

**Rayat Shikshan Sanstha's**  
**YASHAVANTRAO CHAVAN INSTITUTE OF SCIENCE,**  
**SATARA**

**(AUTONOMOUS)**

Constituent college of

**Karmaveer Bhaurao Patil University, Satara**

Reaccredited by NAAC with 'A+' Grade

**Proposed Syllabus for**

**Master of Science**

**Part – I**

**FORENSIC SCIENCE**

Syllabus to be implemented w. e. f. June 2024 As

per NEP 2020

**Rayat Shikshan Sanstha's**  
**Yashavantrao Chavan Institute of Science, Satara**  
**(Autonomous)**

**Syllabus for M.Sc. Part – I**

**Title: Forensic Science**

**Year of Implementation: The syllabus will be implemented from June, 2024 onwards.**

**Preamble:**

This syllabus is framed to give advanced knowledge of Forensic Science to Postgraduate students in the first year of two years of M.Sc. degree course.

In order to keep pace with the advancement of forensic science and development of new investigative and analysis techniques, there has been a quantum jump in the demand for forensic personnel.

The new syllabus is based on a basic and applied approach with vigor and depth. At the same time precaution is taken to make the syllabus comparable to the syllabi of other universities and the needs of forensic science laboratory and research.

The syllabus is prepared after discussion at length with a number of faculty members of the subject and experts from industries and research fields. The units of the syllabus are well defined, taking into consideration the level and capacity of students.

**Program Objectives:**

<b>PO No.</b>	<b>PO Statement</b>
	<b>After completing the Master of Science in Forensic Science students will be able to-</b>
<b>PO-1</b>	Expertise in the subject
<b>PO-2</b>	Qualified to continue Ph.D. in his subject
<b>PO-3</b>	Eligible to research scholar abroad
<b>PO-4</b>	Qualified to appear for the examinations for jobs in government organizations, private industries, research laboratories, etc.
<b>PO-5</b>	Eligible to appear for jobs with minimum eligibility as science post graduate.

**Program Specific Objectives:**

1. The students are expected to know the core knowledge and recent developments in the Forensic Science.

2. The practical course is designed in consequence with the theory courses to expand the understanding of the several concepts in Forensic Science.
3. It is predicted to inspire and improve interest of the students in Forensic Science.
4. To grow the power of appreciations, the successes in science and part in society and nature.
5. To develop student sense in recent research areas.

**Program Specific Outcomes:**

<b>PSO No.</b>	<b>PSO Statement</b>
PSO-1	Understand the advances in Forensic Science.
PSO-2	Study, plan and perform experiments in the labs to prove the ideas, values and theories learned in the classrooms.
PSO-3	Improve scientific knowledge in Forensic Science.
PSO-4	Classify their area of attention in academic, research and development.
PSO-5	Perform job in various fields like science, engineering, education, banking, business and public service, etc. or be an entrepreneur with precision, analytical mind, innovative thinking, clarity of thought, expression, and systematic approach.

**Duration: Two year full time.**

**Pattern: Semester examination.**

**Medium of Instruction: English.**

## Semester I

Level	Semester	Course Code	Course Title	No. of hours per Week	Credits
6	III	MFST 411	FORENSIC SCIENCE AND CRIME SCENEMANAGEMENT	4	4
		MFST 412	CRIMINOLOGY AND LAW	4	4
		MFST 413	FORENSIC BALLISTICS AND EXPLOSIVES	4	4
		MFST 414 E-I	E-I : ANALYTICAL INSTRUMENTAL TECHNIQUE	2	2
		MFST 414 E-II	E-II : INSTRUMENTATION		
		MFST 415	RESEARCH METHODOLOGY	4	4
		MFSP 416	Practical- I: LAB I	4	2
		MFSP 417	Practical- II:LAB II	4	2
TOTAL					22

## Semester II

Level	Semester	Course Code	Course Title	No. of hours per Week	Credits
6	II	MFST 421	FINGERPRINT AND IMPRESSIONS	4	4
		MFST 422	QUESTIONED DOCUMENT	4	4
		MFST 423	FORENSIC PHYSICS	4	4
		MFST 424 E-I	E-I : FORENSIC CHEMISTRY	2	2
		MFST 424 E-II	E-II : FORENSIC TOXICOLOGY		
		MFSP 425	RESEARCH PROJECT	8	4
		MFSP 426	Practical- III: LAB III	4	2
		MFSP 427	Practical- IV: LAB IV	4	2
TOTAL					22

## SEMESTER I

### MFST 411: FORENSIC SCIENCE AND CRIME SCENE MANAGEMENT

**Course Objectives:** Students should be able to...

1. learn Development of Forensic Science.
2. know the Crime scene management and their steps.
3. learn about Forensic Photography and their importance in Crime Scene Investigation.
4. understand about Quality Management in Forensic Science Laboratory and Forensic Statistics.

<b>Credits4</b>	<b>MFST 411: FORENSIC SCIENCE AND CRIME SCENE MANAGEMENT</b>	<b>No. of hours Per unit/ Credits</b>
<b>UNIT I</b>	<b>FORENSIC SCIENCE AND CRIME SCENE MANAGEMENT</b>	<b>(15)</b>
	<b>Forensic science:</b> definition, history & development, scope, ethics in forensic science and significance, Organization of forensic science laboratories of center and state, NCRB, CFPB etc. <b>Crime and crime scene management:</b> definition & causation, crime scene: nature, types, preservation of scene of crime, protection and recording of crime scene, search of physical clues, preservation, packing and forwarding of physical clues, chain of custody. <b>Criminal investigations:</b> unnatural deaths, criminal assaults, sexual offences, poisoning, vehicular accidents.	
<b>UNIT II</b>	<b>FORENSIC PHOTOGRAPHY</b>	<b>(15)</b>
	<b>Photography:</b> basic principles and techniques of black and white and color photography, camera and lenses, exposing, developments and printing, different kinds of developers and fixtures, modern developments in photography, linkage of cameras and film negative, digital photography, digital watermarking and digital imaging, photogrammetric, videography /high speed videography, crime scene and laboratory photography, IR, UV, photography, portrait photography, photomicrography and macro photography.	
<b>UNIT III</b>	<b>QUALITY MANAGEMENT (ISO/IEC/NABL) IN FORENSIC INSTITUTIONS</b>	<b>(15)</b>

	General requirements for the competence of testing and calibration laboratories- introduction, scope, management requirements: organization quality system, document control, review of requests, tenders and contracts, subcontracting of tests and calibrations, purchasing service and supplies, service of the clients, complaints, corrective and preventive action, control of records, internal audits, technical requirements, general, personnel, accommodation and environmental conditions, test and calibration methods and methods validation, equipment, measurement traceability sampling, handling of test and calibration results and reporting the results. Laboratory management: laboratory information management System, validation and safety equipment.	
<b>UNIT IV</b>	<b>FORENSIC STATISTICS</b>	<b>(15)</b>
	Forensic statistics- types of data, basic concept of frequency distribution, measure of central values- mean, median and mode, measure of dispersion, range, mean deviation and standard deviation, correlation and regression analysis, probability, theory and classical definition of probability, conditional probability and coincidence probability. Large sample test (test in proportions, mean, variance) small sample test (x <sup>2</sup> , t, f tests) test for independence of attributes.	

**Course Outcomes:** Students will be able to...

1. describe the Development of Forensic Science and Structure of Forensic Science Laboratories.
2. utilize the aspects of Crime scene management.
3. perform Forensic photography and its application in forensic investigation
4. evaluate forensic data by applying statistical approaches.

**Reference Books:**

1. Lee H., Palmbach T., Miller M; “*Henry Lee’s Crime Scene Handbook*”, Elsevier, Academic Press, 2001.
2. Malony M., Housman D., Gardner R.; “*Crime Scene Investigation: A Procedural Guide*”, CRC Press, Taylor & Francis Group, 2014.
3. Fisher B.A, Fisher D.R.; “*Techniques of Crime Scene Investigation, 8th Edition*”, CRC Press London, 2012.
4. Davis R.; “*Evidence Collection and Presentation*”, 2nd Edition, Law Tech Publishing Group, 2016.
5. Lewis J.; “*Criminalistics for Crime Scene Investigators*”, Law Tech Publishing Group, 2014.
6. ISO/IEC 17025:2005, NABL 113,113A, 131, guidelines of NABL.
7. Nordby J.J “*Deed Reckoning: The Art of Forensic Science Detection*”, CRC Press LLC, Boca Raton FL, 1999. Page | 29

8. Saferstein R.; “*Forensic Science Handbook*”, Vol. I, II, III.
9. Sutton R., Trueman K. and Moran C.; “*Crime scene management: Scene Specific Methods*”, John Wiley & Sons, 2016.
10. James S.H., Nordby J.J.; “*Forensic science: An introduction of Scientific and Investigative Technique*”, CRC press 2003 and 2005.
11. Shaler R.C.; “*Crime Scene Forensics: A Scientific Method Approach*”, CRC Press London, 2012.

## MFST 412: CRIMINOLOGY AND LAW

**Course Objectives:** Students should be able to...

1. study the Criminal Justice System & Indian Penal Code related to forensic science.
2. learn the Indian Evidence Act, Criminal Procedure code and provisions of the Constitution of India related to forensic science.
3. know the Crime Typologies, Victimology and Sociology.
4. study the Report writing, Court Testimony and Forensic Examination.

