



FORENSIC SCIENCE UNIT

Department of Chemistry

Osmania University

Hyderabad

**CHOICE BASED CREDIT SYSTEM
SYLLABUS
OF
M.Sc. FORENSIC SCIENCE**

(Effective from the batch admitted in 2016-2017)

FORENSIC SCIENCE UNIT
 Department of Chemistry
 Osmania University
M. Sc. (Forensic Science)
Choice Based Credit System Syllabus
 (Effective from the batch admitted in academic year 2016 -2017)

SEMESTER – I**THEORY**

Code	Paper	Hrs/week	Internal assessment	Semester Examination	Total	Credits
FS 101	Criminal Justice System & Forensic Science	4	20 marks	80 marks	100 marks	4
FS 102	Analytical Chemistry	4	20 marks	80 marks	100 marks	4
FS 103	Instrumental methods of analysis - I	4	20 marks	80 marks	100 marks	4
FS 104	Computer Basics & Cyber crime	4	20 marks	80 marks	100 marks	4

PRACTICALS

FS 151	Crime Scene Management Lab	4	-	50 marks	50 marks	2
FS 152	Analytical Chemistry Lab	6	-	75 marks	75 marks	3
FS 153	Instrumental analysis Lab	6	-	75 marks	75 marks	3
TOTAL					600 marks	24

SEMESTER – II**THEORY**

Code	Paper	Hrs/week	Internal assessment	Semester Examination	Total	Credits
FS 201	Forensic Physics & Ballistics	4	20 marks	80 marks	100 marks	4
FS 202	Instrumental methods of analysis - II	4	20 marks	80 marks	100 marks	4
FS 203	Forensic Biology & Biological techniques	4	20 marks	80 marks	100 marks	4
FS 204	Forensic Medicine	4	20 marks	80 marks	100 marks	4

PRACTICALS

FS 251	Forensic Physics Lab	6	-	75 marks	75 marks	3
FS 252	Forensic Ballistics Lab	4	-	50 marks	50 marks	2
FS 253	Forensic Biology Lab	6	-	75 marks	75 marks	3
TOTAL					600 marks	24

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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	Seminar	2	-	25 marks	25 marks	1
FS 352	Forensic Chemistry lab	6	-	75 marks	75 marks	3
FS 353	Forensic Toxicology lab	8	-	100 marks	100 marks	4
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	Seminar	2	-	25 marks	25 marks	1
FS 452	Forensic Serology & DNA Fingerprinting lab	8	-	100 marks	100 marks	4
FS 453	Fingerprints, Impressions & Questioned documents lab	6	-	75 marks	75 marks	3
TOTAL					600	24

FS 101: CRIMINAL JUSTICE SYSTEM AND FORENSIC SCIENCE

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

UNIT I

Forensic Science – Introduction – History - Organization of Forensic Science Laboratories and other allied institutions (FSL, CFSL, GEsQD, FPB etc) - Duties of Forensic Scientists - Physical evidence and Locard’s exchange principle – Classification of physical evidence - Role of Forensic Science in crime investigation - Crime scene – Types - Processing of crime Scene - Chain of custody - Probative value of physical evidence - Reconstruction of scene of crime - Investigation of crime - Modus operandi – Court Testimony – Introduction - Admissibility of expert testimony - Expert and lay witnesses - Giving testimony as an Expert

UNIT II

Sociology – Introduction – Society - Culture and socialization – Social problems in India – Social change – Sociological causes of crime – Relation of sociology to other sciences
 Criminology – Introduction – Scope of Criminology – Concept and definition of crime – Criminal behaviour - Types of crimes – Schools of Criminology – Causes of crime – Juvenile delinquency - Criminal profiling
 Penology – Theories of punishment – Types of punishments – Capital punishment – Prisons and correctional institutions – Objectives – Administration – Functioning and limitations

UNIT III

Psychology – Introduction – Scope and importance – Principles of development – Attention and perception – Process of learning – Memory and forgetting – Motivation – Attitudes – Values of emotions – Behavioural problems – Conflict and use of defense mechanisms – Various types of mental disorders – Psychology of criminal behaviour – Forensic Psychology and Psychiatry – Narcoanalysis – Polygraphy – Brain fingerprinting

UNIT IV

Criminal Justice system in India – Introduction – Administration of civil and criminal justice – Hierarchy of courts – Powers of courts – Types of courts – Lok Ayukta system
 The structure of Police organizations in India – Functions and duties of police – Investigation of crimes and prosecution – Cognizable and Non- cognizable offences - Powers of police to search, seize and arrest – Role and responsibilities of prosecution – Third degree methods - Human rights – Scientific methods of investigation
 Introduction to constitution of India – Indian penal Code - Introduction – Sections 171B, 171E, 291, 292, 293, 299, 300, 302, 304B, 308, 309, 362, 375, 376, 390, 391, 415, 420, 463, 465 - Criminal Procedure Code Introduction – Sections 291, 292, 293, 300 – Indian Evidence Act - Introduction – Sections 45, 46, 47, 57, 58, 60, 73, 135, 136, 137 and 159

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

Suggested Reading:

