

OSMANIA UNIVERSITY, HYDERABAD

(Esttd. 1917)

Accredited with 'A+' by NAAC



FORENSIC SCIENCE

Department of Chemistry

Osmania University

Hyderabad

FACULTY OF SCIENCE

CHOICE BASED CREDIT SYSTEM

SYLLABUS

OF

M.Sc. FORENSIC SCIENCE

SEM III & IV

(Effective from the batch admitted in 2016-2017)

M. Sc. (Forensic Science)
Choice Based Credit System Syllabus
 (Effective from the batch admitted in academic year 2016 -2017)

SEMESTER – III

THEORY

Code	Paper	Hrs/week	Internal assessment	Semester Examination	Total	Credits
FS 301	Forensic Chemistry	4	20 marks	80 marks	100 marks	4
FS 302	Forensic Toxicology	4	20 marks	80 marks	100 marks	4
FS 303	CB I: Biochemistry and biochemical applications	4	20 marks	80 marks	100 marks	4
	CB II: Forensic phonetics, Psycholinguistics, Voice analysis and Speaker Recognition					
FS 304	CB I: Standards, Quality management, Laboratory management & safety	4	20 marks	80 marks	100 marks	4
	CB II: Statistics and Forensic Applications					

PRACTICALS

FS 351	Forensic Chemistry lab	6	-	75 marks	75 marks	3
FS 352	Forensic Toxicology lab	8	-	100 marks	100 marks	4
SMNR3	Seminar	2	-	25 marks	25 marks	1
	TOTAL				600	24

SEMESTER – IV

THEORY

Code	Paper	Hrs/week	Internal assessment	Semester Examination	Total	Credits
FS 401	Forensic Serology & DNA Fingerprinting	4	20 marks	80 marks	100 marks	4
FS 402	Fingerprints and Impressions	4	20 marks	80 marks	100 marks	4
FS 403	CB I: Questioned documents	4	20 marks	80 marks	100 marks	4
	CB II: IPR, Entrepreneurship, Ethics and Research methodology					
FS 404	CB I: Molecular Biology & Immunology	4	20 marks	80 marks	100 marks	4
	CB II: Advanced Instrumental methods in Forensic Chemistry					

PRACTICALS

FS 451	Forensic Serology & DNA Fingerprinting lab	8	-	100 marks	100 marks	4
FS 452	Fingerprints, Impressions & Questioned documents lab	6	-	75 marks	75 marks	3
SMNR4	Seminar	2	-	25 marks	25 marks	1
	TOTAL				600	24

FS 301: FORENSIC CHEMISTRY

Instruction

4 periods per week

Duration of University Examination

3 Hours

University Examination

100 Marks / 4 Credits

UNIT I: Forensic Chemistry: Introduction

UNIT II: Standard analysis of petroleum, arson residues and trace evidences

UNIT III: Examination of NDPS and Alcoholic beverages

UNIT IV: Examination of 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 real-world scenarios
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: Introduction

Forensic Chemistry - Introduction - Types of cases / exhibits - Preliminary screening - presumptive tests (colour and spot tests) - Examinations procedures involving standard methods and instrumental techniques
Qualitative and quantitative forensic analysis of inorganic and organic material - Chemical fertilizers (N,P,K) - Insecticides (Endosulfan, Malathion, Carbaryl) - Metallurgical analysis (Fe, Cu, Zn, Au, Ag) - Natural products (tobacco, tea, sugars, rubber) - Industrial chemicals - Sulphuric, Nitric and Hydrochloric acids, Sodium, Potassium hydroxide, Ammonium nitrate, Potassium chlorate, Organic solvents like Methanol, Ethanol, Acetone, Chloroform and Ether - Organic chemicals like Acetanilide, p-Aminophenol, Nitrobenzene etc. with reference to forensic work

UNIT II: Standard analysis of petroleum, arson residues and trace evidences

Examination of petroleum products - Distillation and fractionation - various fractions and their commercial uses - Standard method of analysis of petroleum products - Analysis of petroleum products for adulteration and arson residues

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

Analysis of trace evidence - Dyes, Trace related evidence materials, Paints, Oils fats, Greases, Industrial dusts

UNIT III: Examination of NDPS and Alcoholic beverages

Analysis of beverages: Composition and analysis of alcoholic and non-alcoholic beverages, country made liquor, illicit liquor and medicinal preparations containing alcohol - Common adulterants and toxic substances in alcoholic beverages.

Analysis of Narcotic Drugs and Psychotropic Substances - Introduction - classification of NDPS/ drugs of abuse - Drug abuse - Drugs of abuse in sports - Designer drugs - Forensic examination of NDPS - Clandestine laboratories - Drug profiling

The study of NDPS should be exemplified by Opiates, Cannabis, Cocaine, Amphetamines,

Benzodiazepines, Disubstituted Quinazolones, Barbiturates and LSD, Psilocybin, Mescaline and MDMA - Drugs and Cosmetic Act, Excise Act, NDPS Act

UNIT IV: Examination of Explosives

Explosives and Explosion residues – composition, Classification, and characteristics of explosives, pyrotechnics, IEDs - Explosion process and effects - 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 in the laboratory using chemical and instrumental techniques (exemplified by country bomb compositions, Picric acid, Gun powder, Ammonium nitrate, NG, NC, TNT, PETN, TETRYL, RDX and HMX) - Synthesis of above organic explosives – Profiling and tagging of explosives- Interpretation of results, Explosives Act and Explosive Substances Act.

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

Suggested reading:

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

FS 302: FORENSIC TOXICOLOGY

Instruction
Duration of University Examination
University Examination

4 periods per week
3 Hours
100 Marks / 4 Credits

UNIT I: Introduction to Forensic Toxicology

UNIT II: Introduction to Pharmacology

UNIT III: Forensic Toxicology Analysis

UNIT IV: Management of acute poisoning

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: Introduction to Forensic Toxicology

Toxicology- Introduction- History- Scope- Areas of Toxicology- Role of forensic toxicologist- Poisons - Classification of poisons- Types of poisoning- Sample collection and preservation of toxicological exhibits in fatal and survival cases- Storage of samples- Signs and symptoms of poisoning- Toxicological investigation/examination of poisoned death- Interpretation of toxicological data- Courtroom testimony in toxicological cases. Case Histories

UNIT II: Introduction to Pharmacology

Principles of Toxicology- Introduction – Pharmacokinetics - Methods of transportation of toxicant Absorption- Distribution- Storage of toxicants- Redistribution - Metabolism-Oxidation – Reduction – Hydrolysis – Conjugation - Excretion- Other routes of elimination- Toxicokinetics- one and two compartmental model – Toxicodynamics- Spectrum of undesired (toxic) effects- Interaction of chemicals- Tolerance- Dose response relationship- Developmental and reproductive toxicity- Mutagenicity- Toxicity testing