Credits 4	MFST 412: CRIMINOLOGY AND LAW	No. of hours per unit/Credit
<b>UNIT I</b>	<b>CRIMINOLOGY</b>	<b>(15)</b>
	<p>Advanced study of crime, criminal and criminal behavior, Schools of criminology, theories of criminology (differential association theory, self- concept and containment theory, labeling theory, barrier theory), punitive aspects (theories of Punishment), probation &amp; parole, correctional institutions.</p> <p><b>Victimology:</b> victim, science of victimology, role of victim in crime, victim-offender relationship, effects on the victim postcrime, justice system to the aid of the Victim, relief and compensatory aids.</p> <p><b>Offenses:</b> criminal offenses nature and types, juvenile delinquency, child abuse- physical abuse, Emotional abuse, sexual abuse, child neglect, crime against women, crime against elderly, Youth and crime. Alcoholism and drug addiction.</p> <p><b>Sociology:</b> sociological contentions about the causes of crime (correlates of crime) - social, Cultural, economic, psychological, geographical, immigration etc. The theory of social and Environmental determinism, “born-criminals”, “criminoids”.</p>	

<b>UNIT II</b>	<b>INDIAN CONSTITUTION AND CRIMINAL JUSTICE SYSTEM</b>	<b>(15)</b>
	<p><b>Fundamental Rights:</b> Right of Equality (Articles 14 to 18) and Right of Freedom (Articles 19 to 22).</p> <p><b>Courts:</b> Types, powers and jurisdiction, Admissibility of evidence in Courts, Criminal justice system: structure of police, police and forensic scientist relationship with reference to crime investigation, modus operandi bureau and its role in crime record. Prosecution &amp; judicial organizations.</p>	
<b>UNIT III</b>	<b>NEW LEGAL PROVISIONS</b>	<b>(15)</b>
	<p>New Legal Provisions in IPC i.e. Bharatiya Nyaya Sanhita, 2023 (BNS)</p> <p>New Legal Provisions in CrPC i.e. Bharatiya Nagarik Suraksha Sanhita, 2023 (BNSS)</p> <p>New Legal Provisions in IEA i.e. Bharatiya Sakshya Adhinyam, 2023 (BSA)</p>	
<b>UNIT IV</b>	<b>REPORT WRITING</b>	<b>(15)</b>
	<p>Introduction to Forensic Report Writing: Importance and purpose of forensic reports, Types of forensic reports, The role of a forensic scientist as an expert witness</p> <p>Structure of Forensic Reports: Standard formats and sections</p> <p>Tailoring reports to specific forensic disciplines (e.g., toxicology, DNA analysis)</p> <p>Importance of documentation in forensic science.</p> <p>Legal and ethical considerations.</p>	

**Course Outcome:** Students will be able to...

1. describe the structure of law enforcement agencies and Judicial organizations of India
2. explain various sections of BNS, BNSS and BSA with respect to forensic applicability
3. utilize the fundamental rights as per constitution of India
4. apply the important aspects of criminology and victimology during forensic investigation and preparation of report writing.

**Reference Books:**

1. James, S. H. Forensic science; “*An introduction of Scientific and Investigative Technique*”, CRC press 2003 and 2005
2. Sharma B.R. ; “*Forensic Science in criminal Investigation and Trails*”, Universal pub., 2013
3. Brown J.M. & Campbell, E. A; “*The Cambridge handbook of Forensic Psychology*”, Cambridge, England: Cambridge University Press, 2010



4. Belmont C.A.; “*Justice, 7th Ed*”, Thomson Wordsworth
5. Lee H.; “*Physical Evidence*”, Elsevier, 2000
6. Indian Evidence Act
7. Indian Penal Code
8. Code of Criminal Procedure
9. James, S.H. And Nordby, J. J.; “*Forensic Science; An Introduction to Scientific and Investigative Techniques*”, 4 th Edition, CRC Press USA, 2014
10. Saferstein R.; “*Criminalistics: An Introduction to Forensic Science*”, Prentice Hall Inc. USA.
11. Saferstein R.; “*Forensic Science: An Introduction*”, Prentice Hall Inc., USA, 2010
12. William Eckert, “*Introduction to Forensic Sciences*”, 2nd Edition, CRC Press London, 1997

## **MFST 413: FORENSIC BALLISTICS AND EXPLOSIVES**

**Course Objectives:** Student should able to...

1. Learn about ballistics and history of ballistics.
2. Understand the types of firearms, different parts and their functions.
3. Learn about identification of different firearms and ammunition.
4. Study explosives & their type's identification and examination.

Credits 4	<b>MFST 413: FORENSIC BALLISTICS AND EXPLOSIVES</b>	<b>No. of hours Per unit/ Credits</b>
<b>UNIT I</b>	<b>FIREARMS</b>	<b>(15)</b>
	<p>History and background of firearms, their classification and characteristics ,various components of small arms, smooth bore and rifled firearms, different systems and their function, rifling various class characteristics, purpose of rifling, type of rifling and methods to produce rifling, trigger and firing mechanism, cartridge-firing mechanism, projectile velocity determination, theory of recoil methods for measurement of recoil, techniques of dismantling/assembling firearm, identification of origin, improvised / country made/imitative firearms and their constructional features.</p> <p>Types of ammunition, classification and constructional features of different types of cartridges, types of primers and priming composition, propellants and their composition, velocity and pressure characteristics under different condition, various types of bullets and compositional aspects, latest trends in their manufacturing and design, smooth bore firearm projectile, identification of origin, improvised ammunition and safety aspects for handling firearms and ammunition.</p>	
<b>UNIT II</b>	<b>INTERNAL, EXTERNAL AND TERMINAL BALLISTIC</b>	<b>(15)</b>
	<p><b>Internal ballistic:</b> definition, ignition of propellants, shapes and sizes of propellants, manner of burning, various factors affecting the internal ballistics lock time, ignition time, barrel time erosion, corrosion and gas cutting.</p> <p><b>External ballistics:</b> principle problems of exterior ballistics, vacuum trajectory, effect of air resistance on trajectory, base drag, yaw, shape of projectile and stability, trajectory computation, ballistics coefficients and limiting velocity, measurements of trajectory parameters, introduction to automated system of trajectory computation and automated management of ballistics data.</p> <p><b>Terminal ballistics:</b> effect of projectile on hitting the target; function of bullet shape, striking velocity, striking angle and nature of target, tumbling of bullets, effects of instability of bullet, effects of intermediate targets, influence of range, cavitation; temporary and permanent cavities, ricochets and its effects, stopping power.</p> <p>Wound ballistics: Penetration power, wounding mechanism, nature of wounds of entry, exit, explosive wounds, and evaluation of injuries caused due to shotgun, rifle, handguns and country made firearms, methods of measurement of wounds ballistic parameters, postmortem firearm injuries.</p>	

<b>UNIT III</b>	<b>EXAMINATION OF BALLISTIC EVIDENCE</b>	<b>(15)</b>
	<p><b>Principles and practice of identification of firearms-</b> ammunition and their components, different types of marks produced during firing process on cartridge-firing pin marks, breech face marks, chamber marks, extractor and ejector marks and on bullet number/ direction of lands and grooves, striation marks on the lands and grooves, identification of various parts of firearms, techniques of obtaining test material from various types of weapons and their linkage</p> <p>with fired ammunition, class and individual characteristics,</p> <p><b>Determination of range of fire</b> –burning, scorching, blackening, tattooing and metal fouling, shots dispersion and GSR distribution, time of firing – different methods employed, and their limitations, stereo and comparison microscopy, automatic bullet and cartridge comparison system.</p> <p><b>Analysis of gunshot residues</b> – mechanism of formation of GSR sources and collection, spot test chemical test, identification of shooter and instrumental methods of GSR analysis, management and reconstruction of crime scene; Suicide, murder and accidental and self-defense cases, arms and explosives act, report writing and court findings.</p>	
<b>UNIT IV</b>	<b>EXPLOSIVES</b>	<b>(15)</b>
	<p><b>Explosives:</b> definition, classification, nature, composition, chemistry and characteristics of explosives, pyrotechnics, IED’S, explosion process and effects, types of hazards, effects of blast wave on structures, human etc. Specific approach to scene of explosion, post blast residues collection, reconstruction of sequence of events, evaluation and assessment of scene of explosion, systematic examination of explosive and explosion residue in the laboratory using</p> <p>Chemical and instrumental techniques in the laboratory and interpretation of results, explosive act.</p>	

**Course Outcomes:** Student will be able to...

1. discuss about firearms, ammunition and their types.
2. utilize the aspects of internal, external and terminal ballistics phenomena in shooting cases.
3. perform examination of firearms for establishing its linkage with bullets and cartridges.
4. identify various types of explosive substances and IED’s explosions.

**Reference Books:**

1. Sharma, B.R.; “*Firearms in Criminal Investigation & Trials*”, Universal Law Publishing Co PvtLtd, New Delhi, 4th Edition, 2011.