1. James, S. H. and Nordby, J. J.: Forensic Science: An Introduction to Scientific and Investigative Techniques, CRC Press, 2003 & 2005
2. Saferstein R.: Criminalistics – An Introduction to Forensic Science, 5th edn, Prentice Hall, 1998
3. Siegel, J. A., Sukoo, R. J, and Knupfer, G. C: Encyclopedia of Forensic Science, Vol I, II and III, Academic Press, 2000
4. John Horse well: The Practice for Crime Scene Investigation, CRC Press, 2004
5. Anthony J. Bertino: Forensic Science: Fundamentals and Investigations, Cengage Learning, 2008
6. Brown & Davenport: Forensic Science: Advanced Investigations, Cengage Learning, 2012
7. Barry A. J. Fisher, William J. Tilstone, Catherine Woytowicz: Introduction to Criminalistics: The foundation of Forensic Science, Elsevier 2009
8. Barry A. J. Fisher: Techniques of Crime Scene Investigation: Seventh edition, CRC Press, 2004
9. William G. Eckert: Introduction to Forensic Sciences: Second edition, CRC Press, 1997
10. Allan Jamieson, Andre Moenssens: Encyclopedia of Forensic Science, John Wiley & Sons Ltd., 2009
11. Bhuban Mohan, Chakravarthy: Sociology: Theory, Methodology and Concepts
12. Vidya Bhushan, Sachdeva: An Introduction to Sociology: Sixteenth Edition, Kitab Mahal, 1986
13. C. N. Shankar Rao: Sociology: Principles of Sociology with an Introduction to Social Thought: Sixth Revised Edition, S. Chand & Company Ltd., 2009
14. Sandra Walklate: Criminology: The basics, Taylor & Francis, 2005
15. Don C. Gibbons: Society, Crime and Criminal Careers: An Introduction to Criminology: Third Edition: Prentice Hall, 1973
16. Rohinton Mehta: Crime & Criminology: A Socio-Legal Analysis of the Phenomenon of Crime: First Edition, 1999
17. Bruce A. Arrigo, Stacey L. Shipley: Introduction to Forensic Psychology, Second Edition
18. Jadunath Sinha: Elementary Psychology
19. Bruce, A. A: Introduction to Forensic Psychology, Academic Press, 2000
20. Shapiro, D. L.: Forensic Psychology Assessment – An Investigative Approach, Allen & Bacon, 1991
21. Kleiner, M.: Handbook of Polygraph Testing, Academic Press, 2002
22. Turrey, B.: Criminal profiling – An Introduction to Behavioral Evidence Analysis, Academic Press, 1999
23. Paddala Rama Reddi: Criminal Major Acts
24. The Indian Evidence Act (1872), Amendment Act (2001): Universal Law Pub., 2002
25. The Code of Criminal Procedure Code (1973) Amendment Act, (2001) Universal Law Pub. Co., 2002
26. Rattan Lal and Dhiraj Lal: The Indian Penal Code, 28th edn., Wadhwa & Co., 2002.
27. Ram Ahuja: Criminology, Rewal Pub. Co., 2000
28. Meguire, M., Morgan, R and Reiner, R.: Oxford Hand Book of Criminology, 2nd edn. Biddles Ltd., 1997
29. B. R. Sharma: Forensic Science in Criminal Investigations and Trials
30. Dr. R. Thilagaraj: Human Rights and Criminal Justice Administration

FS 102: ANALYTICAL CHEMISTRY

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

UNIT I

Nature and scope of analytical chemistry – Classification of analytical methods - Conventional and instrumental methods of analysis - Theoretical principles of analytical chemistry – Law of mass action and its application – Le Chatelier and Braun principle – Van't Hoff reaction isotherm – Dissociation theory – Electrolytes and non-electrolytes – Classification of acids, bases and salts according to their degree of dissociation – Dissociation of acids, bases and salts – Dissociation constants – Common ion effect – Solubility product – Diverse ion effect – Ionization of water – pH value – pOH value - Relation between pOH & pH scale – pH scale - Salt hydrolysis – Degree of hydrolysis and hydrolysis constant – Buffer solutions - Buffer action - Calculation of pH of a buffer solution – Preparation of buffer solutions – Completeness of a chemical reaction

UNIT II

Organic reagents in detection of inorganic ions – Oxidizing and reducing agents in organic chemistry – Inorganic and organic spot tests – Micro chemical tests – Physical tests – Qualitative inorganic analysis – Group separations for cations and anions – Interfering radicals - Elemental analysis of organic compounds – Functional group analysis – Schemes of identification of unknown solids, liquids and gases (inorganic and organic) – Confirmation tests and their importance – Sensitivity and limit of detection – Alternative methods of analysis – Physical separation methods – Distillation – Extraction – Precipitation – Crystallization - Chromatographic methods