UNIT III: Forensic Toxicology Analysis

Toxicological Analysis- Introduction- Sample preparation – Deproteinization – Deconjugation - Liquid–liquid, solid phase, supercritical fluid extraction methods, Isolation and Clean-up procedures in toxicological analysis- Identification and quantitation of poisons by physical, chemical, chromatographic, spectrophotometric, electrophoretic, immunoassay- and other methods (Metals, anions, volatile poisons, gases, drugs, pesticides and miscellaneous poisons) - Field testing in toxicological work – Therapeutic drug monitoring – Emergency hospital toxicology

UNIT IV: Management of acute poisoning

Management of acute poisoning- Introduction- Maintenance of vital functions- Measures to enhance elimination of poisons- Removal of unabsorbed poisons- Antidotes- Classification of antidotes-Mechanism

of action of antidote (cyanide, methanol, arsenic, opiate, carbon monoxide, nitrite, acetaminophen and pesticides) Identifying route of administration of poison- Estimation of time and dose after administration of poison- Recovery and after care of patients- Poison Information/Control Centre

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

FS 303: CB I: BIOCHEMISTRY & BIOCHEMICAL TECHNIQUES

Instruction

4 periods per week

Duration of University Examination

3 Hours

University Examination

100 Marks / 4 Credits

UNIT I: Introduction to Biomolecules & Cells, Proteins & Peptides

UNIT II: Introduction & Analysis of Amino acids & Enzymes

UNIT III: Introduction to Nucleic acid, DNA sequencing techniques

UNIT IV: Electrophoresis and Biochemical techniques

Course Objectives

1. Learn and understand various biomolecules, cells and their functions
2. Understand the various methods of separation, characterization and identification methods of various biomolecules
3. Learn about enzymes, types of enzymes, enzyme kinetics and enzyme assay techniques
4. Learn basics of nucleic acids, DNA sequencing methods and PCR technique
5. Understand the basic principle, techniques, instrumentation and forensic applications of electrophoretic and biochemical techniques

Learning Outcomes

Students will be able to

1. Acquire the knowledge of the biomolecules and cells
2. Separate, purify and characterize the various biomolecules
3. Apply the principles of biochemical, electrophoretic and DNA sequencing methods to isolate the DNA and biomolecules from the trace samples obtained from the crime scene to identify the individual
4. Apply the various principles of biochemistry to identify in paternity, kinship cases, etc.
5. Apply the biochemical techniques in forensic applications

UNIT I: Introduction to Biomolecules & Cells, Proteins & Peptides

Biomolecules and cells – Biological fitness of organic compounds – Hierarchy of molecular organization of cells – Primordial biomolecules – Specialization and differentiation of biomolecules- The dimensions and shapes of biomolecules- Biomolecules supra molecular structures and cell organelles- Structural organization of cells.

Proteins and peptides – Composition of proteins – Size of protein molecules – Confirmation of protein supra molecular assemblies of proteins – Denaturation – Estimation of proteins Functional diversity of proteins – Antibodies and immune response – The species specificity of proteins – Sequence isomerism in polypeptide chains – Genetic coding of amino acid sequences in proteins- Mutation – Structure of peptides – Optical and chemical properties of peptides- Steps in determination of amino acid sequence – Separation and analysis of peptides – Sequence analysis of peptide fragments.

UNIT II: Introduction & Analysis of Amino acids & Enzymes

Amino acids – Common amino acids of proteins – Rare amino acids of proteins – Non protein amino acids- Physicochemical properties of amino acids – Absorption spectra of amino acids – Chemical reactions of amino acids – Analysis of amino acid mixtures – Complete hydrolysis of polypeptide chains and determination of amino acid composition – Identification of N-terminal and C-terminal residues of peptides
Enzymes – Definition, types and classification - Biological activities – Kinetics – Inhibition - Types of inhibition - Poisoning – Micheles-Mentor's equation – Enzyme polymorphism – Purification of proteins and enzymes – Enzyme assay techniques: UV-Vis, Luminescence, Radio isotope and immunochemical methods – Automated enzyme analysis – Immobilized enzymes

UNIT III: Introduction to Nucleic acid, DNA sequencing techniques

Nucleotides – General structure of the nucleotides – Pyrimidines and purines – Nucleosides, Nucleotides – Nucleic acids – RNA and DNA - Short hand representation of nucleic acid back bones- Hydrolysis of nucleic acids by acids and bases – Enzymatic hydrolysis of nucleic acids – Analysis of nucleotide sequence in nucleic acids – Nucleic acid- Protein supra molecular complexes – DNA sequencing – PCR technique

UNIT IV: Electrophoresis and Biochemical techniques

Electrophoretic Techniques – Overview of Electrophoresis – Principles – Factors affecting migration – Instrumentation, Techniques and Applications of: Zone Electrophoresis – Cellulose Acetate Membrane Electrophoresis – Agar Gel Electrophoresis – Acryl amide Gel Electrophoresis – Capillary electrophoresis - Isoelectric Focusing – Isotachopheresis –
Biochemical techniques – General principles – pH and buffers – physiological solution – Cell and tissue culture – Cell fractionation – Centrifugation techniques

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

Suggested Reading:

1. Nelson, D. L., and Cox, M. M.: Lehninger Principles of Biochemistry, 3rd edn., Macmillan Worth, 2000
2. Voet, D. and Voet, J.G.: Biochemistry, 2nd edn., John Wiley, 1995
3. Rao, P. Gundu,,: Biochemistry, Vallabh Prakashan, 1995
4. White, A., Handler, P. and Smith, E.: Principles of Biochemistry
5. Turner, P.C, McLennan, A. G., Bates, A. D., and White, M. R. H.: Molecular Biology, 2nd edn. Bio Scientific/Viva Books, 2001
6. Rao, Rama. A. V. S. S.: A Text Book of Biochemistry, 8th edn., L. K & S Pub, 1998
7. Henry, B. J.: Clinical Diagnosis and Management by Laboratory Methods, 19th edn., Harcourt / Thomson, 1999
8. Gowenlock, A. H.: Practical Clinical Biochemistry, 6th edn., Butterworth / CBS, 1988
9. Plummer, D. T.: An Introduction to Practical Biochemistry, 15th edn., Tata McGraw Hill, 1988

FS 303: CB II: FORENSIC PHONETICS, PSYCHOLINGUISTICS, VOICE ANALYSIS & SPEAKER RECOGNITION

Instruction	4 periods per week
Duration of University Examination	3 Hours
University Examination	100 Marks / 4 Credits