2. Hatcher, Jury and Weller; “*Firearms Investigation, Identification and Evidence*”, StackpoleBooks, Harrisburg, Pa, 1997.
3. Heard, B.J; “*Handbook of Firearms and Ballistics*”, John Wiley, England, 1997.
4. Jauhari M; “*Identification of Firearms, Ammunition, & Firearms Injuries*”, BPR&D, New Delhi.
5. Hogg, I.V; “*The Cartridge guide – A Small arms Ammunition Identification Manual*”, TheStackpole publishing Co., Harrisburg, Pa, 1982.
6. Janes, T.J.G; “*Infantry Weapons*”, Janes Information Group, Sentinal House, Surrey, U.K. (2004- 05)
7. Burrard; “*The Identification of Firearms and Forensic Ballistics*”, Herbert Jenkins, London, 1956.
8. Gunther and Gunther; “*The Identification of Firearms*”, New York, 1935.
9. Wilber; “*Ballistic Science for the Law Enforcement Officer*”, Charles C. Thomas, USA, 1977.
10. Hayes, T.J; “*Elements of Ordnance*”, John Wiley & Sons, Inc, London, 2013.
11. Smith and Smith; “*Book of Rifles*”, Stackpole Books, Harrisburg, Pa, 1972.
12. Smith and Smith; “*Book of Pistols and Revolvers*”, Stackpole Books, Harrisburg, Pa, 1968.
13. Nelson; “*The World’s Submachine Guns*”, Vol I, Arms & Ammunition Press, London, 1977.
14. Greener; “*Gun and its Development*”, Arms & Ammunition Press, London, 1910.
15. Ezell; “*Small arm Today*”, Stackpole Books, Harrisburg, Pa, 1988.
16. Hobart Willard; “*Instrumental Methods of Analysis*”, Wadsworth Publishing Company, 1988
17. Douglas Skoog, James Holler and Stanley Crouch; “*Principles of Instrumental Analysis*” 7th Edition, Cengage Learning, 2017.
18. James W R; “*Atomic Spectroscopy*”, 2nd Edition, Marcel Dekkar, In, NY, 1966.
19. Patania V. B; “*Spectroscopy*”, Campus Books International, 2004.
20. Jauhri M.; “*Identification of Firearms, Ammunition & Firearm Injuries*”, BPR&D, New Delhi.

### **MFST 414 E1: Analytical Instrumental Techniques**

**Course Objectives:** Student should be able to...

1. study spectroscopy and their types.
2. understand the Atomic Absorption and Emission spectroscopy, Infrared Spectroscopy.
3. learn the Chromatographic, Electrophoresis and Microscopic techniques.
4. study Microscopy and their different types.

<b>Credits<sup>4</sup></b>	<b>MFST 414 E1: ANALYTICAL INSTRUMENTAL TECHNIQUES</b>	<b>No. of hours per unit/ Credits</b>
<b>UNIT I</b>	<b>ULTRA VIOLET AND VISIBLE SPECTROSCOPY</b>	<b>(15)</b>
	Ultraviolet and visible spectrophotometer: Types of sources and stability, wavelength selection, filters- cells and sampling devices, detectors, resolution, qualitative and quantitative methods for detection. Instrumentation and Working , Forensic Application Fluorescence and phosphorescence spectrophotometer: Types of sources, structural factors, instrumentation, comparison of luminescence and UV visible absorption method.	
<b>UNIT II</b>	<b>ATOMIC ABSORPTION AND INFRARED SPECTROSCOPY</b>	<b>(15)</b>
	Atomic absorption spectroscopy: Instrumentation and techniques, interference in AAS, background correction methods, qualitative analysis. Atomic emission spectroscopy: Instrumentation and techniques arc/spark emission, ICP-AES, comparison of ICP vs. AAS methods, qualitative analysis, application. Infrared spectroscopy: Dispersive and Fourier Transform spectroscopy, sample handling, qualitative analysis and Interpretation of IR spectra.	
<b>UNIT III</b>	<b>CHROMATOGRAPHY</b>	<b>(15)</b>
	Chromatographic techniques – Basic principles, theory and instrumentation of paper and thin layer ,Column chromatography, gas chromatography ,high performance liquid chromatography, Gas liquid chromatography, high performance thin layer chromatography. Forensic application of chromatographic techniques.	
<b>UNIT IV</b>	<b>MICROSCOPY</b>	<b>(15)</b>
	Microscopy - Basic principles, Simple and Compound microscope, Comparison microscope, Phase contrast Microscope, Phase contrast Microscope, Stereoscopic microscope, Polarizing microscope, Fluorescent Microscopy, Infra-red Microscopy, Scanning Electron Microscope (SEM) & Transmission Electron Microscope (TEM).	

**Course outcomes:** Students will be able to...

1. apply the spectrophotometric and spectroscopic techniques in forensic analysis.

2. describe the principles, instrumentation and application of different thermal analysis methods.
3. utilize the chromatographic techniques in forensic examination.
4. explain types, instrumentation and application of Microscopy.

### Reference Books:

1. Willard H.; *“Instrumental Methods of Analysis”*, Wadsworth Publishing Company, 1988.
2. Skoog D., Holler J. and Crouch S.; *“Principles of Instrumental Analysis”* 7th Edition, Cengage Learning, 2017.
3. James W R; *“Atomic Spectroscopy”*, 2nd Edition, Marcel Dekkar, NY, 1966.
4. Patania V.B; *“Spectroscopy”*, Campus Books International, 2004.
5. Khandpur R.S; *“Handbook of Analytical Instruments”*, Tata McGraw Hill Publ. Co., 2004.
6. Chatwal G.R & Anand S.K; *“Instrumental Methods of Chemical Analysis”*, Himalaya Publishing House, 2004.
7. Thomson K. C & Reynolds R.J; *“Atomic Absorption Fluorescence & Flame Emission Spectroscopy: A Practical Approach”*, 2nd Edition, Charles Griffin & Co., 1978.
8. Silverstein R.M Webster F.X; *“Spectrometric Identification of Organic Compounds”* 6th Edition, John Wiley & Sons, Inc., 1997.
9. Clark E.G.C; *“Isolation and Identification of drugs”*, Vol.1 and Vol.2, Academic Press, 1986.
10. Banwell C.L & Elani M.M.C; *“Fundamental of Molecular Spectroscopy”*, 4th Edition, Tata McGraw Hill Pub. Co., 1995.
11. Chatwal G.R; *“Analytical Spectroscopy”*, 2nd Edition, Himalaya Publishing House, 2002.
12. Sunshine I; *“Ultraviolet Spectrophotometry”*, CRC Press, 1969.

## MFST 414 E II: INSTRUMENTATION

**Course Objectives:** Students should be able to...

1. know the Thermal Analytical techniques and their Forensic Application.
2. study the Electrophoresis techniques and their Forensic Importance
3. understand the Instrumentation and working of X-ray Spectroscopy & AES
4. study Mass Spectroscopy, Inductively coupled plasma MS (ICP-MS), Ion Microprobe Mass Analyzer (IMMA).

Credits 4	<b>MFST 414 E2 II: INSTRUMENTATION</b>	<b>No. of hours per unit/ Credits</b>
<b>UNIT I</b>	<b>THERMAL ANALYSIS AND NMR</b>	<b>(15)</b>
	<p><b>Thermal analysis method:</b> Basic principles and theory differential scanning calorimetry and differential thermal analysis thermogravimetry.</p> <p><b>Nuclear magnetic resonance spectroscopy:</b> Basic principles, theory and instrumentation.</p>	
<b>UNIT II</b>	<b>ELECTROPHORESIS</b>	<b>(15)</b>
	<p><b>Electrophoresis Technique-</b> Basic principles, theory and instrumentation Horizontal and Vertical Gel Electrophoresis Systems , Agarose Gel Electrophoresis ,Polyacrylamide Gels, Sodium Dodecyl, Sulphate-Polyacrylamide, Gel Electrophoresis, Native (Buffer) Gels, Gradient Gels, Capillary Electrophoresis</p>	
<b>UNIT III</b>	<b>X RAY SPECTROSCOPY</b>	<b>(15)</b>
	<p><b>X-ray spectroscopy:</b> Introduction to X-ray absorption and fluorescence methods, X-ray diffraction, Auger emission spectroscopy (AES), and electron spectroscopy for chemical analysis (ESCA). Radiochemical technique: Basic principles and theory, introduction about nuclear reactor and radiation neutron sources neutron activation analysis (NAA).</p>	
<b>UNIT IV</b>	<b>MASS SPECTROSCOPY</b>	<b>(15)</b>
	<p>Mass Spectrometry Sample flow, Ionization methods, Mass analyzer, Vacuum systems, data handling correlation of mass spectra and molecular structure, Fourier transform mass spectrometry, Tandem mass spectrometry, Inductively coupled plasma MS (ICP-MS), Ion Microprobe Mass Analyzer (IMMA), HR GC MS, LCMS, Secondary Mass Spectrometry, Laser Mass Spectrometry, Fast Atom bombardment and liquid secondary Ion Mass Spectrometry, Electro spray ionization Mass Spectrometry.</p>	

**Course outcomes:** Students will be able to...

1. utilize the Thermal Analytical methods in forensic analysis
2. describe principles, instrumentation and application of different electrophoretic methods
3. utilize the Spectroscopic technique such as X-ray, AES in forensic analysis
4. describe about principles, instrumentation and forensic application of mass spectrometry.