UNIT III

Volumetric / Titrimetric methods of analysis – General principle – Equivalence point and end point – Fundamental requirement of a titrimetric method – Standard solution – Detection of end point – Indirect titrations – Types of reactions – Calculations in titrimetry – Aqueous acid-base titrimetry – Acids and bases – Preparation of standard solutions – Primary standards – Indicators – Theory of indicators – Strong acid-strong base; weak acid-strong base; weak base-strong acid and weak acid-weak base titrations – Acid-base titrimetry in nonaqueous solvents – Redox titrimetry – Oxidation and reduction – Oxidant and reductant – Iodimetry and iodometry – Permanganometry – Dichromatometry – Precipitation methods – Argentometry – Complexometry – EDTA methods

UNIT IV

Gravimetric methods of analysis – Basic Digestion of precipitates – Washing of precipitates – Drying and ignition of precipitates – Thermal decomposition of precipitates – Organic precipitants – Determination of chloride, sulphate, iron, calcium and nickel as examples - Principles – Factors affecting gravimetric analysis – Requirements of quantitative separation – The process of precipitation – Saturated and supersaturated solution – Nucleation – Crystal growth – Conditions of precipitation – Completeness of precipitation – Factors influencing solubility – Purity of a precipitate – Adsorption of ions on precipitates – Co precipitation – Occlusion and post-precipitation

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

Suggested Reading:

1. Christian, Gary D: Analytical Chemistry, 6th Edn. John Wiley, 2004
2. Jeffery, G. H., Bassett, J, Mendham, J., and Denney, R. C: Text Book of Quantitative Chemical Analysis, 5th Edn., Longman, 1989
3. Svehla, G: Vogel's Qualitative Inorganic Analysis, 7th Edn., Longman, 1996
4. Verma, R. M: Analytical Chemistry, 3rd Edn, CBS Pub, New Delhi, 1994
5. Ghoshal, A., Mahapatra, B and Nad, A. K: An Advanced Course in Practical Chemistry: New Central Book Agency, Kolkata, 2000
6. Kasture, A. V., Mahadik, K. R., Wadodkar, S. G and More, H. N: Pharmaceutical Analysis Vol.I, 6th Edn., Nirali Prakshan, Pune, 2002
7. Alexeyev, V. N: Qualitative Chemical Semi micro Analysis, CBS Pub., New Delhi, 1994
8. Alexeyev, V: Quantitative Analysis, CBS Pub, New Delhi, 1994
9. Fiegel's Inorganic Spot Tests
10. Fiegel's Organic Spot Tests
11. Harris, Daniel C: Quantitative Chemical Analysis, 5th Edn., W. H. Freeman, 1998
12. Vogel, A: Qualitative Organic Analysis, 2nd Edn., CBS Pub, New Delhi, 1987
13. Vogel, A: Quantitative Organic Analysis, 2nd Edn., CBS Pub, New Delhi, 1987
14. Connors, K. A: A Text Book of Pharmaceutical Analysis, 3rd Edn., John Wiley, 1999

FS 103: INSTRUMENTAL METHODS OF ANALYSIS - I

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

UNIT I

Atomic Spectrometry – General properties of Electromagnetic Radiation – Wave and quantum mechanical properties of radiation – Optical Atomic Spectra – Principles, instrumentation, techniques and forensic applications of Atomic Absorption and Atomic Fluorescence Spectrometry – Atomic Emission Spectrometry – Atomic Mass Spectrometry - Atomic X-Ray Spectrometry

UNIT II

Molecular Spectroscopy – Introduction to UV-Visible Molecular Absorption Spectrometry – Measurement of Transmittance and Absorbance – Beer’s Law – Instrumentation of UV- Visible Molecular Absorption Spectrometry – Molar Absorptivities – Absorbing Species – Application to Qualitative Analysis – Quantitative Analysis – Photometric Titrations – Photo acoustic Spectroscopy – Molecular Luminescence Spectrometry – Theory of Fluorescence and Phosphorescence – Instrumentation for Fluorescence and Phosphorescence Measurements – Applications of Photoluminescence methods – Chemiluminescence

UNIT III

Infrared Spectrometry – Theory – Infrared Sources and Transducers – Instrumentation –Dispersive and FT instruments - Techniques and Applications – Mid IR Absorption, Mid IR Reflection and Photo acoustic IR Spectrometry – Near and Far IR Spectrometry – IR Micro spectrometry – Forensic Applications of IR Spectrometric methods

Raman Spectroscopy – Principles – Instrumentation – Techniques - Applications

Nuclear Magnetic Resonance Spectrometry – Principles, Instrumentation, Techniques (Proton NMR, Carbon13 NMR, FT- NMR, Magnetic Resonance Imaging) and Forensic Applications

UNIT IV

Electrochemical techniques – Introduction – Principles, instrumentation, techniques and applications of potentiometry, coulometry, polarography and ion selective electrodes

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

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

X-Ray diffractometry – Principle, instrumentation, techniques and applications

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

Suggested Reading:

1. Atkins, P. W.: Physical Chemistry, 6th edn., Oxford University Press, 1998
2. Fifield, F. W. and Kealy, D.: Principles and practice of Analytical Chemistry, 5th edn,

