OSMANIA UNIVERSITY, HYDERABAD

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FORENSIC SCIENCE Department of Chemistry

Osmania University Hyderabad

FACULTY OF SCIENCE

CHOICE BASED CREDIT SYSTEM

SYLLABUS

OF

M.Sc. FORENSIC SCIENCE

SEM I & II

(Effective from the batch admitted in 2016-2017)

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

SEMESTER – I									
THEORY									
Code	Paper	Hrs/week	Internal	Semester	Total	Credits			
			assessment	Examination					
FS 101	Criminal Justice System & Forensic	4	20 marks	80 marks	100 marks	4			
	Science								
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	Semester	Total	Credits			
			assessment	Examination					
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	4	20 marks	80 marks	100 marks	4			
	techniques								
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			

FS 101: CRIMINAL JUSTICE SYSTEM AND FORENSIC SCIENCE

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

UNIT I: Introduction to Forensic Science and criminal investigation UNIT II: Sociology, Criminology and Penology UNIT III: Forensic Psychology UNIT IV: Criminal justice system and Law

Course Objectives:

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

Learning Outcomes:

Students will be able to

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

UNIT I: Introduction to Forensic Science and criminal investigation

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, Criminology and Penology

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: Forensic Psychology

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 and Law

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

 Saferstein R.: Criminalistics – An Introduction to Forensic Science, 5th edn, Prentice Hall, 1998
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, 20049. 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 Duration of University Examination University Examination 4 Periods per week 3 Hours 100 Marks / 4 Credits

UNIT I: Introduction to Analytical Chemistry UNIT II: Inorganic and organic analysis UNIT III: Volumetric Analysis UNIT IV: Gravimetric Analysis

Course Objectives:

1. Understand the principles and concepts of Analytical Chemistry

2. Explain various classical and modern analytical techniques used in qualitative and quantitative analysis

- 3. Develop problem solving skills through application of analytical methods to real world scenarios
- 4. Teach students to accurately interpret and analyze analytical data
- 5. Improve students' ability to communicate scientific results

Learning Outcomes:

Students will be able to

- 1. Explain core principles and theories of Analytical Chemistry
- 2. Perform inorganic and organic analysis of chemical compounds
- 3. Understand the concept of volumetric and gravimetric analysis
- 4. Apply analytical methods to solve chemical problems in diverse contexts
- 5. Conduct laboratory experiments proficiently and communicate scientific results

UNIT I: Introduction to Analytical Chemistry

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: Elemental analysis of inorganic and organic ions

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 Analysis

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 non-aqueous solvents – Redox titrimetry – Oxidation and reduction – Oxidant and reductant – Iodimetry and iodometry – Permanganometry – Dichromatometry – Precipitation methods – Argentometry – Complexometry – EDTA methods

UNIT IV: Gravimetric Analysis

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:

 Christian, Gary D: Analytical Chemistry, 6th Edn. John Wiley, 2004
Jeffery, G. H., Bassett, J, Mendham, J., and Denney, R. C: Text Book of Quantitative Chemical Analysis, 5th Edn., Longman, 1989
Svehla, G: Vogel's Qualitative Inorganic Analysis, 7th Edn., Longman, 1996
Verma, R. M: Analytical Chemistry, 3rd Edn, CBS Pub, New Delhi, 1994
Ghoshal, A., Mahapatra, B and Nad, A. K: An Advanced Course in Practical Chemistry: New Central Book Agency, Kolkata, 2000
Kasture, A. V., Mahadik, K. R., Wadodkar, S. G and More, H. N: Pharmaceutical Analysis Vol.I,
Edn., Nirali Prakshan, Pune, 2002
Alexeyev, V. N: Qualitative Chemical Semi micro Analysis, CBS Pub., New Delhi, 1994

FS 103: INSTRUMENTAL METHODS OF ANALYSIS - I

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

UNIT I: Atomic Spectroscopy UNIT II: Molecular Spectroscopy UNIT III: IR spectroscopy, NMR spectroscopy and Raman spectroscopy UNIT IV: Electrochemical and Other instrumental methods

Course Objectives:

1. Understand the principles and theory underlying modern analytical instrumentation

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

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

- 4. Teach students interpretation and analysis of data obtained from instrumental techniques
- 5. Improve students' ability to effectively communicate scientific results

Learning Outcomes:

Students will be able to

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

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

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

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

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

UNIT I: Atomic Spectroscopy

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

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: IR spectroscopy, NMR spectroscopy and Raman spectroscopy

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 and Other instrumental methods

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. 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. Ha ines, 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 Kuby, J: Immunology, 5th Edn., Freeman, 2003.