## Reference Books:

1. Willard H.; *“Instrumental Methods of Analysis”*, Wadsworth Publishing Company, 1988.
2. Skoog D., Holler J. and Crouch S.; *“Principles of Instrumental Analysis”* 7th Edition, Cengage Learning, 2017.
3. James W R; *“Atomic Spectroscopy”*, 2nd Edition, Marcel Dekkar, NY, 1966.
4. Patania V.B; *“Spectroscopy”*, Campus Books International, 2004.
5. Khandpur R.S; *“Handbook of Analytical Instruments”*, Tata McGraw Hill Publ. Co., 2004.
6. Chatwal G.R & Anand S.K; *“Instrumental Methods of Chemical Analysis”*, Himalaya Publishing House, 2004.
7. Thomson K. C & Reynolds R.J; *“Atomic Absorption Fluorescence & Flame Emission Spectroscopy: A Practical Approach”*, 2nd Edition, Charles Griffin & Co., 1978.
8. Silverstein R.M Webster F.X; *“Spectrometric Identification of Organic Compounds”* 6th Edition, John Wiley 7 Sons, Inc., 1997.
9. Clark E.G.C; *“Isolation and Identification of drugs”*, Vol.1 and Vol.2, Academic Press, 1986.
10. Banwell C.L & Elani M.M.C; *“Fundamental of Molecular Spectroscopy”*, 4th Edition, Tata McGraw Hill Pub. Co., 1995.
11. Chatwal G.R; *“Analytical Spectroscopy”*, 2nd Edition, Himalaya Publishing House, 2002.
12. Sunshine I; *“Ultraviolet Spectrophotometry”*, CRC Press, 1969.
13. Koji N.; *“Infrared Absorption Spectroscopy”*, Holden-Day, Inc. 1969)
14. Frank W.; *“Standard Methods of Chemical Analysis”*, 6th Edition, Van Nostrand Reinhold, 1969.

## MFST 415: RESEARCH METHODOLOGY

**Course Objectives:** The student should be able to...

1. study the basic knowledge on the fundamentals of research methodology.
2. understand to present research in scientific manner.
3. get acquainted with different bio statistical tools in modern research.
4. understand the relationship between statistics and biological research.

<b>Credits 4</b>	<b>MFST 415: RESEARCH METHODOLOGY</b>	<b>No. of hours per unit/ credits</b>
<b>UNIT I</b>	<b>INTRODUCTION TO RESEARCH METHODOLOGY I</b>	<b>(15)</b>



	<ul style="list-style-type: none"> <li>i. Research Methods vs. Methodology: Introduction, Types: Library research, field research, laboratory research.</li> <li>ii. Defining a Research Problem: Concept, Selecting the research problem, Techniques involved in defining problem, Conclusion of the problem.</li> <li>iii. Research Design: Need for research design, Concept in research design, Types of research design.</li> <li>iv. Developing a Research Plan – Need, Essential characteristics of research plan.</li> </ul>	
<b>UNIT II</b>	<b>INTRODUCTION TO RESEARCH METHODOLOGY II</b>	<b>(15)</b>
	<ul style="list-style-type: none"> <li>i. Reporting Practical and Project Work: Structure of report, Title, authors and their institution, abstract, keywords, abbreviations.</li> <li>ii. IMRAD technique: Introduction, Material and methods, Result discussion and conclusion, Acknowledgements.</li> <li>iii. Preparing a Grant Proposal for Research Project Manuscript</li> <li>iv. Submission to Research Journals: Statement of proposal, Ethical considerations, Publishing editorial issues, Preparation and submission.</li> </ul>	
<b>UNIT III</b>	<b>DESCRIPTIVE STATISTICS</b>	<b>(15)</b>
	<ul style="list-style-type: none"> <li>i. Importance of statistics in Biology: Samples and Population, Types of data, random sampling methods and sampling errors, scales and variables, accuracy and precision.</li> <li>ii. Measures of Central Tendency: Mean (arithmetic, geometric, harmonic), median, percentile and mode, Measures of dispersion – mean deviation, standard deviation and variance, Measures of Skewness, Kurtosis.</li> </ul>	
<b>UNIT IV</b>	<b>HYPOTHESIS TESTING</b>	<b>(15)</b>
	<ul style="list-style-type: none"> <li>i. Introduction to Hypothesis Testing: Null hypothesis, Alternate hypothesis.</li> <li>ii. Statistical Tools: Significance level, type I and type II errors, p-value, one tailed and two tailed tests, Distribution of sample means, standard error and confidence interval, Degrees of freedom, Equality of two population means, proportions: t-tests and z test, Chi square test - test for goodness of fit, independence and homogeneity, F test and ANOVA</li> </ul>	

**Course Outcomes:** Student will be able to...

1. design a research plan.
2. present research in scientific language.

3. analyze research data employing bio statistical tools.
4. statistically signify the importance of research data.

**Reference Books:**

1. Gurumani N., *Scientific thesis writing and Paper presentation*, (MJP Publishers, Chennai, 2010) – UNIT I, II.
2. Kothari C.R., *Research Methodology; Methods and Techniques*, 2 nd Ed, (New Age International Publishers, New Delhi, 2004) - UNIT I, II.
3. Khan I.A. and Khanum A., *Fundamentals of Biostatistics*, 3 rd (Ukaaz, Publications, Hyderabad, 2004) - UNIT III, IV.
4. Sokal R.R. and Rohlf F.J., *Introduction to Biostatistics*, 2<sup>nd</sup> Ed, (Dover Publications, INC. Mineola, New York, 1969) – UNIT III, IV.
5. Arora P.N., Malhan P.K., *Biostatistics*, (Himalaya Publishing House, Mumbai, 2006) – UNIT III, IV.

**MFSP 416 Practical**

**(Lab based on MFST 411,412)**

**Course objectives:** Student should be able to...

1. study Crime scene management, crime scene photography, videography and sketching.
2. know about Cognizable and Non cognizable offence, Power of Judges and Expert Witness testimony.
3. learn the mechanism and working of camera.
4. study how to make crime scene report.

Credit 2	MFSP 416: Practical Course (LAB-I)	No. of hour (60)
	1. To perform Crime scene protection and security	
	2. To perform the photography of scene of crime by Bird-eye view, wide range, mid-range, close-up.	
	3. Sketching the scene of crime – Rough and Final.	
	4. Sketching the crime scene using Rectangular coordinates, Baseline and Triangulation method.	
	5. Collection and Packaging of various Physical evidences.	
	6. To study the different parts of the camera.	
	7. To study the Photographic technique by using SLR/ Digital camera.	

	8. To study the Functions of International Organization of Standardization (ISO).	
	9. To study the Functions of National Accreditation Board for Testing and Calibration Laboratories (NABL).	
	10. To perform Small Sample Tests ( $X^2$ , t, f tests).	
	11. To prepare a schedule of five cognizable and five non cognizable offenses.	
	12. To study the powers and limitations of the Court of Judicial Magistrate of First Class.	
	13. To prepare a schedule of the offenses which may be tried under Section 260(2) of Criminal Procedure Code.	
	14. To cite an example of a case in which the opinion of an expert was called for under Section 45 of the Indian Evidence Act.	
	15. To study the annual reports of National Crime Records Bureau and depict the data on different types of crime cases by way of smart art/templates.	
	16. To study different types of reports.	
	17. To study important aspects of report writing.	
	18. To study the structure of report.	
	19. To write report on murder crime case.	
	20. To write report on toxicological laboratory findings in poison case.	

**Course outcomes:** Student will be able to...

1. perform Crime scene management, crime scene photography, videography and sketching.
2. differentiate about Cognizable and Non cognizable offence, Power of Judges and Expert Witness Testimony.
3. handle and use camera.
4. make crime scene report.

**Reference Books:**

1. Lee H., Palmbach T. & Miller M.; *“Henry Lee”s Crime Scene Handbook*, Elsevier, Academic Press, 2001.
2. Malony M., Housman D. & Gardner R.; *“Crime Scene Investigation: A Procedural Guide”*, CRC Press, Taylor & Francis Group, 2014.

3. Fisher B.A.J, Fisher D.R.; “*Techniques of Crime Scene Investigation, 8th Edition*”, CRC Press London, 2012.
4. Belmont, CA; “*Justice, 7th Ed*”, Thomson Wordsworth.
5. H. Lee; “*Physical Evidence*”, Elsevier, 2000
6. *Indian Evidence Act.*
7. *Indian Penal Code*
8. *Code of Criminal Procedure*
9. Wilber; “*Ballistic Science for the Law Enforcement Officer*”, Charles C. Thomas, USA, 2003.

### **MFSP 417 Practical**

#### **(Lab based on MFST 413,414)**

**Course objectives:** Student should be able to...

1. study the handling of firing case, examination of firing case exhibits, Entrance and Exit wound.
2. learn about crime scene management of explosive cases and Instrumentation of Spectroscopic techniques and Microscopy.
3. know how to make crime scene report.
4. study principle, working of different chromatographic and spectroscopic techniques.