UNIT I: Phonetics

UNIT II: Psycholinguistics

UNIT III: Voice analysis

UNIT IV: Speaker recognition

Course Objectives

1. Learn basics of phonetics and stylistics
2. Learn and understand the methods of analyzing speech, voice and audio recordings of the suspects
3. Learn the types and methods of speaker recognition
4. Understand the admissibility and integrity of audio video analysis and speaker recognition in identification of witness in the court room and suspects involved in various cases

Learning Outcomes

Students will be able to

1. Extract the evidence from tape recordings and video recordings
2. Utilize the various methods for the identification of suspects and lay witness
3. Distinguish and identify the authorship of the writings

UNIT I: Phonetics

Phonetics: Introduction, Authentication of tape recordings- Physical examination and laboratory examination, Difficult tapes and transcripts- Enhancing speech- Speech decoding and transcripts - Decoding mechanics, Speaker identification- Ear witness identification- Aural perceptual approaches machine/computer approaches, Vocal behaviours- Stress- Alcohol speech relationships

UNIT II: Psycholinguistics

Psycholinguistics- Written and spoken utterances as special evidence- Psycholinguistics distinguished - Stylistics- Contribution of psycholinguistics- Identifying authorship- Inferring characteristics of author- Predicting consequence

UNIT III: Voice Analysis

Voice analysis: Introduction, Human voice- Nature of voice and production of speech- Perception of voice and speech, Collection of evidence, Quality of evidence- Types of evidences - Speaker variability and simulation- Transmission channel distortion- Recording system distortion - Admissibility

UNIT IV: Speaker recognition

Speaker recognition- Types- Procedure and methods - Feature extraction - Feature comparison – Classification, Speaker recognition by listening - Recognition by non-experts and experts, Speaker recognition by visual comparison of spectrograms- Technology- Kersta method- Tosi study, Automatic speaker recognition- Feature extraction – Feature comparison and normalization techniques-, Interpretation of results, Speaker profiling, Intelligibility enhancement of audio recordings, Transcription & analysis of disputed utterances- Authenticity and integrity examination of audio recordings

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

Suggested Reading:

1. Siegel, J. A, Saukko, P. J and Knupfer, G. C (Eds.): Encyclopedia of Forensic Sciences, Academic Press, 2000
2. K. Lee Lerner and Brenda Wilmoth Lerner: World of Forensic Science, Thomson Gale, 2006
3. Allan Jamieson, Andre Moenssens, Wiley Encyclopedia of Forensic Science, John Wiley & Sons Ltd, 2009
4. Gerald R. McMenamin, Forensic Linguistics - Advances in Forensic Stylistics, CRC Press LLC, 2002
5. Philip Rose, Forensic Speaker Identification, Taylor & Francis, 2002
6. Homayoon Beigi, Fundamentals of Speaker Recognition, Springer, 2011

FS 304: CB I: STANDARDS, QUALITY MANAGEMENT, LABORATORY MANAGEMENT & SAFETY

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	100 Marks / 4 Credits

UNIT I: Standards of analysis

UNIT II: Quality Management

UNIT III: Laboratory Management

UNIT IV: Laboratory safety

Course Objectives

1. Understand the basics and importance of standards in chemical analysis
2. Gain understanding of quality management principles and explore different quality management systems such as ISO 9000, 14000, 17000
3. Understand the principles of effective laboratory management
4. Learn about resource management, workflow optimization and laboratory information systems and develop skills to ensure compliance with accreditation requirements
5. Develop skills to identify, assess and mitigate safety risks

Learning Outcomes

Students will be able to

1. Explain the significance of standards in ensuing product and service quality
2. Develop and implement a quality management system in an organizational context
3. Manage laboratory resources effectively, including personnel, equipment and supplies
4. Ensure compliance with laboratory standards, regulations and accreditation requirements
5. Identify and explain safety hazards and risks in different work environments and conduct safety audits and risk assessments

UNIT I: Standards of Analysis

Standards for analysis – Basic standards – Need of standards in analytical sciences – Basic chemical standards – Analytical standards – Reference materials – High purity substances – Certified reference materials – Working or secondary standards – Matrix effect in standards – Biological standards – Biochemical standards – Microbial cell lines and standards

UNIT II: Quality Management

Quality Management – Introduction – Quality - Quality system – Quality plan – Inspection and testing – Test records – Control of inspection - Handling, storage, packaging, preservation and delivery of the material – Control of quality records – Internal quality audits – Quality assurance – Training

Laboratory Accreditation – ISO 9000 - ISO 14000 and 17000 series of standards – Accreditation Boards – NABL guidelines for accreditation in India

Proficiency testing system – Internal quality control – Inter and intra laboratory testing programmes – Designing and running the proficiency testing programmes – Confidentiality Advantages of accreditation

UNIT III: Laboratory Management

Laboratory Management: Administration of Laboratories – Types of laboratories – Connection between field work and laboratory – Educational requirements of laboratory personnel – Routine laboratory work – Research and development – Internal organization of a laboratory Architectural requirements – Laboratory design – Floor area - Furniture design – Auxiliary services – Receipt of reports and remnants – Record management – Requirement of equipment, glassware, chemicals and other material – Purchase procedure – Disposal of wastes –

Security of the premises

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 – Commercial or Bespoke LIMS – Evaluation – Purchase and installation – Demonstration – Validation – User training and implementation

UNIT IV: Laboratory Safety

Laboratory safety – Planning – Written safety plan – Safety policies – Safety resources – Operations - Hazards of chemicals, solvents, poisons and explosives – Storage facilities –

Biological hazards - Pressure vessels and then handling – Electrical safety – Fume cup boards-

Exhausts system – Protective equipment - Emergency care and medical facilities

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

Suggested Reading

1. Woodget, B. W. and Cooper, D.: Sample and Standards, ACOL Series, Wiley 1987
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
16. Siegel, J. A, Saukko, P. J and Knupfer, G. C (Eds.): Encyclopedia of Forensic Sciences, Academic Press, 2000

FS 304: CB II: STATISTICS AND FORENSIC APPLICATIONS

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	100 Marks / 4 Credits

UNIT I: Basics of Statistics

UNIT II: Probability

UNIT III: Statistical tests

UNIT IV: Forensic Applications

Course Objectives:

1. Gain solid foundation in statistical concepts and methods
2. Develop the ability to analyze and interpret statistical data
3. Explore role of statistics in forensic science
4. Develop problem solving skills through case studies and practical applications
5. Learn about statistical techniques used in forensic investigations and apply to forensic scenarios

Learning Outcomes:

Students will be able to

1. Apply statistical methods to analyze and interpret forensic data, including DNA analysis and fingerprint comparison
2. Conduct statistical analysis of evidence using techniques like regression, hypothesis testing, and confidence intervals
3. Evaluate and criticize statistical evidence in court cases, including assessing validity and reliability
4. Apply statistical techniques to analyze evidence from crime scenes, including bullet trajectories and bloodstain pattern analysis
5. Integrate statistical analysis with other disciplines to reconstruct crime scenes and identify perpetrators, including using Bayesian networks and spatial analysis

UNIT I: Basics of Statistics

Statistics: Definition – Importance of statistics in interpreting forensic data in research work and quality control – Data – Population – Distribution – Location - Random experiment - Brief introduction to sampling and data collection - Frequency distribution - Concept of measures of central tendencies Normal distribution - Arithmetic mean - Median & Mode concept of measures of dispersion – Variance Normal distribution- Variance, Standard Deviation, Coefficient of variation

UNIT II: Probability

Concept of probability – Definitions of probability – Discrete random variables and probability distributions - Addition, multiplication and Bayes's theorem & applications – Probability in Forensic Evidence - Concept of random variable - Discrete and continuous – Some examples, Concept of probability distribution – Binomial - Poisson - Normal distribution – Definitions, statements of properties of above distribution and examples - Simple linear regression and correlation – Concept of computational methodology – Examples - Concept of tests of hypothesis – Null and alternative hypothesis - Critical region - Types of errors & level of significance

UNIT III: Statistical tests

Large samples tests – Test for single mean, Difference of means, Single proportion and difference of proportion examples - Chi square test for goodness of fit and test for independence of attributes – Examples - Hypothesis testing for one or two population means - Student t-test - t-test for simple mean Difference of means – Examples. Hypothesis testing for small sample sizes and multinomial experiments
Fisher's exact test- Analysis of variance and multiple comparison tests - F-test for equality of variance – Examples - Concept of analysis of variance – Computational procedure for ANOVA one way and two way classification- Examples

UNIT IV: Forensic Applications

Introduction to Scientific evidence and statistics – Data Bases – Type and geographical factors -Statistical approach to DNA fingerprinting – Loci and alleles - Simple case genotypic frequencies – Hardy Weinberg equilibrium – Simple case of allelic frequencies – Accounting for sub-population – Paternity mother and father unrelated – Data base searches and value of evidence- Evidence evaluation examples – Blood group frequencies – Clothing fibres – Shoe types – Air weapon projectiles – Height identification from eye witnesses - Uncertainty in scientific experimentation – Determination of uncertainty

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

Suggested Reading:

1. David Lucy: Introduction to Statistics for Forensic Scientists, Wiley, 2004
2. Colin Aitken & Franco Taroni: Statistics and Evaluation of Evidence for Forensic Scientists (Statics in practice)
3. Wing kam Fung & Yue-Quing Hu: Statistical DNA Forensics, Theory Methods & Computation, Wiley, 2008
4. I. W. Evett & B. S. Wier: Interpreting DNA Evidence – Statistical Genetics for Forensic Scientists, 1998
5. Miller, J. C. and Miller, J. N.: Statistics for Analytical Chemistry, Ellis Horwood, 1988
6. Fisher, R. A.: Statistical Methods for Research Workers, John Wiley, 1954
7. Sokal, R. R. and Rolf, F. J.: Biometry – Principles and Practices of Statistics in Biological Research, Freeman, 1981
8. Bhaskar Rao T.: Methods of Biostatistics, Paras, 2001
9. Rama Krishnan P., Biostatistics, Saras, 1995
10. Meier, P. C. and Zund, R. E.: Statistical Methods in Analytical Chemistry, Wiley, 2000
11. Rao, V. K., Biostatistics – A Manual of Statistical methods for use in Health, Nutrition and Anthropology, Jaypee Medical Pub., 1996

FS 401: FORENSIC SEROLOGY AND DNA FINGERPRINTING

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	100 Marks / 4 Credits

UNIT I: Forensic Serology

UNIT II: Serogenetic Markers

UNIT III: DNA Typing

UNIT IV: Interpretation of DNA Typing Results

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

Forensic Serology- Introduction- The nature of blood- Blood stain pattern interpretation and significance- Age of bloodstain- Collection and preservation of blood, semen, saliva, urine, faeces, milk samples - Identification of above biological stains by chemical- Biochemical- Crystal- Chromatographic - Spectroscopic methods- Determination of origin of species by immunological methods- Methods of grouping biological stains- Secretor and non-secretor status- Identification of menstrual blood, amniotic fluid and parturition stains

UNIT II: Serogenetic markers

Serogenetic Markers: 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- LDHPCE- Cellular proteins- PGM-AK-ADA-PepA-EsD-GLO-GPT-G6PD- Haemoglobin variants- Hbf – Hbs – Hbc – HbA - Determination of sex and race from blood- White blood group system HLA and its forensic significance

UNIT III: DNA typing

DNA Typing- Introduction- Forensic significance - History- Why DNA- Introduction to human genetics - Physical basis of hereditary- Alleles- Population genetics- Molecular biology of DNA- Variation - Enzymes- Collection and Preservation of physical evidence for DNA typing

Forensic DNA Analysis- Introduction- Isolation of DNA - Determination of quality and quantity of DNA-RFLP analysis- PCR amplification- Types of PCR - Analysis of PCR product- Sequence polymorphism (HLA DQA1,

Polymarker Amplitype PM6, Mitochondrial DNA) – Length polymorphism (STRs, Gender identification, D1S80) - DNA separation – Slab Gel & Capillary Electrophoresis – DNA detection – Fluorescent dyes and silver staining – Instrumentation for STR typing – STR Genotyping - Automated analysis system- Applications of DNA profiling- Legal standards for admissibility of DNA profiling - Future technologies DNA chips, SNPs, DNA cloning

UNIT IV: Interpretation of DNA Typing Results

Interpretation of DNA Typing Results- Introduction to complicating factors- Multiple contributors - Degradation- Extraneous substance- System specific interpretational issues- RFLP based system - Multi banded patterns- Single banded patterns – PCR based systems - Nuclear DNA- Mitochondrial DNA Determination of genetic concordance- Evaluation of results- Bayes theorem- Hardy Weinberg law - Frequency estimate calculations- Population sub structure- Likelihood ratios

Introduction to bioinformatics, Genomics and Proteomics- DNA databank and database- Certification and accreditation

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

Suggested reading:

1. Saferstein, Richard. 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. Rudin, N., Inman. K. An Introduction to Forensic DNA Analysis, 2nd 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. Lydyard, P.M., Whelan, A.& Fanger, M.W., Instant Notes in Immunology, 1st ed, Viva Books Pvt. Ltd. (2000)
17. Kuby, Immunology
18. Turner, P.C., McLennan, A.G., Bates, A.D.& White, M.R.H., Instant notes in Molecular Biology, 2nd ed, Viva Books Pvt. Ltd.,(2001)
19. Winter, P.C., Hickey, G.I., & Fletcher, H.L., Instant Notes in Genetics, Viva Books Pvt. Ltd. (1999)
20. Rashidi, H.H.& Buehler, L.K. Bioinformatics Basics: Applications in Biological Sciences and Medicine, CRC Press, (2000)
21. Jambeck, P.& Gibas, C., An Introduction to Software Tools for Biological Applications: 21. Gibas, and Jambeck, P: Developing Bioinformatics Computer Skills, 1st ed, (O Reilly) Shroff Publishers, (2001)
22. Misner, S and Krawetz, S. A: Bioinformatics – Methods and Protocols, Humana Press, 2000
23. Butler John M : Forensic DNA Typing, 2nd Edn.