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

FS 104: COMPUTER BASICS AND CYBER CRIME

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

UNIT I

Introduction to computers – Applications of computers in science, engineering, technology and communication – Applications of computers in forensic science
 The computer system and CPU – Types of computers (Corporate, departmental, desk top, lap top & personal computers) – The foundations of modern information technology – Binary numbers, digital signals, Moore’s law, bits & bytes, the binary code, CPU, the microprocessor, the part of progress – Memory – ROM and RAM - Virtual memory – Caches – Buffers – Machine cycle – Registers – Buses for input and output – Adapter cards and multimedia systems – Computer ports – USC and fire wire input and output devices – Key board – Mouse – OCR bar codes – Speech recognition graphics – Scanners – Photoshop – Digitalizing photos and video pointing devices – Pixels and resolution fonts – Range of colour display screens – Types of resolution printers (Laser, dot matrix and ink jet, photo, colour & thermal) – Concepts of hard ware and soft ware

UNIT II

Secondary storage devices – Storage devices and media – Storage characteristics – Tracks and sectors – Storage media – Floppy disks, HDD, optical discs, CDs, pen drives – Increasing data storage capacity – Back up smart card – The software – Introduction – OS – Application programme user interface – OS types - File management – Utilities – Document centric computing – Object linking and embedding (ole) - Major software issues – Network computing – Windows – Word processing – Desk top publishing – Power point presentation – Entering and editing documents – Formatting documents – Spread sheet and data base applications – Internet browsing

UNIT III

Introduction to Cyber Forensics – Storage fundamentals – File systems concepts – Data recovery – Cyber Forensic Investigation – Investigation tools – eDiscovery – Digital evidence collection – Evidence presentation – E-mail investigation – E-mail tracking – IP tracking – E-mail recovery – Encryption and decryption methods – Search and seizure of computers – Recovering deleted evidence – Password cracking – Formatted partition recovery – Data recovery tools – Data recovery procedures and ethics - Preservation and safe handling of the original media – Chain of custody.

UNIT IV

Complete time line analysis of computer files based on file creation – File modification and file access – Recovery of internet usage data – Recovery of swap files / temporary files / cache files – Introduction to encase Forensic Edition – Forensic Tool Kit
 Internet – Hacking – Cracking – Viruses – Virus attacks - Mail Bombs – Bug Exploits – Pornography – Software piracy – Intellectual property – Legal systems of Information Technology – Cyber crime laws – IT laws

Cyber security – Implementing hardware based security – Software based Fire walls – Security standards – Assessing threat levels – Forming an incident response team – Reporting cyber crime – Operating system attacks – Application attacks – Reverse Engineering – Cracking techniques – Financial frauds – Forensic accounting

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

FS 201: FORENSIC PHYSICS & BALLISTICS

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

UNIT I

Glass: Types of glass and their composition - Forensic examination of glass fractures under different conditions - Determination of direction of impact: cone – Fracture, rib marks, hackle marks, backward fragmentation - Color and fluorescence - Physical matching - Density comparison - Physical measurements - Refractive index by refractometer - Elemental analysis - Interpretation of glass evidence
 Soil: Formation and types of soil - Composition and color of soil - Particle size distribution - Turbidity test - Microscopic examination - Density gradient analysis - Ignition loss - Differential thermal analysis - Elemental analysis - Interpretation of soil evidence - Discussion on important case studies of glass and soil

UNIT II

Paint: Types of paint and their composition - Macroscopic and microscopic studies - Pigment distribution - Micro-chemical analysis – Solubility test, pyrolysis chromatographic techniques, TLC, UV-Vis and IR spectrophotometric and X-Ray diffractometric methods - Elemental analysis - Interpretation of paint evidence

Tool Marks: Types of tool marks - Class characteristics and individual characteristics - Tracing and lifting of marks - Photographic examination of tool marks and cut marks on clothes and walls, etc. - Restoration of erased/ obliterated marks - Method of marking - Methods of obliteration - Method of restoration - Recording of restored marks – Restoration of marks on wood, leather, polymer, etc.

Elements of Forensic Engineering: Building materials - Cement and its composition – Determination of adulteration in cement – Reinforced Cement Concrete – Bitumen and road tar - Examination of electrical appliances and installations

UNIT III

Introduction – History and background of firearms – Classification of fire arms based on various parameters – Techniques of dismantling / assembling of fire arms – Identification of origin – Improved / country made / imitative fire arms and their constructional features – Ammunition and their components - Types of ammunition – Classification and construction features of different types of cartridges – Types of primers, priming compositions – Propellants and their compositions – Velocity and pressure characteristics – Various types of bullets and compositional aspects – Identification of origin – Improved ammunition and safety aspects of handling fire arms and ammunitions

Internal and external ballistics – Introduction – Direction of fire – Time of fire – Range of fire – Projectile velocity determination – Theory of recoil – Trajectory determination – Terminal ballistics – Effect of projectile on hitting the target – Function of bullet shape – Striking velocity, striking angle – Tumbling bullets – Cavitations – Ricochet and its effects – Wound ballistics – Threshold velocity for penetration of skin, flesh, bones – Nature of wounds of entry, exit – Explosive wounds - Evaluation of injuries caused due to shot gun, rifle, handguns and country made firearms – Methods of measurement of wound ballistic parameters – Post mortem and anti-mortem firearm injuries