<b>Credit 2</b>	<b>MFSP 417: Practical Course (LAB-II)</b>	<b>No. of hour (60)</b>
	1. To study the working mechanism of firearm.	
	2. To study Marking, Preservation, Transmission of fired evidence.	
	3. To study the working of Comparison Microscope.	
	4. Examination of comparison of class and individual characteristics of fired bullets.	
	5. Examination of Entrance Versus Exit wounds.	
	6. Identification of explosives by color tests & group analysis.	
	7. To separate explosive substances using thin layer chromatography.	
	8. To study the mechanism of bullet firing.	
	9. To analyze the Gun Shot Residue.	

	10. To prepare a case report on explosion scene management.	
	11. To study the principal, working and applications of UV-VIS Spectroscopy.	
	12. To determine the unknown drug sample using UV-VIS Spectroscopy. (Any 2)	
	13. To study the principal, working and applications of Infra-Red Spectroscopy.	
	14. To determine the functional group of unknown drug sample using IR Spectroscopy. (Any 2)	
	15. To study the principal, working and applications of Atomic Absorption Spectroscopy.	
	16. To prepare the TLC plate and utilize it to separate the components of drug compound. (Any 2)	
	17. To study the High Performance Liquid Chromatography.	
	18. To study the principal, working and applications of Stereo Microscope.	
	19. To study the principal, working and applications of Phase Contrast Microscope.	
	20. To study the principal, working and applications of Scanning Electron Microscope (SEM).	
	21. To study and perform Capillary Electrophoresis.	
	22. To perform Agarose Gel Electrophoresis.	

**Course outcomes:** Student will be able to...

1. examine firing case exhibits, differentiate Entrance and Exit wound.
2. handle and investigate crime scene management of explosive cases.
3. make crime scene report.
4. perform different chromatographic and spectroscopic techniques to analyze exhibits.

### Reference Books:

1. Lee H., Palmbach T. & Miller M.; *“Henry Lee’s Crime Scene Handbook”*, Elsevier, Academic Press, 2001.
2. Malony M., Housman D. & Gardner R.; *“Crime Scene Investigation: A Procedural Guide”*, CRC Press, Taylor & Francis Group, 2014.
3. Fisher B.A.J, Fisher D.R.; *“Techniques of Crime Scene Investigation, 8th Edition”*, CRC Press London, 2012.
4. Belmont, CA; *“Justice, 7th Ed”*, Thomson Wordsworth. 5. H. Lee; *“Physical Evidence”*, Elsevier, 2000

6. *Indian Evidence Act.*
7. *Indian Penal Code*
8. *Code of Criminal Procedure*
9. Wilber; “*Ballistic Science for the Law Enforcement Officer*”, Charles C. Thomas, USA, 2003.
10. Hayes, T.J; “*Elements of Ordnance*”, John Wiley & Sons, Inc, London, 2013.
11. Smith and Smith; “*Book of Rifles*”, Stackpole Books, Harrisburg, Pa, 2012. 12. Smith and Smith; “*Book of Pistols and Revolvers*”, Stackpole Books, Harrisburg, Pa,2004.

## Semester II

### MFST 421 – FINGERPRINT AND IMPRESSIONS

**Course Objectives:** Student should able to...

1. learn about historical development of fingerprints in an investigation.
2. study several classifications of frictional ridges.
3. study different types of fingerprints.
4. learn about significance of footprints in criminal investigation.

Credits 4	<b>MFST 421: FINGERPRINT AND IMPRESSIONS</b>	No. of hours per unit/credits
<b>UNIT I</b>	<b>FINGERPRINT</b>	<b>(15)</b>
	History and development of fingerprint, formation of ridges, pattern types, pattern areas, ridge tracing, ridge counting, taking of fingerprints and palm prints from living and dead person, post mortem fingerprinting, forgery of fingerprints, comparison of fingerprints, poroscopy, edgeoscopy.	
<b>UNIT II</b>	<b>DEVELOPMENT OF FINGERPRINT</b>	<b>(15)</b>
	Classification of fingerprint for comparison purpose, classification of fingerprints for recording Purpose- symbols, numerical values, primary classification, secondary classification, subdivision and classification by ridge tracing and counting, sub classification of mixed type pattern, henry system of classification, single digit classification, Extension of henry system, search of fingerprints, finger bureau, automatic fingerprint identification system.	
<b>UNIT III</b>	<b>EXAMINATION OF FINGERPRINT</b>	<b>(15)</b>

	Chance fingerprints, latent and visible fingerprints, plastic fingerprints, comparison of sweat, development of latent fingerprints, conventional methods of developments of fingerprints– fluorescents methods, magnetic powder method, fuming method, chemical method, digital imaging and enhancement, application of laser and other radiations to develop latent fingerprints, metal deposition method and development of latent prints of skin. Preserving and lifting of fingerprints, photography of fingerprints, digital transmission, and comparison of fingerprints, basis of comparison characteristics, individual characteristics and various types of Ridge characteristics.	
<b>UNIT IV</b>	<b>IMPRESSION EVIDENCE</b>	<b>(15)</b>
	<p>Footprints- importance, gait pattern, casting of footprints in different medium, electrostatic lifting of latent footprints, taking of control samples. Tool marks: types of tool mark: compression marks, striated marks, combination of compression and striated marks, repeated marks, class characteristics and individual characteristics, tracing and lifting of marks, photographic examination of tool marks and cut marks on clothes and walls etc.</p> <p>Restoration of erased/obliterated marks Tyre marks/ prints and skid marks, taking control samples.</p> <p>Lip print- nature, collection and evolution.</p> <p>Bite marks – forensic significance, photography, lifting and preservation of bite marks and evaluation, taking control samples.</p>	

**Course Outcomes:** Students will be able to...

1. utilize the basic principles of fingerprint identification.
2. describe the formation of ridges and various fingerprint patterns.
3. classify fingerprints for recording, searching for databases and comparison purposes.
4. perform collection, development and examination of latent fingerprints found at crime scenes.

**Reference Books:**

1. Bridges B.C.; *“Criminal Investigation, Practical Fingerprinting, Thumb Impression, Handwriting expert Testimony, Opinion Evidence”*, Univ. Book Agency, Allahabad, 2000.
2. Cowger J.; *“Friction Ridge Skin- Comparison & Identification of Fingerprints”*, CRC Press, NY, 1993.
3. Cossidy M.J.; *“Footwear Identification”*, Royal Canadian, Mounted Police, 1980.
4. Iannavelli A.V.; *“Ear Identification, Forensic Identification Series”*, Paramount, 1989.
5. Henry C.L. & R.E Ganesslen; *“Advances in Fingerprint Technology”*, CRC Press, London, 1991.

6. H.R Hardless; *“Disputed Documents Examinations & Fingerprint Identification”*, Law Book Company, Allahabad,1995.
7. Richard Saferstein; *“Criminalistics: An Introduction of Forensic Science”*, Prentice Hall Inc, USA, 2007.
8. Hara C.E. & Osterburg J.W.; *“An Introduction to Criminalistics”*, Indiana Univ. Press, London, 1972.
9. Morris R.N.; *“Forensic Handwriting Identification”*, Academic Press, London, 2001
10. Houck M.M. & Siegel J.A.; *“Fundamentals of Forensic Science”*, Academic Press, London, 2006.
11. Blitzer H.L & Jacob J.; *“Forensic Digital Imaging and Photography”*, Academic Press, 2002
12. Henry H.; *“Color photography – A Working Manual”*, Little Brown Co. Boston, 1995
13. Vacca J.R.; *“Computer Forensics”*, Firewall Media Pub. New Delhi, 2002.
14. Sharma B.R, *“Forensic Science in Criminal Investigation & Trials”*, Universal Publishing Co., New Delhi, 2003.
15. James S.H. and Nordby J.J.; *“Forensic Science- an Introduction to Scientific and investigative Techniques”*, CRC Press, USA, 2003.

### **MFST 422: QUESTIONED DOCUMENT**

**Course Objectives:** Students should be able to...

1. learn the nature and problem of document examination.
2. study the significance of disguised writing and anonymous letters.
3. learn the examination of multiple aspects of forgeries.
4. know the investigative approach of determination of age of documents.

<b>Credits 4</b>	<b>MFST 422: QUESTIONED DOCUMENT</b>	<b>No. of hours per unit/credits</b>
<b>UNIT I</b>	<b>DOCUMENT</b>	<b>(15)</b>



	Nature and problem of document examination, classification of documents procurements of standard admitted /specimen writing , handling and making of documents, preliminary examination of documents, basis of hand writing identification, individuality of hand writing ,variation in genuine handwriting ,natural variations, process of comparison, various types of documents- genuine and forge documents and holographic documents, various writing features and their estimation, general characteristics of handwriting, individual characteristics of handwriting, basic tools needed for forensic documents examination and their use.	
<b>UNIT II</b>	<b>HANDWRITING</b>	<b>(15)</b>
	Disguised writing and anonymous letters- identification of writer, examination of signature-characteristics of genuine and forge signature, writing instrument and their influence on handwriting, examination of alterations, erasers, overwriting, addition and obliterations, decipherment of secret, indented and charred documents, examination of Sealed impressions and other mechanical impressions, photography of questioned documents.	
<b>UNIT III</b>	<b>EXAMINATION OF DOCUMENT</b>	<b>(15)</b>
	Examination of black and white, color Xeroxed copies , carbon copies fax messages forgeries and their detections, various types of forgeries and their detection, examination of built up documents, determination of sequence of strokes, physical matching of documents, identification of type writings, identification of typist, identification of printed matter, various types of printing security documents, printing of currency notes, examination of counterfeit currency notes, passport , visa, stamp, papers, postal stamps, lottery.	
<b>UNIT IV</b>	<b>TYPEWRITER AND LINGUISTIC</b>	<b>(15)</b>
	Determination of age of documents by examination of signaturepaper, ink and writing signature. Examination of computer printout, identification of dot- matrix, ink-jet and laser printers, electronic typewriter, credit cards, Forensic stylistics, forensic linguistics, e-documents, digital signature.	