FS 402: FINGERPRINTS AND IMPRESSIONS

Instruction
Duration of University Examination
University Examination

4 Periods per week
3 Hours
100 Marks / 4 Credits

UNIT I: Fingerprints

UNIT II: Types of evidentiary fingerprints

UNIT III: Footwear Impressions & Tire impressions

UNIT IV: Lip Prints, Ear Prints & Bite Marks

Course Objectives:

1. Apply advanced principles of fingerprint analysis and impression evidence
2. Develop skills in collecting, processing, and analyzing fingerprint and impression evidence
3. Learn to identify and compare fingerprint patterns and impression marks
4. Apply fingerprint and impression analysis to real-world forensic scenarios
5. Integrate fingerprint and impression evidence with other forensic disciplines

Learning Outcomes:

Students will be able to

1. Collect and process fingerprint evidence from crime scenes using appropriate techniques and materials
2. Analyze and compare fingerprint patterns using various techniques, including AFIS and manual comparison
3. Identify and analyze impression marks, including footwear, tire tracks, and tool marks
4. Apply fingerprint and impression analysis to solve crimes and resolve legal issues
5. Integrate fingerprint and impression evidence with other disciplines, such as DNA analysis and forensic anthropology, to reconstruct crime scenes and identify perpetrators

UNIT I: Fingerprints

Fingerprints- Introduction- History and development of fingerprints- Structure of skin- Elements of fingerprinting - Classification of fingerprint patterns- Classification of fingerprints- Identification and comparison- Poroscopy- AFIS- Introduction- History- Operation- Search technology- Palm prints – Administration and networking.

Types of evidentiary fingerprints- Development of latent fingerprints- Physical and chemical methods - Visualization methods of illumination- Photography- Preservation and lifting of fingerprints - Development techniques on porous and non-porous surfaces- Development on adhesive surface - Development with blood and grease contamination-Development of latent fingerprints on dead body - Digital imaging of fingerprints- Case histories.

UNIT II: Types of evidentiary fingerprints

Types of evidentiary fingerprints- Development of latent fingerprints- Physical and chemical methods- Visualization methods of illumination- Photography- Preservation and lifting of fingerprints-Development

techniques on porous and non-porous surfaces- Development on adhesive surface - Development with blood and grease contamination-Development of latent fingerprints on dead body - Digital imaging of fingerprints- Case histories

UNIT III: Footwear Impressions

Footwear Impressions- Introduction- Forms of footwear impressions- Information from footwear impressions- Location and recovery of footwear impressions- Enhancement methods- Preparation of Exemplars- The examination process- Case histories

Tire impressions- Introduction- Original equipment tires, Replacement tires and tire construction- Tread nomenclature and sidewall information- Tread wear indicators- Retreated tires- Tire reference material and databases- Tire track evidence and recovery- Known tires and exemplars- Tire impressions examination process- Case histories

UNIT IV: Lip prints

Lip Prints- Introduction- History- Scope- Application in crime detection

Ear Prints- Introduction- History- Morphology of ear – Ear prints location- Producing standards from suspects- Identification and comparison

Bite marks- Introduction- Significance- Judicial Acceptance- Description of prototypical bite marks - Evidence collection on victim and suspects- Identification and comparison- Case histories

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

Suggested reading:

1. Saferstein, Richard. Criminalistics. An Introduction to Forensic Science, 5th ed., Prentice Hall, 1998
2. Saferstein, R., Handbook of Forensic Science (Vol 1,2,3),
3. Eckert, An Introduction to Forensic Science
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. Saferstein,R., Criminalistics. An Introduction to Forensic Science, 5th ed., Prentice Hall, 1998
7. Saferstein, R., Handbook of Forensic Science (Vol. 1,2,3),
8. Kirk, P.,: Criminal Investigation, Interscience, 1953
9. James, S. H. and Nordby, J. J.: Forensic Science: An Introduction to Scientific and Investigative Techniques, CRC Press, 2003 & 2005
10. Siegel, J. A., Sukoo, R. J, and Knupfer, G. C: Encyclopedia of Forensic Science, Vol, I, II and III, Academic Press, 2000.
11. Hara, C.E.O., & Osterburg, J.W., An Introduction to Criminalistics Indiana University Press, (1972)

FS 403: CB I: QUESTIONED DOCUMENTS

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	100 Marks / 4 Credits

UNIT I: Handwriting examination**UNIT II: Other document frauds****UNIT III: Xerox copies, typewriting and security documents****UNIT IV: Computer printouts and analytical instrumentation****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: Handwriting examination

Nature and problems of document examination – Classification of documents – Procurement of standard admitted / specimen writings – Handling and marking of documents – Preliminary examination of documents- Basic s of handwriting identification – Individuality of handwriting – natural variations, process of comparison – Various types of documents – Various writing features and their estimation – General characteristics of hand writing – Individual characteristics of hand writing – Basic tools for forensic document examination

UNIT II: Other document frauds

Disguised writing and anonymous letters – Identification of writer – Examination of signatures – Characteristics of genuine and forged signatures – Examination of alterations, erasers, over writings, additions and obliterations – Decipherment of secret, indented and charred documents – Examination of seal impressions and other mechanical impressions

UNIT III: Xerox copies, typewriting and security documents

Examination of black and white, colour Xeroxed copies, carbon copies, fax messages – Forgeries and their detection – Various types of forgeries and their detection – Examination of built up documents – Determination of sequence of strokes, physical matching of documents, identification of typewriter writings – Identification of typewriter – Identification of printed matter – Various types of printing of security documents , printing of currency notes – Examination of counterfeit currency notes, passports, visa, stamp papers, postal stamps etc.

UNIT IV: Computer printouts and analytical instrumentation

Determination of age of documents by examination of signatures, paper, ink, writing / signatures etc. -

Examination of computer print outs – dot-matrix, ink-jet and laser printers, electronic typewriters – credit cards – e- documents – Digital signatures – Opinion writing – Reasons for opinion – Court testimony
Analytical instrumentation used in document examination – Video spectral comparators, Microscopes, TLC, HPLC, Spectrofluorimetry and X-ray fluorimetry etc.