UNIT IV

Principles and practice of identification of firearms - Different types of marks produced during firing process on cartridge and on bullet - Techniques for obtaining test material from various types of weapons and their linkage with fired ammunition - Class and individual characteristics - Determination of range of fire - Time of firing – Different methods employed and their limitations - Stereo and comparison microscopy - Automatic bullet and cartridge comparison system - Analysis of Gunshot Residues – Mechanism of formation of GSR - Source and collection - Spot tests, chemical tests - Identification of shooter - Instrumental methods of GSR analysis - Management and reconstruction of crime scene - Suicide, murder and accidental and self-defense cases - Arms act - Report writing and court testimony

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

Suggested Reading:

1. Saferstein, R., Criminalistics. An Introduction to Forensic Science, 5th ed., Prentice Hall, 1998
2. Saferstein, R., Handbook of Forensic Science (Vol. 1,2,3)
3. Kirk, P.: Criminal Investigation, Interscience, 1953
4. James, S. H. and Nordby, J. J.: Forensic Science: An Introduction to Scientific and Investigative Techniques, CRC Press, 2003 & 2005
5. Siegel, J. A., Sukoo, R. J, and Knupfer, G. C: Encyclopedia of Forensic Science, Vol, I, II and III, Academic Press, 2000
6. Hara, C.E.O., & Osterburg, J.W., An Introduction to Criminalistics Indiana University Press, (1972)
7. Working Procedure Manual: Physics, BPR&D Publication (2000)
8. Caddy, B., Forensic Examination of Glass & Paints. Analysis and Interpretation ISBN (2001)
9. Mathews, H.J., & Thomas, C.C., Firearms Identification (Vol1,2,3) , Springfield, (1973)
10. Hatcher, Jury & Weller, Firearms Investigation, Identification and Evidence, Stackpole Books, (1977)
11. Heard, B.J., Handbook of Firearms and Ballistics, John Wiley & Sons, (1997)
12. Warlow, T.A. , Firearms: The Law and Forensic Ballistics, Taylor & Francis , (1996)
13. Johari, M., Identification of Firearms, Ammunition and Firearm Injuries; BPR&D, (1980)
14. Sellier, K.G. et.al., Wound ballistics and The Scientific Background, Elsevier, (1994)
15. Jahne, B., Digital Image Processing, Heidelberg Springer (1996)
16. Jacobson, B.H.E., Sidney, R.G., Attridge, G., The Manual of Photography, focal Press, (1998)
17. Horeustein, H., Colour Photography; A Working Manual, Little Brown Company, (1995)
18. Red Sicker, D. R., The Practical Methodology of Forensic Photography, CRC Press, (1994)
19. Brain J. H., Hand Book of Fire arms and Ballistics, John Wiley
20. Sharma B. R., Fire arms in Criminal Investigation and Trials, 3rd Edn. Universal (2002)
21. Kumar K., Forensic Ballistics in Criminal Justice, Eastern Book Co (1987)

FS 202: Instrumental Methods of Analysis - II

Instruction:

4 Periods per week

Duration of University Examination:

3 Hours

University Examination:

100 Marks / 4 Credits

UNIT I

Molecular Mass Spectrometry – Molecular mass spectra – Ion sources – Mass spectrometers – Interpretation of mass spectra – Applications of mass spectrometry – Atomic mass spectrometry – Mass spectrometers – Inductively coupled plasma-Mass spectrometry – Applications
SEM – EDX Microanalysis – Principles – Instrumentation – Technique - Applications

UNIT II

Chromatographic Techniques – Introduction – History of Chromatography - Theoretical principles of Chromatography – Classification of Chromatographic Methods – Adsorption and Partition Chromatography - Principles, instrumentation, techniques and applications of Thin Layer and High Performance Thin Layer Chromatography - Method Development in Planar Chromatography - Gas Chromatography – Instrumentation – Detectors - Adsorption, Partition, Gas-Solid, Gas-Liquid, Isothermal, Linear Temperature Programming, Chiral, Pyrolysis and Derivatization Chromatography - Columns and Stationary Phases – Column Efficiency – Method Development - Forensic Applications of Gas Chromatography

UNIT III

High Performance Liquid Chromatography – Instrumentation - Detectors – Columns and Stationary Phases - Isocratic, Gradient, Adsorption, Partition, Ion and Derivatization Chromatography – Method Development – Applications of Liquid Chromatography - Super Critical Fluid Chromatography – Properties of Super Critical Fluids – Instrumentation – Columns – Detectors – Applications – Capillary electrophoresis – Principles, instrumentation, technique and applications

UNIT IV

Unit Measurements, signals and data – Introduction – Signal to noise ratio – Sensitivity and detection limit, sources of noise – Evaluation and measurement – Accuracy and instrument calibration
Hyphenated techniques – Principle, instrumentation, techniques and applications of GC-FTIR, GC-MS, LC-MS, CE-MS and MS-MS.