FS 104: COMPUTER BASICS AND CYBER CRIME

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

UNIT I: Introduction to computers UNIT II: Basics of operating system and networking UNIT III: Introduction to cyber forensics UNIT IV: Cyber law and cyber security

Course Objectives:

1. Understand computer fundamentals, basics of computer systems, networks, and digital storage devices

- 2. Analyze various types of cybercrimes, including hacking, phishing, and digital forgery
- 3. Learn techniques for collecting, analyzing, and preserving digital evidence
- 4. Apply forensic tools and software for digital evidence analysis
- 5. Understand relevant laws and regulations related to cybercrime and digital evidence

Learning Outcomes:

Students will be able to

- 1. Explain computer hardware and software and describe network fundamentals and protocols
- 2. Recognize types of cybercrimes and their characteristics and analyze cybercrime case studies
- 3. Handle digital evidence and apply techniques for collecting and preserving digital evidence
- 4. Analyze forensic tools and software for digital evidence analysis and interpret results
- 5. Apply laws related to cybercrime and understand ethical considerations in digital evidence analysis

UNIT I: Introduction to computers

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: Basics of operating system and networking

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 –MS word, MS PowerPoint and MS sheet and data base applications – Internet browsing

UNIT III: Introduction to cyber forensics

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: Cyber law and cyber security

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 – Cybercrime laws – IT laws

Cyber security – Implementing hardware based security – Software based Fire walls – Security standards – Assessing threat levels – Forming an incident response team – Reporting cybercrime – 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 Duration of University Examination University Examination 4 Periods per week 3 Hours 100 Marks / 4 Credits

UNIT I: Forensic examination of glass and soil

UNIT II: Forensic examination of tool marks, paint and Forensic engineering UNIT III: Introduction to forensic ballistics UNIT IV: Analysis of the GSR and examination of fired bullets and cartridges

Course Objectives:

1. Understand the examination of physical evidences recovered from crime scene

- 2. Apply the principles of engineering in failure investigations
- 3. Identify the various firearms, understand their firing and action mechanisms and ammunition
- 4. Understand external, internal, terminal and wound ballistics
- 5. Reconstruct the shooting incident and apply the principles of ballistics in crime investigation

Learning Outcomes:

Students will be able to

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

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

- 3. Distinguish standard firearms from local made firearms, identify their firing mechanism
- 4. Collect and analyze GSR useful in identification of shooter and crime weapon
- 5. Conduct test firing, reconstruct the shooting incident and will be able to present an expert testimony in the court of law

UNIT I: Forensic examination of Glass and soil

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: Forensic examination of tool marks, paint and Forensic engineering

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 to forensic ballistics

Introduction – History and background of firearms – Classification of fire arms based on various parameters – Techniques of dismantling / assembling of fire arms – Identification of origin – Improvised / 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 – Improvised 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: Analysis of the GSR and examination of fired bullets and cartridges

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

UNIT I: Molecular Mass Spectrometry and SEM-EDX UNIT II: Chromatographic Techniques UNIT III: HPLC and Capillary electrophoresis UNIT IV: Hyphenated techniques

Course Objectives:

1. Understand principles and applications of instrumental methods of analysis in forensic science

2. Develop skills in operating and maintaining complex instrumental techniques, including mass spectrometry, chromatographic techniques and hyphenated techniques

3. Apply advanced instrumental methods to analyze and identify complex forensic evidence, including biological fluids, explosives, and toxicants