**Course outcomes:** Students will be able to...

1. describe the basic principles of forensic document examination.
2. perform examination and comparison of handwriting and signatures.

3. interpret the types of document forgeries and will be able to perform their examination.
4. analyze the security features present in legal documents like currency, passport, visa.

### **Reference Books:**

1. Hilton O.; "*Scientific Examination of Questioned Documents*", Revised Edition, Elsevier, NY 1982. Osborn A.S.; "*Questioned Documents*", 2nd Ed., Universal Law Pub., Delhi 1998.
2. Osborn A.S.; "*The Problem of Proof*", 2nd Ed., Universal Law Pub. Delhi 1998.
3. Thomas C.C.; "*I.S.Q.D. Identification System for Questioned Documents*", Billy Prior Bates Springfield, Illinois, USA 1971.
4. Harrison W.R.; "*Suspect Documents Their Scientific Examination*", Universal Law Pub. Delhi Indian Reprint, 2001.
5. *Working manual of VSC-5000*.
6. Hardless H.R.; "*Disputed Documents. Handwriting and Thumb – Print Identification, profusely illustrated*", Law Book, Allahabad 1988.
7. Morris Ron N; "*Forensic Handwriting Identification*", Academic Press, London, 2001.
8. Kelly J.S. & Lindblom B.S.; "*Scientific Examination of Questioned Documents*", Taylor Francis Group London and New York.
9. Davin E.; "*Questioned Documents – Scientific Examination*", Taylor & Francis, Washington, 1997. Page | 80
10. Brunelle R.L & Reed R.W.; "*Forensic Examination of Ink and Paper*", Charles C Thomas Springfield, Illinois, USA.
11. Alfassi Z.B.; "*Activation Analysis*", CRC Press, 1990.
12. Kappenhaver K.M.; "*CDE-Forensic Document Examination*", Humana Press.
13. Levinson J; "*Questioned Documents*", Academic Press, London, 2001.
14. Mehta M.K.; "*The Identification of Handwriting & Cross Examination of Expert*", 1970.
15. Coulthard M. & Johnson A.; "*An Introduction to Forensic Linguistics*", Taylor & Francis Group London & New York.
16. Memenamin G. R; "*Forensic Linguistics- Advances in Forensic Stylistics*", CRC Press, Washington Dc, 2002.
17. Hardless H.R.; "*Disputed Documents Examinations & Fingerprint Identification*", Law Book Company, Allahabad, 1995.

## MFST423: FORENSIC PHYSICS

**Course objectives:** Students should be able to...

1. Study the importance of trace evidence and its analysis.
2. learn the collection and analysis of evidentiary clues.
3. study image processing and construction.
4. understand the fundamentals of mobile phone forensic.

<b>Credits 4</b>	<b>MFST 423: FORENSIC PHYSICS</b>	<b>No. of hours per unit/ credits</b>
<b>UNIT I</b>	<b>FORENSIC TRACE ANALYSIS</b>	<b>(15)</b>
	Hair & Fibers: Nature, Types, Structure and Examination, Dust & Soil: Nature, Types, Forensic Examination, Paint, Lacquer & Varnishes: Nature, composition and forensic examination, Glass: Composition, Types, Fractures, Examination, Cement, Mortar and Concrete: General Composition, Forensic Analysis, miscellaneous clue materials- physical, chemical and instrumental methods of examination of string/ropes, fibers, threads and fabrics, wires/cables, seals, counterfeit coins, physical matches of broken objects.	
<b>UNIT II</b>	<b>MOTOR VEHICLE CRIMES</b>	<b>(15)</b>
	Abandoned Vehicles Vehicle involved in terrorism and Investigation. Evidentiary clues; the vehicle, the scene, the culprit/victim. Collection and Evaluation of; Tyre, tyre marks, tyre residues, tyre bursts. Mechanical failure. Crime Scene Management in motor vehicle cases, Forwarding Exhibits in Motor vehicle cases, Important Crime cases: - Vehicle involved in Explosion Legal Aspects:- Case studies and relevant provisions of offenses under Motor Vehicle Act,1988.	
<b>UNIT III</b>	<b>IMAGE PROCESSING</b>	<b>(15)</b>

	Image processing, identification of digital/manipulated photographs, photogrammetry, radiography, photography using scientific equipment, demonstrative photography. Modern developments in photography, scanning and printing technologies. Photomicrography, microphotography, U.V., I.R., fluorescence, transmitted & oblique light photography, close-up photography, trick photography, Photography of bloodstain, fingerprint, imprints, and micro evidence, linkage of cameras and film negatives, Reconstruction photography, Stereo-photography, Forensic Remote Sensing. Photography for presentation of evidence in the court of law.	
<b>UNIT IV</b>	<b>MOBILE AND WIRELESS DEVICE FORENSICS</b>	<b>(15)</b>
	Fundamentals of computer, Hardware and accessories, operating system, software, Computer Forensic – Introduction, objective and methodology of computer crime, Types of Computer crimes, Digital evidence- Seizure, Acquisition and Forensic examination, opinion writing and reason for opinion. Attacks, Rules of Digital Forensic, Standard Operating Procedure (SOP) of Digital Crime Scene. Incident Response tools and techniques. Search and Seizure of Volatile and Non-Volatile Data. Imaging and Hashing Digital Evidence, Analyzing and Recovering Deleted files and folders. Mobile phone Forensics: Introduction, Mobile Phone Forensics-Fundamental of Mobile applications and android OS, Mobile app security, Mobile application attacks, introduction to IOS & IPA applications, Mobile, VoIP, Hacking & security, Mobile application security (Android).	

**Course outcomes:** Student will be able to...

1. perform examination of various physical evidences.
2. describe the principles and examination procedure for Speaker identification and tape authentication.
3. perform the image processing of different evidences.
4. utilize the techniques in mobile forensics and their application in forensic investigation.

**Reference Books:**

1. Bengold & Moryson N.; “*Speech and Audio signal processing*”, John Wiley & Sons, USA (1999)
2. Fry D.B.; “*The Physics of Speech, Cambridge University Press*”, (2004)
3. Dwight Bolingeret. al.; “*Aspects of Language*”, Third Edition, Harcourt Brace Jovanovich College Publishers, USA, (1981)

4. Borden G.J. et. al.; “*Speech Science Primer (Physiology, Acoustics and perception of Speech)*”, 6th Ed, a Wolters Kluwer Company, USA, (2011)
5. Hollien H.; “*Forensic Voice Identification*”, Academic Press, London. (2001)
6. Hollien H.; “*The Acoustics of Crime- The New Science of Forensic Phonetics*”, Plenum Press, New York and London (1990)
7. Tosi O.; “*Voice Identification-Theory of Legal Applications*”, University Park Press, Baltimore (1979)
8. Tom A.; “*The Complete Photographer*”, Dorling Kindersley Ltd., 2010.
9. Helmut G.; “*A concise history of Photography*”, 3rd Ed., Dover Publications, 1986.
10. Michael F.; “*The Complete Guide to Digital Photography*”, 4th Ed., Lark Books, 1945.
11. Ian F.; “*Complete Guide to Digital Photography*”, Quercus Publications, 2017.
12. Martin E.; “*The Underwater Photographer*”, Focal Press, 2010.
13. Joachim B., Gelbke E., Mehliiss W.; “*Practical Photomicrography*”, Focal Press, 1966.
14. Laurie W.; “*Advance Infrared Photography*”, Amherst Media, 1995.
15. Andreas F.; “*The Complete Photographer*”, Prentice Hall, 1965.
16. Godbole N. and Belapore S.; “*Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives*”, Wiley Publications, 2011.
17. Harris S., “*All in One CISSP, Exam Guide Sixth Edition*”, McGraw Hill, 2013.
18. Nelson B., Phillips A. and Steuart C.; “*Guide to Computer Forensics and Investigations*” – 3<sup>rd</sup> Edition, Cengage, 2010 BBS.

## MFST 424 E I: FORENSIC CHEMISTRY

**Course Objectives:** Student should able to...

1. learn about titration, acid-base reaction.
2. study techniques used in analytical chemistry.
3. study about Dyes and Pigments Dyes & Forensic significance.
4. know about Forensic nanotechnology.