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

Suggested reading:

1. Morris, Ron. Forensic Handwriting Identification Fundamental Concepts and Principles, Academic Press, (2000)
2. Huber, Roy, A. and Headrick, A. M. Handwriting Identification: Facts and Fundamentals, CRC Press, (1999)
3. Osborn, A. S. The Problem of Proof, 2nd ed, Universal Law Publishers, (1998)
4. Thomas, C.C. , Typewriting Identification I.S.Q.D., Billy Prior Bates, (1971)
5. Harrison, W.R., Suspect Documents: Their Scientific Examination, Universal Law Publisher, (1997)
6. Lerison, J., Questioned Documents, Academic Press, (2000)
7. Hilton, O., Scientific Examination of Questioned Documents, Elsevier, (1982)
8. Saferstein, Richard. Criminalistics. An Introduction to Forensic Science, 5th ed., Prentice Hall, 1998
9. Saferstein, R., Handbook of Forensic Science (Vol 1,2,3),
10. Eckert, An Introduction to Forensic Science
11. James, S. H. and Nordby, J. J.: Forensic Science: An Introduction to Scientific and Investigative Techniques, CRC Press, 2003 & 2005
12. Siegel, J. A., Sukoo, R. J, and Knupfer, G. C: Encyclopedia of Forensic Science, Vol I, II and III, Academic Press, 2000.
13. Saferstein,R., Criminalistics. An Introduction to Forensic Science, 5th ed., Prentice Hall, 1998
14. Saferstein, R., Handbook of Forensic Science (Vol. 1,2,3),
15. Kirk, P.,: Criminal Investigation, Interscience, 1953
16. James, S. H. and Nordby, J. J.: Forensic Science: An Introduction to Scientific and Investigative Techniques, CRC Press, 2003 & 2005
17. Siegel, J. A., Sukoo, R. J, and Knupfer, G. C: Encyclopedia of Forensic Science, Vol, I, II and III, Academic Press, 2000.
18. Hara, C.E.O., & Osterburg, J.W., An Introduction to Criminalistics Indiana University Press, (1972)

FS 403: CB II: IPR, ENTREPRENEURSHIP, ETHICS AND RESEARCH METHODOLOGY

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	100 Marks / 4 Credits

UNIT I: Intellectual property rights**UNIT II: Entrepreneurship****UNIT III: Ethical issues****UNIT IV: Research methodology****Course Objectives**

1. Understand the need and importance of Intellectual property rights in science and technology
2. Understand the role of entrepreneur in business and project management
3. Learn the steps involved in the project management and understand the challenges faced by entrepreneur in developing innovative methods and techniques
4. Learn about the need of ethical principles for the good laboratory practices and also to maintain the chain of custody in analysis of forensic evidences
5. Study the various types and steps involved in the research and their methods of research approach

Learning Outcomes

Students will be able to

1. Acquire knowledge about the need of IPR's and patenting their work
2. Apply the theories of entrepreneurship to develop business and also innovate the new principles and techniques
3. Know the importance of ethics in forensic investigation
4. Follow the good laboratory and manufacturing practices for the accurate results in chemical analysis
5. Identify the problem, design the research plan and process it to develop new innovations and technology useful in the day to day life

UNIT I: Intellectual property rights

Intellectual property rights: Meaning, - Evolution – Classification and forms – Rationale for protection of IPRs – Importance of IPRs in the fields of science and technology – Patents – Concepts and principles of patenting – Patentable subject matter – Procedure of obtaining patents – Rights of patents – Infringement of patent rights – Remedies for infringement of patent rights – Patentability and emerging issues

UNIT II: Entrepreneurship

Entrepreneurship : Concept – Definition – Structure – Theories of entrepreneurship – Types of Start-ups – Types of entrepreneurs – Environment – The process of entrepreneurial development – entrepreneurial culture – Entrepreneurial leadership – Product planning and development – project Management – Search for business idea – Concept of projects – project identification – Formulation – Design and network analysis – Project report and project appraisal - Basis and challenges of entrepreneurship – Innovation and Entrepreneurship in technology based organizations – Technology absorption – Networking with industries and institutions

UNIT III: Ethical issues

Ethical issues – Introduction – Causes of unethical acts – Ignorance of laws, codes, policies and procedures – Recognition – Friendship – Personal gain - Professional ethics – Professional conduct - Ethical decision making – Ethical dilemmas - Teaching ethical values to scientists – Forensic Science ethics and Personal ethics – Organizational Forensic Science Ethics – Code of ethics in Forensic Science

practice – Standards for good forensic practice - Good laboratory practices – Good manufacturing practices

UNIT IV: Research Methodology

Research methodology – Introduction – Basic research – Applied research – Need based research - Identification of the problem - Defining the problem – Research project planning – Literature search – Information sources – Library resources - Books, journals, abstracts, hand books, procedure manuals, encyclopedias, annual reports, data banks, CDROMS and online literature search – Internet access, websites and directories of information resources - Design of the experimental programme –Variables in the experiments – Materials and methods –Evolution of method –Application of the method - Progress of research – Evaluation of results – Statistical approach – Comparison with existing methodologies – Validation of findings – Research communications – Impact factors of journals

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

Suggested reading:

1. Hisrich Peters: Entrepreneurship, TMH, 2000
2. Desai Vasant: Dynamics of Entrepreneurial development and Management, Himalaya, 1997
3. HBR on Entrepreneurship, HBSP, 1999
4. Rao T. V: Entrepreneurship
5. American Academy of Forensic Sciences: Code of Ethics and Conduct, Colorado Springs, 1998
6. Chadwick, R: Concise Encyclopedia of the Ethics of New Technologies, Academic Press, 2001
7. Siegel, J. A, Saukko, P. J and Knupfer, G. C (Eds.): Encyclopedia of Forensic Sciences, Academic Press

FS 404: CB I: MOLECULAR BIOLOGY & IMMUNOLOGY

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	100 Marks / 4 Credits

UNIT I: Regulation of gene expression in Prokaryotes & Eukaryotes

UNIT II: Recombinant DNA technology

UNIT III: Introduction to Immunology

UNIT IV: Basics of Immunotechnology & Applications

Course Objectives

1. Learn about the steps involved in gene expression and need of gene regulation in prokaryotes and eukaryotes
2. Learn about the overview of the recombination DNA technology and understand the role of recombined products and organisms in day-to-day life
3. Study the basics of immunology and immunological techniques
4. Apply the molecular biology, recombinant DNA technology and immunology in solving forensic cases
5. Learn how to produce the monoclonal and poly-clonal antibodies and their role in diagnosis and treatment of various diseases and also in identification of various biological samples in forensic labs

