to

1. Apply forensic accounting techniques in detecting and investigating various types of financial frauds
 2. Identify and analyze fraudulent activities and demonstrating ability to detect irregularities and financial discrepancies
 3. Collect, examine and document financial evidence maintaining its integrity
 4. Utilize forensic tools and softwares to analyze financial data, uncover evidence and support fraud investigation
 5. Study case studies related to various types of frauds and the laws applicable in India
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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

Course Objectives:

1. Provide practical experience in forensic linguistic analysis including authorship attribution, language profiling and discourse analysis
2. Equip students with practical skills in analyzing written texts and spoken language for identifying speaker characteristics
3. Train students in techniques for collecting, authenticating and enhancing multimedia evidence including detecting tampering, recovering lost data and improving quality
4. Provide practical experience in analyzing multimedia evidence, including images, audio, and video, for forensic purposes
5. Equip students with skills in using digital forensic tools and software for multimedia analysis, such as image forensic tools, audio analysis programs, and video editing software

Learning Outcomes:

Students will be able to

1. Apply forensic linguistic analysis to various cases
2. Analyze written and spoken language for forensic investigation
3. Demonstrate proficiency in analyzing various multimedia evidence including video, images, and audio for forensic purposes
4. Apply forensic techniques to detect tampering in multimedia evidence and ensuring integrity of evidence
5. Utilize open source softwares for image enhancement, audio analysis and video editing

Experiments

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