<b>Credits 4</b>	<b>MFST 424 E1: FORENSIC CHEMISTRY</b>	<b>No. of hours per unit/ Credits</b>
<b>UNIT I</b>	<b>BASIC CONCEPT OF ANALYTICAL CHEMISTRY</b>	<b>(15)</b>

	<p>Preparation of solution, Concentration units, mole, molarity, molality, equivalent weight, normality, ppm, milli equivalents and other related units.</p> <p><b>Titrations:</b> Acid-base, redox, precipitation, complexometric, Indicators, theory of indicators, Metal-ion indicators, non-aqueous titrations.</p> <p><b>Gravimetric Analysis:</b> Preparation of sample solution, precipitation, types of precipitates. Role of organic precipitants in gravimetric analysis. Some important organic precipitants. Sampling, extraction, purification and identification of substances.</p>	
<b>UNIT II</b>	<b>BASIC OF SOLUTIONS</b>	<b>(15)</b>
	<p>Concentration of a solution based on volume and mass units. Calculations of ppm, ppb and dilution of the solutions, concept of mmol. Stoichiometry of chemical reactions, concept of kgmol, limiting reactant, theoretical and practical yield. Solubility and solubility equilibria, effect of presence of common ion. Calculations of pH of acids, bases and acidic and basic buffers. Concept of formation constants, stability and instability constants, stepwise formation constants.</p>	
<b>UNIT III</b>	<b>DYES AND PIGMENTS</b>	<b>(15)</b>
	<p>Dyes and Pigments Dyes: Different types of dyes, role of dyes in crime investigation, food colours (edible and non- edible dyes); dyes used in cosmetic and pharmaceutical products. Chemical and instrumental methods of analysis of dyes; Analysis of trace evidence: cosmetics, dyes, Trap related evidence materials, fibers, oils, fats, grease, chemicals and plant material. Pigments: Introductions, white pigments, Manufacturing process and properties of blue pigment, red pigment, green pigment, yellow pigment.</p>	
<b>UNIT IV</b>	<b>FORENSIC NANOTECHNOLOGY</b>	<b>(15)</b>
	<p>Introduction to Nanomaterials, Strategies for scalable synthesis of quantum dots and related nano dimensional materials Detection of Forensic evidences by nanotechnology i.e. Biological samples, fingerprints, documents, explosives, drugs and trace materials.</p>	

**Course Outcomes:** Student will be able to: -

1. describe Basics of analytical terms such as titration, acid-base reaction.
2. utilize the techniques used in analytical chemistry.
3. differentiate between the Dyes and Pigments and perform their forensic analysis.

4. explain the important aspects of analytical chemistry, forensic chemistry, Forensic nanotechnology.

### Reference Books:

1. Skoog D.A. and West D.M., *Fundamental of Analytical Chemistry*, International Edition, 7th Edition (1996), Saunders College Publishing, Philadelphia, Holt, London
2. Pecsok R.L., Shields L.D., Cairns T. and McWilliam L.C., *Modern Methods of Chemical Analysis*, (1976), John Wiley & Sons, New York.
3. G. D. Christian, *Analytical chemistry*, Sixth Edition, Wiley publications.
4. M. Kolthoff: *Treatise on Analytical Chemistry* Vol. I and II
5. F. J. Welcher, *standard Methods of chemical Analysis* Vol.3, Part A & B.
6. Chatwal and Anand, *Instrumental Methods of Analysis*.
7. Bassett, Denney-Jeffer and Mendham, *Vogel's Textbook of Quantitative Inorganic Analysis*.
8. *Electro-analytical chemistry*, edited by H.W. Nurnberg
9. *Text Book of Quantitative inorganic analysis*: A.I. Vogel.
10. C. N. R. Rao, *University General Chemistry -An Introduction to Chemical Science* (NewDelhi,Macmillan, 2009).
11. Puri, Sharma &Kalia, *Principles of Inorganic Chemistry* (Vishal Publishing Co., 2020)
12. Gary Miessler, Donald Tarr, *Inorganic Chemistry* (Pearson Education, 2008).
13. James Huheey, Allen Keiter, Richard Keiter, OkhilMedhi, *Inorganic Chemistry, Principlesof Structure and Reactivity* (Pearson Education, 2014).
14. R. D. Madan, *Modern Inorganic Chemistry* (S. Chand Ltd, 1987)
15. J. D Lee, *Concise Inorganic Chemistry* (Wiley Oxford University Press, 2008).
16. Arthur Vogel, *Vogel's TextBook of Quantitative Analysis* (Longman, 1989).
17. Kotz.J.C.,Treichel, P.M. &Townsend,J.R. *GeneralChemistryCengage Learning India Pvt. Ltd.*, New Delhi(2009).
18. *Forensic Science in Criminal Investigation and Trials* by B. R. Sharma, Fourth Edition,
19. *Modi's: Medical Jurisprudence & Toxicology*, M. M. Trirathi Press Ltd. Allahabd, 1988.
20. S. N. Tiwari: *Analytical Toxicology*, Govt. of India Publications, New Delhi, 1987.
21. "Laboratory Procedure Manual: Petroleum Products", Directorate of Forensic Science, MHA, Govt. of India, 2005.
22. "Working Procedure Manual on Chemistry", Directorate of Forensic Science MHA Govt. of India.
23. *Bureau of Indian Standard Specifications related to Alcohols and Petroleum Products*. Page | 93
24. Frank W.; "Standard Methods of Chemical Analysis", 6th Edition, Van Nostrand Reinhold, 1969.
25. Watson C.A; "Official and Standardized Methods of Analysis", Royal Society of Chemistry, UK, 1994.
26. "Laboratory Procedure Manual Forensic Toxicology", Directorate of Forensic Science, MHA, Govt. of India, 2005.

27. Narayanan, T. V; “*Modern Techniques of Bomb Detection and Disposal*”, R. A. Security system, 1995.
28. Jacqueline Akhavan; “*The chemistry of explosives*”, Royal Society of Chemistry, UK, 1998.
29. Pearson D; “*Chemical Analysis of Food*”, Chemical Publ. Co. New York, 1971.
30. Somani S M; “*Chemical Warfare Agent*”, CRC Press, 2000.

## **MFST 424 E II– FORENSIC TOXICOLOGY**

**Course Objectives:** Student should be able to...

1. study about screening tests, color tests used in forensic analysis.
2. learn about the drugs and its types, NDPS act, Excise act.
3. study about Forensic Pharmacology, drug metabolism, drug toxicity.
4. learn the Forensic Examination of Fire and Arson cases.

<b>Credits 4</b>	<b>MFST 424 E2: FORENSIC TOXICOLOGY</b>	<b>No. of hours per unit/credits</b>
<b>UNIT I</b>	<b>TECHNIQUES IN FORENSIC CHEMISTRY</b>	<b>(15)</b>
	Forensic chemistry: introduction, types of case/exhibits, preliminary screening, presumptive test(color and spot test) inorganic analysis, micro-chemical methods of analysis, examination procedures involving standard methods and instrumental techniques, Drugs of abuse; introduction, classification of drugs of abuse, drugs of abuse in sports, narcotic drugs and psychotropic substances, designer drugs and their forensic examination, drugs and cosmetic act, excise act, NDPS act and detective dye added.	
<b>UNIT II</b>	<b>FORENSIC TOXICOLOGY</b>	<b>(15)</b>
	Forensic toxicology: introduction and concepts of forensic toxicological examination and its significance. Law relating to poisons. Poison: classification, mode of action and factors modifying the action of poisoning, medico-legal procedures in poisoning, antidotes, signs and symptoms of poisoning, collection and preservation of viscera in fatal and survival cases. Submission of Samples to the laboratory, and postmortem examination report / findings studies, specific analysis plan/ approach to toxicology examination of poisoning samples.	
<b>UNIT III</b>	<b>FORENSIC PHARMACOLOGY</b>	<b>(15)</b>



	Forensic pharmacology- forensic pharmacological studies, absorption, distribution, metabolism, pathways of drug metabolism, drug metabolism and drug toxicity, excretion of drugs and poisons, detection of poison on the basis of their, metabolic studies, interpretation of analytical data and formation of opinion.	
<b>UNIT IV</b>	<b>FIRE AND ARSON</b>	<b>(15)</b>
	Fire and Arson: Analyses of Petroleum Products and other incendiary materials, chemistry of fire, definition, scientific investigation and evaluation of clue materials, analysis of arson exhibits by instrumental methods, managements of arson cases, Investigation in Arson related cases Qualitative and quantitative forensic analysis of organic and inorganic industrial products: chemical fertilizers, insecticides, pesticides, metallic and non- metallic products, consumer items such as gold, silver, tobacco, salts, acids, alkalis.	

**Course Outcomes:** Student will be able to...

1. utilize the analytical techniques in Forensic examination of different exhibits.
2. apply the toxicological techniques in Poisoning cases
3. utilize the Forensic pharmacology & Metabolism of Drugs, Detoxification of drugs in poisoning cases.
4. perform the Fire and Arson cases exhibits analysis.