Learning Outcomes:

Students will be able to

1. Acquire the knowledge of gene expression and need for the regulation of gene expression
2. Produce and screen the recombined molecules or organisms essential to solve various problems in the field of biology, medicine and forensics
3. Recognize the mechanisms of immune system and produce the antibodies essential for diagnosing, treating and prevention of various diseases
4. Acquire the knowledge of vaccines and their role
5. Implement the principles of immuno-technology to identify various biological samples in forensic investigation

Unit I: Regulation of gene expression in Prokaryotes & Eukaryotes

Regulation of gene expression – Regulation by operons in prokaryotes – lac operon – Catabolite repression – Attenuation – promoter flipping – Central dogma and levels of gene regulation by chromatin remodeling – Transcriptional regulation by transcription factors – Post transcriptional regulation by alternate splicing – Translational regulation – Post translational modifications to modulate gene product activity

Unit II: Recombinant DNA technology

Recombinant DNA technology – Overview of cloning – History of rDNA technology – Bacterial and eukaryotic vectors – Restriction enzymes for production recombinant DNA – Polymerases, kinase and ligase for production of recombinant DNA – Preparation of cDNA and genomic DNA libraries – Screening to select clone of interest – Over expression of cloned proteins in bacteria – Production of transgenic animals – production of transgenic plants – Silencing using RNAi

Unit III: Introduction to Immunology

Immunology – Organization of the immune system – Haematopoiesis – Production and differentiation of

the immune cells - Cells of the immune system – Primary and secondary lymphoid organs - Innate immunity – Specific acquired immunity – Active and passive immunity - Cell mediated immunity – Humoral immunity – Structure of a typical immunoglobulin - Classes of immunoglobulins – Genetics of Antibody production – Generation of Antibody diversity - Antigens and immunogens – Super antigens Auto immune disorders – Blood group antigens – Vaccines and their types

Unit IV: Basics of Immunotechnology & Applications

Immuno technology – Antigen-Antibody interaction - Precipitation and agglutination of the Ag –Ab – Mancini's Radial immunodiffusion - Ouchterlony's Double diffusion – Haemagglutination – Agglutination inhibition – Passive agglutination - Immuno electrophoresis – Rocket immuno electrophoresis – RIA – ELISA – Western blot – Complement fixation test – Inhibition of complement fixation – Direct and indirect Coomb's test - Immediate and delayed Hypersensitivity – Generation of Monoclonal antibodies – Generation of Polyclonal antibodies – Abzymes

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

Suggested reading:

1. Kindt T. J., Osborne B. A. & Goldsby R. A.: Kuby Immunology, 6th Edition, 2006
2. Roitt I: Essential Immunology, 8th edition, Blackwell, 1994
3. Nelson D. L., Cox M. M.: Lehninger's Principles of Biochemistry, Mcmillan, 2000
4. Glick B.R. & Pasternak J. J: Molecular Biotechnology – Principles and applications of recombinant DNA, asm Press, 1998
5. Watson, J. D., Baker T. A., Bell S. P., Gann A., Levine M. & Losick R: Molecular Biology of the Gene, 5th Edition, 2003
6. Alberts B, Bray D., Lewis J & Raff M: Molecular Biology of the Cell, 3rd Edition, Garland Pub., 1994
7. Brown T. A.: Gene Cloning and DNA Analysis, 6th Edition, Wiley- Blackwell, 2010

FS 404: CB II: ADVANCED INSTRUMENTAL METHODS IN FORENSIC CHEMISTRY

Instruction
Duration of University Examination
University Examination

4 Periods per week
3 Hours
100 Marks / 4 Credits

UNIT I: Stable Isotope Ratio Mass Spectrometry

UNIT II: Surface Enhanced Raman Spectroscopy

UNIT III: Chemiluminescence Methods

UNIT IV: Ion Mobility Spectrometry

Course Objectives

1. Learns the basic principles of advanced instrumentation techniques
2. Understands the techniques and instrumentation of various advance techniques
3. Studies the forensic applications of the advanced techniques
4. Learn to interpret the findings from the obtained data and report the results

Learning Outcomes:

Students will be able to

1. Apply the principles of advanced techniques to analyse and identify the samples of forensic interest
2. Interpret the results and can provide the results for solving cases
3. Stand as expert witness in proving and disproving the evidences in the court room

Unit I: Stable Isotope Ratio Mass Spectrometry

Stable Isotope Ratio Mass Spectrometry – Introduction – Basics of mass spectrometry – Gas source (Stable isotope) – Static gas (noble gas) – Solid source (Radiogenic isotope) Mass spectrometry – Multiple Collector Inductively Coupled Plasma Mass Spectrometry (MC-ICP-MS) – Moving wire Isotope Ratio Mass Spectrometry) – Accelerator Mass Spectrometry – Geological, food, biochemical, pharmaceutical and forensic applications

Unit II: Surface Enhanced Raman Spectroscopy

Surface Enhanced Raman Spectroscopy – Introduction – Historical – Basics of Raman Spectroscopy – Principle of resonance – Mechanism of Surface Enhancement – Charge Transfer – Advantages and Disadvantages of SERM – Surface Enhanced Raman Scattering – SERS Substrates – Studies of SERS / SERRS Enhancement – Single Molecule Spectroscopy - Electromagnetic theory – Chemical theory – Surfaces – Selection rules – Applications – Sensors – Drugs – Explosives – Surface Coatings – Intracellular SERS – DNA

Unit III: Chemiluminescence Methods

Chemiluminescence Methods – Introduction – Principles – Chemical reactions – Reaction kinetics and observed signal - Instrumentation – Sample and reagent introduction – Detection of emitted light – Electro generated luminescence – Techniques of qualitative and quantitative analysis - Selectivity – Chemiluminescence detection versus fluorescence detection - Corrected Emission Spectra – gas Phase Reactions – Liquid Phase Reactions – Solid Phase Reactions – Applications

Unit IV: Ion Mobility Spectrometry

Ion Mobility Spectrometry – History – Principles - Ion mobility – Instrumentation – Ionization – Analyzer – Time of flight ion mobility spectrometry – DMS – DMA – Drift gas detector – Ion traps – Hyphenated ion mobility spectrometry – GC-IMS,IMS-MS, LC- IMS, LC-IMS-MS – Applications

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

Suggested reading:

1. Skoog, D. A., Holler, J. F., and Neiman, T. A.: Principles of Instrumental Analysis, Thomson, 1997.
2. Settle, F. A.: Hand Book of Instrumental Techniques for Analytical Chemistry, Prentice Hall, 1997.
3. Townsend Allen (Ed.): Encyclopedia of Analytical Science, 2nd Edition, Academic Press, 2005
4. Gross J. H. & Roepstorff P.: Mass Spectrometry – A Text Book, 2nd Edition, Springer, 2011
5. Platzner I. T.: Modern Isotope Ratio Mass Spectrometry, J. Wiley, 1997
6. Schcker S. & kiefer W.: Surface Enhanced Raman Spectroscopy: Analytical, Biophysical and Life Science Applications, Wiley VCH, 2011
7. Aroca R.: Surface Enhanced Vibrational Spectroscopy, J. Wiley, 2006
8. Moskkovits M. & Knepp H.: Surface Enhanced raman scattering – Physics and Applications, Springer, 2010
9. Campbell A. K.: Chemiluminescence: Principles and Applications in Biology and Medicine, VCH, 1988
10. Garcia – Campana A. N. & Bayeyens W. R. G. (Eds.) : Chemiluminescence in Analytical Chemistry, Dekker 2001
11. Van Dyke K. (Ed.) : Bioluminescence and Chemiluminescence: Instrumentation and Applications, CRC Press, 1985
12. Eiceman G. A. & Karpas Z.: Ion Mobility Spectrometry, 2nd Edition, CRC Press, 2004

**PRACTICALS
SEMESTER III
FS 351: FORENSIC CHEMISTRY LAB**

Instruction	6 Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks / 3 Credits

Course Objectives

1. Detection of drugs and adulteration present in alcoholic liquors
2. Extract and identify the inorganic and organic explosives by colour test and TLC
3. Detect the NDPS drugs by colour test and TLC
4. Detect the NDPS drugs by instrumental techniques like UV spectrophotometry, GC, HPLC, FTIR and hyphenated techniques
5. Identify the trap related evidences

Learning Outcomes:

Students will be able to

1. Identify the drugs and adulteration present in alcoholic liquors
2. Isolate and identify the explosives from the explosive residues
3. Detect the drugs present in the samples
4. Acquire the knowledge of instrumentation techniques and be able to interpret the data obtained
5. Identify the trap related evidences and prove the evidence in bribe trap cases

Experiments

1. Detection of methanol, chloral hydrate and alprazolam in alcoholic liquors
2. Extraction and detection of inorganic explosive / explosion residues by spot/ colour tests
3. Extraction and detection of organic explosive / explosion residues by spot/ colour tests and TLC
4. Detection of Narcotic Drugs and Psychotropic Substances (NDPS) eg. Opiates, barbiturates, benzodiazepines, amphetamines and cannabis by spot / colour tests.
5. Detection of (NDPS) by TLC
6. Determination of a drug of forensic interest by spectrophotometry
7. Determination of a drug of forensic interest by GC
8. Determination of a drug / explosive of forensic interest by HPLC
9. GC- MS / LC- MS of a drug of forensic interest (Demo only)
10. IR spectroscopy of samples of forensic interest
11. Examination of a bribe trap case

FS 352: FORENSIC TOXICOLOGY LAB

Instruction

8 Periods per week

Duration of University Examination

6 Hours

University Examination

100 Marks / 4 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 directly on blood / urine / vomitus / tissues for heavy metals, alkaloids, pesticides, cyanide, phenolic compounds and alcohol
2. Detection and determination of ethyl alcohol in blood / urine / visceral tissue by kozelka & Hine's method
3. Detection and determination of ethyl alcohol in blood / urine / visceral tissue by gas chromatography
4. Systematic extraction of basic substances from viscera
5. Systematic extraction of neutral & acidic substances from viscera
6. Identification of basic drugs (from the extract) by colour tests and TLC
7. Identification of neutral and acidic drugs (from the extract) by colour tests and TLC
8. Identification of pesticides (from the extract) by TLC
9. Determination of a drug in urine by visible / UV spectrophotometry
10. Determination of a drug / pesticide in toxicological specimen by GC
11. Determination of a drug / pesticide in toxicological specimen by HPLC
12. GC-MS / LC-MS of a poison of forensic interest (Demo only)

SEMESTER IV
FS 451: FORENSIC SEROLOGY & DNA FINGERPRINTING LAB

Instruction
Duration of University Examination
University Examination

8 Periods per week
6 Hours
100 Marks / 4 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. Examination of blood and its stains: Chemical and crystal tests
2. Examination of semen and its stains: Chemical and crystal tests
3. Examination of saliva and its stains: Chemical and crystal tests
4. Examination of urine and its stains: Chemical and crystal tests
5. Identification of spermatozoa by differential staining method
6. Determination of Species of Origin of blood, semen and saliva by 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 – purification
10. Amplification of DNA using PCR
11. Gel electrophoresis of proteins
12. Assay of amylase
13. Assay of urease
14. Quantitative estimation of proteins

FS 452: FINGERPRINTS, IMPRESSIONS & QUESTIONED DOCUMENTS LAB

Instruction

6 Periods per week

Duration of University Examination

3 Hours

University Examination

75 Marks / 3 Credits

Course Objectives

1. Apply practical skills in fingerprint analysis, impression evidence, and questioned document examination
2. Develop expertise in collecting, processing, and analyzing fingerprint, impression, and document evidence
3. Learn to apply techniques in real-world forensic scenarios
4. Integrate practical skills with theoretical knowledge in forensic science
5. Develop critical thinking and problem-solving skills in forensic analysis

Learning Outcomes:

Students will be able to

1. Collect and process fingerprint evidence from crime scenes and analyze
2. Analyze and compare impression marks, including footwear and tire tracks
3. Examine and analyze questioned documents, including handwriting, signatures, and paper analysis
4. Apply practical skills to solve crimes and resolve legal issues, including identifying perpetrators and authenticating documents
5. Demonstrate expertise in presenting evidence in a court, including testimony & report writing

Experiments

1. To take plain and rolled inked fingerprints and to identify patterns
2. To perform ridge tracing, ridge counting and identify the ridge characteristics
3. Comparison of fingerprints
4. To develop latent fingerprints with powder, fuming and chemical methods
5. Lifting of fingerprints
6. Footprint tracing, casting and comparison
7. Bite mark casting and comparison
8. Tire print tracing, casting and comparison
9. Identification of normal / disguise writing
10. Detection of forgeries (traced, simulated and built up)
11. Examination of rubber stamps and other mechanical impressions like seals etc.
12. Examination of type scripts and printed material
13. Examination of alterations, additions, overwriting and obliterations in documents
14. Examination of erasures (mechanical and chemical)
15. Decipherment of indented writing, secret writing and charred documents
16. Examination of inks by TLC & spectrophotometry
17. Examination of security documents like currency notes, passports, stamp papers, lottery tickets etc.