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

Suggested Reading:

1. Skoog, D. A., Holler, J. F., and Neiman, T. A.: Principles of Instrumental Analysis, Thomson, 1997.
2. Willard, H. H., Merritt, L.L. Jr., Dean, J. A. and Settle, F. A. Jr.: Instrumental Methods of Analysis, 7th edn., Wadsworth, 1998
3. Kealey, D. and Haines, P. J.: Analytical Chemistry, Bios Scientific / Viva Books, 2002.

4. Settle, F. A.: Hand Book of Instrumental Techniques for Analytical Chemistry, Prentice Hall, 1997.
5. Harris, D. C.: Quantitative Chemical Analysis, 5th edn., Freeman, 1999
6. Christian, G. D.: Analytical Chemistry, Theory and Applications, John Wiley, 2004
7. Chatwal, G. R. and Anand, S.: Instrumental Methods of Chemical Analysis
8. Sharma, B. K.: Instrumental Methods of Chemical Analysis
9. Gowenlock, A. H.: Practical Clinical Biochemistry, 6th edn., Butterworth / CBS, 1988
10. Townsends Allen (ed.): Encyclopedia of Analytical Science, Academic Press, 1995
11. Sane, R. T and Joshi, A. P: Electroanalytical Instruction
12. Goldsby, R. A., Kindt, T. J., Osborne, B. A and Kuby, J: Immunology, 5th Edn., Freeman, 2003.
13. Murray, R. K., Granner, D. K., Mayes, P. A and Rodsell, V. W: Harper's Biochemistry, 25th Edn., McGraw-Hill, 2000.
14. Gowenlock, A. H., Mc Murray and J. R, McLauchla, D. M: Varley's Practical Clinical Biochemistry, CBS Pub., 1996
15. Mukherjee, K. L (Ch. Ed): Medical Laboratory Technology, Vol I & II, Tata McGraw-Hill, 1988.
16. Gerstein, A.S (Ed): Molecular Biology - Problem Solver – A Laboratory Guide, Wiley-Liss, 2001

FS 203: FORENSIC BIOLOGY & BIOLOGICAL TECHNIQUES

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

UNIT-I

Forensic Biology - Introduction – Scope - Various forms of biological evidences like wood, timber varieties, seeds and leaves - Their identification and matching
 Forensic Botany - Toxic principles of plants and their forensic significance - Identification of poisonous plants and mushrooms of India
 Diatoms - Types – Morphology - Methods of isolation from tissues and bones - Forensic significance in drowning cases - Study and identification of pollen grains - Identification of starch grains, powder, stains of spices - Paper pulp identification - Isolation and identification of microbial organisms

UNIT II

Forensic Anthropology – History - Scope and development - Role of forensic anthropologist - Collection and preservation of evidences - Human osteology - Determination of age, sex, stature- Determination of personal identity by superimposition technique - Video image analysis - Facial reconstruction - Legal provisions and tools involved in it - Pathology of bones and its importance in identification - Identification of burnt bones, skeletal remains in accidents, crimes and mass disaster
 Forensic Odontology: Introduction - Structure and types of teeth - Dentition and dental formula - Dental diseases - Determination of age, sex and race from teeth - Role of teeth in mass disaster – Forensic significance in identification

UNIT III

Hair Examination – Introduction - Structure of hair - Growth and chemistry of hair - Identification and comparison of hair by microscopic – Chemical - Biochemical and instrumental methods - Identification of animal hair - Assessment of age, sex, race and site of hair - Analysis of drugs and elements in hair - Hair diseases - Hair transfer, persistence and recovery - DNA typing of hair
 Fibre Examination – Introduction - Classification of fibres - Identification and comparison of fibres by physical - Chemical – Microscopic – Spectroscopic - Chromatographic methods - Persistence and recovery of fibres - Forensic significance
 Forensic Entomology: Introduction - Analyzing crime scene for entomological evidence - Collection of climatological data and specimen before body removal - Common arthropod found on the dead body - Determination of time of death - Entomological succession in case of buried, drowned and buried bodies

UNIT IV

Wild Life Forensics: Introduction - Importance of wild life - Wild life Protection Act - Endangered species – CITES - Census of wildlife population - Wild life crime - Methods of smuggling and poaching of wild life artifacts - Crime scene search - Criminal investigation - Determination of time of death - Sex

determination from bones - Identification of teeth, claws, Ivory, Horns, antlers, furs, skin, bite marks, pug marks - Identification of blood, excreta and bones by biochemical and immunological methods
 Microscopy – Basic principles and applications of: Simple and Compound Microscope – Comparison Microscope, Phase Contrast Microscope, Stereo Microscope, Polarizing Microscope, Fluorescent Microscope, Infra red Microscope, Scanning Electron Microscope and Transmission Electron Microscope

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

Suggested Readings:

1. Robertson, J., ed: Forensic Examination of Fibres. Chichester, West Sussex, England: Ellis Horwood Ltd., (1992)
2. Saferstein, Richard: Criminalistics. An Introduction to Forensic Science, 5th ed., Prentice Hall, 1998
3. Robertson, J: Forensic Examination of Hair. Taylor and Francis. (1999)
4. Saferstein, R: Handbook of Forensic Science (Vol 1,2,3),
5. Eckert: An Introduction to Forensic Science
6. Kirk, P: Criminal Investigation, Interscience, 1953
7. James, S. H. and Nordby, J. J: Forensic Science: An Introduction to Scientific and Investigative Techniques, CRC Press, 2003 & 2005
8. Siegel, J. A., Sukoo, R. J, and Knupfer, G. C: Encyclopedia of Forensic Science, Vol I, II and III, Academic Press, 2000.
9. Becker, R. F: Criminal Investigation, Aspen Pub., 2000.
10. Lee, H: Physical Evidence, Elsevier, 2000
11. The Wild Life Protection Act, 1972., Universal Law Publishing
12. Pillay, V.V: Handbook of Forensic Medicine and Toxicology, 12th ed., Paras Publication 2001.
13. Smith, D.G.V: A Manual of Forensic Entomology and Death: A Procedural Guide, Joyce's Publications (1990)
14. Byrd, J.H. & Castner, J, L: Forensic Entomology - The Utility of Arthropods in Legal Investigation, CRC Press, (2000)
15. Biology Methods Manual, Metropolitan Police Forensic Science Laboratory, London, (1978)
16. Castner James L (Ed.), Forensic Entomology, CRC Press (2006)
17. Richard Li, Forensic Biology, CRC Press, 2008
18. Gunn Allen, Essentials of Forensic Biology; Animals, Plants & Microorganisms in Legal Investigations, J. Wiley (2006)
19. Coyle H. M. (Ed.), Forensic Botany – Principles and Applications to Criminal Case Work, CRC Press (2002)

FS 204: FORENSIC MEDICINE

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

UNIT I

Human anatomy and physiology - Structural levels of organization of human body - Cardiovascular system - Structure and Functions of heart - Arterial & Venous system - Digestive system and its parts - Process of digestion and absorption of food in the alimentary canal - Respiratory system and its parts - Mechanism and regulation of respiration - Nervous system – Structure and functions of neuron – Transmission of nerve impulse - Central and Peripheral Nervous systems and their functions - Endocrine system - Characteristics of hormones - Endocrine glands and their hormones - Urinogenital system - Structure and functions of kidneys - Formation and composition of urine - Male and female reproductive systems and their functions

UNIT II

Forensic Medicine – Personal identification of living and dead – Postmortem examination (autopsy) – Medico legal aspects of death – Causes of death - Postmortem changes and their importance in determination of time after death - Mechanical injuries – Thermal injuries – Medico legal aspects of injuries

UNIT III

Forensic pathology – Preservation of pathological evidence - Examination of decomposed, mutilated and burnt bodies – Exhumation procedure - Deaths from poisoning – Mechanical Asphyxia – Drowning - Starvation - Lightning – Electrocution

UNIT IV

Sexual offences – Rape – Unnatural sexual offences and medicolegal aspects - Abortion & Infanticide – Medico legal aspects – Impotence and sterility – Virginity, Pregnancy and Delivery - Medicolegal aspects - MPT Act - Linkage with forensic science laboratory

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

Suggested Readings:

1. Pillay, V.V., Handbook of Forensic Medicine and Toxicology , 12th ed., Paras Publication 2001.
2. Modi, J. P., Textbook of Medical Jurisprudence & Toxicology , M.M. Tripathi Publication, (2001)
3. Parikh, C.K. , Textbook of Medical Jurisprudence & Toxicology
4. Reddy Narayn,. M., Textbook of Medical Jurisprudence & Toxicology
5. James, P.J.: Encyclopedia of Forensic and Legal Medicine, Elsevier, 2005

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 - 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

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, Trap related evidence materials, Paints, Oils fats, Greases, Industrial dusts

UNIT III

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 - Designers 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, Psylocybin, Mescaline and MDMA - Drugs and Cosmetic Act, Excise Act, NDPS Act

UNIT IV

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

UNIT I

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

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

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- 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, 5thed, McGraw-Hill, 1995.
2. Moffat, A.C. : Osselton, D. M. Widdop, B. : Clarke's Analysis of Drugs and Poisons in Pharmaceuticals, body fluids and postmortem material, 3rd ed., Pharmaceutical Press 2004.

3. 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 Presss 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

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

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

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

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 – Isotachophoresis – 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

UNIT I

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- 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: 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- 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 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 – 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: 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 – Planning – Written safety plan – Safety policies – Safety resources – Operations - Hazards of chemicals, solvents, poisons and explosives – Storage facilities – Biological hazards - Pressure vessels and their 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

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

Concept of probability – Definitions of probability – Discrete random variables and probability distributions -Addition, multiplication and Bayer’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

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

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- 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: 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- Hbf – Hbs – Hbc – HbA - Determination of sex and race from blood- White blood group system HLA and its forensic significance.

UNIT III

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- 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. Eppel 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)
14. Gaensslen, R.E. , Sourcebook in Forensic Serology, Immunology and Biochemistry, US Govt. Printing Press, (1983)
15. Lydyard, P.M., Whelan, A.& Fanger, M.W., Instant Notes in Immunology, 1st ed, Viva Books Pvt. Ltd. (2000)
16. Kuby, Immunology
17. 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)
18. Winter, P.C., Hickey,G.I.,& Fletcher, H.L., Instant Notes in Genetics, Viva Books Pvt. Ltd. (1999)
19. Rashidi, H.H.& Buehler, L.K. Bioinformatics Basics: Applications in Biological Sciences and Medicine, CRC Press, (2000)
20. 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)
21. Misner, S and Krawetz, S. A: Bioinformatics – Methods and Protocols, Humana Press, 2000.
22. Butler John M : Forensic DNA Typing, 2nd Edn.