**Reference Books:**

1. *Forensic Science in Criminal Investigation and Trials* by B. R. Sharma, Fourth Edition,
2. *Modi's: Medical Jurisprudence & Toxicology*, M. M. Trirathi Press Ltd. Allahabd, 1988.
3. S. N. Tiwari: *Analytical Toxicology*, Govt. of India Publications, New Delhi, 1987.
4. “*Laboratory Procedure Manual: Petroleum Products*”, Directorate of Forensic Science, MHA, Govt. of India, 2005.
5. “*Working Procedure Manual on Chemistry*”, Directorate of Forensic Science MHA Govt. of India.
6. Clark E.G.C; “*Isolation and Identification of drugs*”. Vol.1 and Vol.2, Academic Press 1986.
7. *NDPS Act, 1985*.
8. Feigl; “*Spot Test in Organic Analysis*”, Elsevier Pub. New Delhi.
9. *Working Procedure Manual – Chemistry, Explosives & Narcotics*”, BPR&D Publications.
10. Siegel, J. A, Saukko, P. J. and Knupfer, G.C; “*Encyclopedia of Forensic Sciences*”, Academic Press, 2000.
11. *Review of forensic medicine and toxicology, including clinical and pathological aspects* by Gautam Biswas, second edition

12. Parikhs C., B.V. Subrahmanyam *textbook of medical jurisprudence forensic medicine and toxicology for classroom and courtrooms*, eighth edition.
13. Narayan Reddy K.S., *Essentials of Forensic Medicine and Toxicology*.
14. Gabor L. Hornyak, Harry F. Tibbals, Joydeep Dutta, John J. Moore *Introduction to Nanoscience and Nanotechnology*.
15. Wolf E.L., *Nano physics and nano technology - an introduction to modern concepts in nanoscience by the forensic pharmacology of drug of abuse* by Morris Odell and Olaf Drummer Mozayani A.,
16. Raymon L.P. *Handbook of Drug Interactions: a Clinical and Forensic Guide*, 2<sup>nd</sup> edn. , editors. , eds. Published by Humana Press, New York. 8 Mar 2011. Hardcover: 828 pp, price \$239.00. ISBN-10: 1617792217; ISBN-13: 978-1617792212.

### **MFSP 425: RESEARCH PROJECT**

<b>Credits 4</b>	<b>MFSP 425: RESEARCH PROJECT</b>	<b>No. of hours: 60</b>
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### **MFSP 426- Practical Course**

**(Based on MFST 421,422)**

**Course objectives:** Student should be able to...

1. study classification of fingerprints, development of fingerprints and classification system of fingerprint.
2. learn the examination of questioned documents.
3. know about gait pattern analysis.
4. understand analysis of ink.

<b>Credit 2</b>	<b>MFSP 426 Practical Course</b>	<b>No. of hours (60)</b>
	1. To perform ridge tracing and ridge counting in fingerprint.	
	2. To develop Latent prints by iodine fuming.	
	3. To develop fingerprints on challenging surfaces.	
	4. To classify fingerprint Henry's classification system.	
	5. To classify fingerprint card by NCIC classification system.	
	6. To classify fingerprint cards by Argentine classification system.	

	7. To compare chance prints with known prints.	
	8. To study the gait pattern.	
	9. To cast the tyre mark impressions and study its characteristics.	
	10. To study the characteristics of lip prints.	
	11. Preparation of paper sheet through recycled paper.	
	12. Identification and detection of different types of ink through instrumental techniques.	
	13. Microscopic examination of different types of ink.	
	14. Identification of source of photocopier machine by examination of photocopied documents.	
	15. Identification of different types of printing technology on documents.	
	16. Identification and detection of type written matter on documents.	
	17. To compare and analyze different signature samples.	
	18. To study the security features of currency notes.	
	19. To study the unique identification features of stamp impressions.	
	20. To study different types of forgeries in document.	

**Course objectives:** Student will be able to...

1. classify fingerprints, develop fingerprints using various techniques.
2. examine and analyze questioned documents.
3. analyze gait pattern.
4. analyze of ink.

**Reference Books:**

1. Bridges B.C.; *“Criminal Investigation, Practical Fingerprinting, Thumb Impression, Handwriting expert, 2005 Testimony, Opinion Evidence”*, Univ. Book Agency, Allahabad, 2000.
2. Cowger J.; *“Friction Ridge Skin- Comparison & Identification of Fingerprints”*, CRC Press, NY, 1993
3. Cossidy M.J.; *“Footwear Identification”*, Royal Canadian, Mounted Police, 2002.
4. Iannavelli A.V.; *“Ear Identification, Forensic Identification Series”*, Paramount, 2005.
5. Harrison W.R.; *“Suspect Documents Their Scientific Examination”*, Universal Law Pub. Delhi Indian Reprint, 2001.
6. *Working manual of VSC-5000.*
7. Hardless H.R; *“Disputed Documents. Handwriting and Thumb – Print Identification, profusely illustrated”*, Law Book, Allahabad 1988.

8. Morris Ron N; “*Forensic Handwriting Identification*”, Academic Press, London, 2001.
9. Helmut G.; “*A concise history of Photography*”, 3rd Ed., Dover Publications, 1986.
10. Michael F.; “*The Complete Guide to Digital Photography*”, 4th Ed., Lark Books, 2201.
11. Ian F.; “*Complete Guide to Digital Photography*”, Quercus Publications, 2017.
12. Martin E.; “*The Underwater Photographer*”, Focal Press, 2010.
13. Joachim B., Gelbke E., Mehliiss W.; “*Practical Photomicrography*”, Focal Press, 2002

### **MFSP 426- Practical Course**

**(Based on MFST 423,424 E1)**

**Course objectives:** Student should be able to...

1. learn Vehicular accident investigation, examination of exhibits related to vehicle theft and accident.
2. understand the Forensic Examination of Glass Fractures.
3. know the analysis of plant poisons.
4. know how to analyze petroleum products.

<b>Credit 2</b>	<b>MFSP 427 Practical Course (Lab-II)</b>	<b>No. of hours (60)</b>
	1. To study the Accident reconstruction.	
	2. Velocity estimation from skid marks.	
	3. Restoration of erased serial numbers using physical / chemical methods.	
	4. To perform photography of accident crime scene.	
	5. Comparison of head light glass and automobile window glass.	
	6. Study of glass fractures.	
	7. Study the refractive index of glass samples.	
	8. Determination of density of solid material by volume displacement method.	
	9. Microscopic examination of paint sample.	
	10. Examination of glass evidence under comparison microscope.	
	11. To detect plant poisons.	
	12. To identify metallic poison.	
	13. Detection and Identification of Explosives Residues Using High-	

	Performance Liquid Chromatography (HPLC)	
	14. Determination of Alcohol Content in Beverage Samples Using Infrared Spectroscopy (IR).	
	15. Identification of Controlled Substances in Drug Samples Using Thin-Layer Chromatography (TLC)	
	16. Estimation of Aspirin	
	17. Determination of strength of acetic acid in commercial vinegar by conductometric method.	
	18. Determination of chloride content from saline water by potentiometry	
	19. Estimation of bicarbonate and carbonate by potentiometric method.	
	20. Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos & soaps using pH meter.	
	21. To determine the normality and strength of HCl using 0.1N NaOH solution pH metrically.	
	22. Analysis of petroleum products by chemical and instrumental methods.	
	23. Estimation of paints and pigments by spectrophotometry (UV)	
	24. Chemical analysis of explosion residues.	
	25. Chemical analysis of cement samples (Silica percentage, acid insoluble percent etc.)	
	26. Extraction and analysis of plant poisons from visceral samples.	
	27. Extraction & Analysis of metal poison from biological matrices. (Copper, Lead, Bismuth, Zinc)	

**Course Outcomes:** Student will be able to...

1. investigate Vehicular accident, examine exhibits related to vehicle theft and accident.
2. do the Forensic Examination of Glass Fractures.
3. analyze of plant poisons.
4. analyze petroleum products.

**Reference Books:**

1. Bridges B.C.; “*Criminal Investigation, Practical Fingerprinting, Thumb Impression, Handwriting expert, 2005 Testimony, Opinion Evidence*”, Univ. Book Agency, Allahabad, 2000.
2. Cowger J.; “*Friction Ridge Skin- Comparison & Identification of Fingerprints*”, CRC Press, NY, 1993.
3. Cossidy M.J.; “*Footwear Identification*”, Royal Canadian, Mounted Police, 2002.
4. Iannavelli A.V.; “*Ear Identification, Forensic Identification Series*”, Paramount, 2005.
5. Harrison W.R.; “*Suspect Documents Their Scientific Examination*”, Universal Law Pub. Delhi Indian Reprint, 2001.
6. *Working manual of VSC-5000.*
7. Hardless H.R.; “*Disputed Documents. Handwriting and Thumb – Print Identification, profusely illustrated*”, Law Book, Allahabad 1988.
8. Morris Ron N; “*Forensic Handwriting Identification*”, Academic Press, London, 2001.
9. Helmut G.; “*A concise history of Photography*”, 3rd Ed., Dover Publications, 1986.
10. Michael F.; “*The Complete Guide to Digital Photography*”, 4th Ed., Lark Books, 2201.
11. Ian F.; “*Complete Guide to Digital Photography*”, Quercus Publications, 2017.
12. Martin E.; “*The Underwater Photographer*”, Focal Press, 2010.
13. Joachim B., Gelbke E., Mehliiss W.; “*Practical Photomicrography*”, Focal Press, 2002.

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