4. Understand the principles of method development, validation, and optimization for complex forensic evidence analysis

5. Interpret and report results of advanced instrumental analysis in a clear and concise manner

Learning Outcomes:

Students will be able to

- 1. Understand the principle and working of Molecular Mass spectrometry and SEM-EDX
- 2. Explain the basic principle, types of chromatographic methods, advantages and their limitations
- 3. Learn the principle and working of various hyphenated techniques
- 4. Apply the instrumental methods for analysis of various evidences in forensic context
- 5. Analyze and interpret the instrumental data for solving real time forensic cases

UNIT I: Molecular Mass Spectrometry and SEM-EDX

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: Introduction to Chromatographic Techniques, Thin layer Chromatography and GC

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: HPLC and Capillary electrophoresis

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: Hyphenated techniques

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. Effective from 2016-2017

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

 Mukherjee, K. L (Ch. Ed): Medical Laboratory Technology, Vol I & II, Tata McGraw-Hill, 1988.
Gerstein, A.S (Ed): Molecular Biology - Problem Solver – A Laboratory Guide, Wiley-Liss, 2001

FS 203: FORENSIC BIOLOGY & BIOLOGICAL TECHNIQUES

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

UNIT I: Forensic Biology and Botany UNIT II: Forensic Anthropology and Forensic Odontology UNIT III: Examination of Hair and Fibre, Forensic Entomology UNIT IV: Wildlife Forensic and Microscopy

Course Objectives:

- 1. Understand the principles and concepts of Forensic Biology
- 2. Introduce students to various types of biological evidences encountered in forensic investigations
- 3. Explain the methods used for collection, preservation and analysis of biological evidences
- 4. Teach individual identification methods using bones, teeth, hair samples
- 5. Explain concepts of forensic entomology, wildlife forensics and understand microscopy principles

Learning Outcomes:

Students will be able to

- 1. Demonstrate an understanding of principles of forensic biology
- 2. Recognize and differentiate various biological evidences found in the crime scene
- 3. Apply various analytical instruments to analyze forensic biological evidence
- 4. Interpret and analyze the biological evidences for obtaining forensic relevant reports

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

UNIT I: Forensic Biology and Botany

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 and Forensic Odontology

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: Examination of Hair and Fibre, Forensic Entomology

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: Wildlife Forensic and Microscopy

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 Publication2001.

13. Smith, D.G.V: A Manual of Forensic Entomology and Death: A Procedural Guide, Joyce's Publications (1990)

14. Byrd, J.H. & Castner, J, L: Forensic Entomology - The Utility of Arthropods in Legal Investigation, CRC Press, (2000)

15. Biology Methods Manual, Metropolitan Police Forensic Science Laboratory, London, (1978)

16. Castner James L (Ed.)., Forensic Entomology, CRC Press (2006)17. Richard Li, Forensic Biology, CRC Press, 200818. 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 Duration of University Examination University Examination 4 Periods per week 3 Hours 100 Marks / 4 Credits

UNIT I: Introduction to Anatomy and Physiology UNIT II: Introduction to forensic medicine and personal identification UNIT III: Introduction to Forensic pathology and deaths due to various aspects UNIT IV: Sexual offences and related aspects

Course Objectives:

- 1. Understand the principles and practices of forensic medicine
- 2. Introduce students to procedures of medico legal investigation of death and injuries
- 3. Understand the autopsy procedure and examination of trauma in forensic pathology
- 4. Familiarize students with assessment of living individuals for legal purposes
- 5. Integrate Medicine with other forensic disciplines

Learning Outcomes:

Students will be able to

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

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

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

4. Assess living individuals in legal context

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

UNIT I: Introduction to Anatomy and physiology

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: Introduction to forensic medicine and personal identification

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: Introduction to Forensic pathology and deaths due to various aspects

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: Examination and identification of sexual assault, infanticide

Sexual offences – Rape – Unnatural sexual offences and medico legal aspects - Abortion & Infanticide – Medico legal aspects – Impotence and sterility – Virginity, Pregnancy and Delivery - Medico legal 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 Publication2001.