FS 402: FINGERPRINTS AND IMPRESSIONS

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

UNIT I

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- 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- 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- 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

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

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

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

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: 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 : 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 – 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 – 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, 2000

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 – 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 – 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

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

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

Unit I

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 – 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 – 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 – 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**FS 151: CRIME SCENE MANAGAMENT LAB**

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

1. Sketching of Outdoor crime scene
2. Sketching of Indoor crime scene
3. Photography of crime scene
4. Collection and packing of physical evidence at the scene of crime
5. Forwarding of physical evidence
6. Reconstruction and evaluation of indoor crime scene
7. Reconstruction and evaluation of outdoor crime scene
8. Physical evidence and Locard's principle
9. Polygraphy (Demonstration only)

FS 152: ANALYTICAL CHEMISTRY LAB

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

1. Qualitative analysis of Lead, Arsenic, Chromium, Zinc, Selenium, Thallium, Cyanide, Thiocyanate, Phosphate, Chlorate, Perchlorate ions in compounds
2. Detection of non nitrogenous and nitrogenous functional groups in organic compounds
3. Partition coefficient of benzoic acid between benzene and water
4. Determination of sodium carbonate and sodium bicarbonate in a mixture with standard HCl
5. Determination of purity of potassium /sodium nitrite by permanganometry
6. Estimation of ferric iron in ferric alum by dichromatometry
7. Estimation of lead by iodimetry
8. Estimation of calcium and magnesium by EDTA complexometry
9. Preparation of buffer mixtures and measurement of pH
10. Study of hydrolysis of an ester catalysed by an acid

FS 153: INSTRUMENTAL METHODS OF ANALYSIS LAB

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

1. Verification of Beer's law and calculation of molar absorption coefficients for CuSO₄
2. Verification of Beer's law and calculation of molar absorption coefficients for KMnO₄
3. Conductometric titration of strong acid vs. strong base
4. Conductometric titration of weak acid vs. strong base
5. Conductometric titration of mixture of acids vs. strong base
6. Potentiometric titration of strong acid vs. strong base
7. Potentiometric titration of weak acid vs. strong base
8. Potentiometric redox titration of potassium dichromate-ferric ammonium sulphate
9. Separation of amino acids by Paper chromatography
10. Paper electrophoresis for separation of amino acids
11. Agarose gel electrophoresis for separation of proteins

FS 251: FORENSIC PHYSICS LAB

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

1. Examination of glass fractures
2. Determination of refractive indices of glass & liquids
3. Physical examination of soil for colour, moisture, organic matter, pH, presence of anthropogenic material and presence of biological material
4. Determination of particle size distribution of soils
5. Soil comparison by density gradient method
6. Examination of paint samples by microscopy
7. TLC and spectrophotometric comparison of paint evidence
8. Examination of counterfeit currency
9. Comparison of tool marks
10. Restoration of erased identification marks from metal surfaces

FS 252: FORENSIC BALLISTICS LAB

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

1. Characteristics of Firearms – Calibre, Choke, Trigger pull, Proof marks etc.
2. Examination and Comparison of fired bullets – Calibre, rifling characteristics, probable type of firearms
3. Examination and Comparison of fired Cartridges/cases (Calibre, firing pin, breech face, Extractor / Ejector marks etc.)
4. Determination of shot number from size and weight of shots
5. Identification of propellants
6. Chemical tests for powder residues (Walker’s test) and Barrel wash
7. Examination of air guns / rifles as per Arms Act 1959

FS 253: FORENSIC BIOLOGY LAB

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

1. Study of human skeletal system
2. Determination of age from skull
3. Determination of age from teeth
4. Determination of sex from skull
5. Determination of sex from pelvic girdle
6. Estimation of stature from long bones
7. Isolation and Identification of diatoms
8. Isolation and Identification of pollen grains
9. Identification of starch granules
10. Microscopic and chemical comparison of paper pulp
11. Morphological & Microscopic characteristics of plant material (Datura, Cannabis, Nerium, etc.)
12. Morphological & Microscopic Examination of human and animal hairs
13. Morphological / Microscopic Examination of natural and synthetic fibres

FS 352: FORENSIC CHEMISTRY LAB

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

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 353: FORENSIC TOXICOLOGY LAB

Instruction	8 Periods per week
Duration of University Examination	6 Hours
University Examination	100 Marks / 4 Credits

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)

FS 452: FORENSIC SEROLOGY & DNA FINGERPRINTING LAB

Instruction 8 Periods per week
 Duration of University Examination 6 Hours
 University Examination 100 Marks / 4 Credits

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 453: FINGERPRINTS, IMPRESSIONS & QUESTIONED DOCUMENTS LAB

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

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.