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

PRACTICALS FS 151: CRIME SCENE MANAGAMENT LAB

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

Course Objectives:

- 1. Understand the principles of crime scene management
- 2. Learn to process and document crime scenes, and apply principles to criminal investigations
- 3. Develop skills in collecting and preserving physical evidence
- 4. Apply crime scene management techniques to real-world scenarios
- 5. Integrate crime scene management with other forensic disciplines

Learning Outcomes:

Students will be able to

- 1. Secure and search the crime scenes for forensic evidences
- 2. Prepare rough and fair sketch of indoor and outdoor crime scenes
- 3. Record the crime scene using note making, photography and videography
- 4. Collect, pack and forward physical evidences to Forensic laboratory for analysis
- 5. Reconstruct and evaluate the indoor and outdoor crime scenes

Experiments

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

Course Objectives:

- 1. Understand the chemical tests used for qualitative analysis of inorganic ions and organic compounds
- 2. Teach students to conduct acid base titrations
- 3. Understand the principle and procedure involved in various redox reactions
- 4. Apply EDTA titrations for real time cases
- 5. Learn concepts of partition coefficient and buffers

Learning Outcomes:

Students will be able to

1. Prepare chemical reagents and conduct chemical tests for identification of various inorganic ions of forensic relevance

- 2. Identify the functional group in an organic compound using chemical tests
- 3. Perform acid base titrations and calculate the concentration of unknown sample
- 4. Perform redox titrations such as Permanganometry, dichromatometry and iodimetry
- 5. Apply complexometric titrations using EDTA in real water samples

Experiments

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 catalyzed by an acid

FS 153: INSTRUMENTAL METHODS OF ANALYSIS LAB

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

Course Objectives:

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

- 2. Develop technical proficiency in utilizing instrumental methods for chemical analysis
- 3. Learn sample preparation methods for instrumental methods
- 4. Develop skills in interpreting and analyzing the instrumental data
- 5. Enhance problem solving skills through practical application of instrumental methods

Learning Outcomes:

Students will be able to

- 1. Demonstrate proficiency in operating colorimeter, potentiometer and conductometer
- 2. Operate and perform paper chromatography and electrophoresis techniques
- 3. Apply sample preparation techniques for different sample analyses
- 4. Draw graphs and calculate the unknown concentrations of samples

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

Experiments

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

Course Objectives:

- 1. Examination of types of glasses and glass fractures
- 2. Determine the characteristics of physical evidences like glass, soil and paint
- 3. Compare and individualize the source of unknown sample from known samples
- 4. Extract and identify the paint samples by physical parameters and TLC
- 5. Develop, compare and identify the characteristics of tool marks
- 6. Restore the identification numbers on metal surfaces and wood surfaces

Learning Objectives:

Students will be able to

- 1. Analyze and identify the glasses and glass fractures
- 2. Determine the direction and angle of impact on glass pane
- 3. Collect and identify the class and individual characteristics of physical evidences like soil and paint
- 4. Collect and identify the class and individual characteristics of tool marks
- 5. Restore the tool marks from various sources and can identify the original marks present on them

Experiments

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

Course Objectives:

1. Understand the parts and action mechanisms of various firearms

2. Learn about the components of ammunition

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

4. Examination of rifling patterns, firing pin marks, breech face marks and GSR

5. Develop skills in reporting and presenting the forensic ballistic reports in courtroom as expert

Learning Outcomes:

Students will be able to

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

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

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

Experiments

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

Course Objectives:

- 1. Learn the human skeletal system and its application in identification of individual
- 2. Use teeth evidence in personal identification
- 3. Apply Forensic botany principles in analysis of forensic botanical evidence
- 4. Understand the structure of hair and its application in crime investigation
- 5. Identify various types of fibres and application in forensic investigation

Learning Outcomes:

Students will be able to

- 1. Identify different human bones and their parts
- 2. Examine bones and teeth evidence found at the crime scene for personal identification of individual
- 3. Conduct microscopic examination for identification of pollen grains, starch grains and paper pulp fibers

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

5. Identify and classify human and animal hair and different types of fibres and their application in crime investigation

Experiments

- 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