## MASTER OF FORENSIC SCIENCE
### FIRST SEMESTER EXAMINATION

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Students will select one of the following specializations beginning with the II Semester:

1. **FS-210**: Forensic Ballistics
2. **FS-220**: Forensic Document Examination
3. **FS-230**: Forensic Chemistry & Toxicology
4. **FS-240**: Forensic Biology, Serology and DNA Profiling
SECOND SEMESTER EXAMINATION  
Specialization in Forensic Ballistics FS-210

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Specialization in Forensic Document FS-220

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## Specialization in Forensic Biology, Serology & DNA Profiling  FS-240

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THIRD SEMESTER EXAMINATION
Specialization in Forensic Ballistics FS-210

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Specialization in Forensic Document FS—220

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### Specialization in Forensic Biology, Serology & DNA profiling FS-240

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FOURTH SEMESTER EXAMINATION - PRACTICAL/LAB BASED COURSE

Specialization in Forensic Ballistics FS-210

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Specialization in Forensic Chemistry & Toxicology FS-230

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Specialization in Forensic Biology, Serology & DNA profiling FS-240

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L = Lecture 1 hour per week gives 1 credit, T = Tutorial 1 hour per week gives 1 Credit
P = Practical 2 hours per week give 1 credit, S = Seminars 1 hour per week gives 1 Credit

Total Credits of the Programme = 108

All the students shall be required to register themselves for all the courses of the Programme and shall also be required to appear in examinations of all the courses; however, they shall become eligible for the award of the degree on securing minimum credits equivalent to 100.
Unit - I  
Criminal Justice System & forensic science in India; What is Forensic Science? Areas of forensic science, Criminalistics, Forensic Pathology, Forensic Anthropology, Forensic Odontology, Forensic Engineering, Toxicology, Behavioural Science, Questioned documents. A bit of forensic science history.
Forensic Science Laboratory: Organisation & services Forensic Science Lab. Administration, Central & State Forensic Science Laboratories in India, Forensic Science Laboratory Services in India, Standard Laboratory services, Evidence intake, analytical sections other laboratory services. Administrative issues with Forensic Science Laboratories; Accountability, Access to Laboratory services. The forensic scientist: Education & training of forensic scientists, Analysis of evidence: Chain of custody, Turnaround time, preservation & spoilages, sampling, reports, expert testimony.

Unit - II  
Court Room; Legal aspects of forensic science– Legal Constraints on the Criminal Investigation process, unreasonable search & seizures, self – incrimination, production of evidence, Expert Witness, Authentication of evidence, Admissibility of evidence, Admissibility of scientific & technical evidence, writing reports, Examples of analysis & reports Testimony; Difference between a civil case & a criminal case, being a witness & an expert consideration for testimony.
**Unit - III**


**Unit – IV**


**Suggested Readings**

Unit - I

Unit - II
Forensic Document Examination and its scope & importance; Classification of documents; Care, handling, preservation of documents; Observation tests and their application in handwriting examination; Preliminary examination of documents; examination of paper & inks, Process of comparison of handwriting; Principle of handwriting examination; Importance of natural variations and disguise in handwriting examination; Latest technological developments in the field of document examination with reference to office automation; Quality Assurance in document Examination; Document Expert in trial courts.


Unit - III
Firearms and tool marks: Firearms, Types of Firearms, Firearm Barrels, Anatomy of Ammunition, What happens when ammunition is discharged? Tool marks, various types of tool marks, cartridge cases and bullet comparison, Tool mark comparisons. Collection of firearms evidence, Safety and operations testing, Firearm Databases and Automated search system, Distance of firing Determination, shot pattern, Gunpowder Residues, Primer Residues, Serial Character Restoration.
Unit – IV

Impression Evidence: Types of Impression Evidence, Significance of Impression Evidence, Footwear Impressions (General Characteristic), Footwear Impressions at the Crime Scene, Casting three Dimensional Footwear impressions, Lifting imprints, Comparison of footwear impressions, Tire Impressions Evidence skid mark, Serial numbers restoration.


Brief about speaker identification & tape authentication techniques and their applications in forensic science.

Suggested Readings

3. Chatterjee, S.K; Speculation in Fingerprint Identification, Jantralekha printing Works, Kolkata, 1981.
17. Phillip Rose; Forensic Speaker Identification, Taylor & Francis, Forensic Science Series, London, 2002
Semester-I, Paper III  
M.Sc. Forensic Science  
FS-103 Chemical Evidence  
L-4,T-1,P-0,S-0 CREDITS-5

Unit - I

Drug of abuse, Introduction and classification why are drugs regulated, preliminary testing of drugs, confirmation of drugs, illicit drugs and clandestine laboratories. Laws related to drugs.


Unit - II


Soil and Glass:- Introduction-What is Soil, Collection of Soil Evidence, Analysis of Soils, Case Studies related to Soil. What is Glass? Glass manufacture, Forensic examination of Glass, the effects of projectiles on Glass, lamp analysis, Case studies related to Glass.

Unit - III


Unit – IV

Suggested Readings

11. Feigl; Spot test in Organic Analysis, Elsevier Pub. New Delhi, 2005
12. Feigl; Spot test in Inorganic Analysis, Elsevier Pub. New Delhi, 2005
16. Chadha, PV; Handbook of Forensic Medicine & Toxicology, Jaypee Brothers, New Delhi, 2004
17. Parikh, C.K; Text Book of Medical Jurisprudence, Forensic Medicine & Toxicology, CBS Pub. New Delhi, 1999
Unit - I
Pathology: Introduction: Cause and manner of death, medico legal examination, Postmortem examination (AUTOPSY) : the external, or visual, examination, other evidence collected, determining time since death, Laboratory Analysis, consultations.

Unit - II

Unit - III
Entomology, Introduction: Insects and their Biology, Life cycles of insects, collecting insects at a crime scene, the postmortem interval, the classification of insects, rearing insects, calculating A PMI, other forensic uses for insects, case studies.

Unit – IV
Serology and Bloodstain, pattern analysis, Introduction: Collection Body Fluids, the major body fluids, presumptive tests or blood, confirmatory tests or blood, species origin, semen, presumptive tests for semen, confirmatory tests for semen, saliva, urine, bloodstain pattern analysis, determining point of origin, documenting bloodstains at the scene, case studies.

DNA Analysis, Introduction, the nature of DNA, DNA typing, Mitochondrial DNA (mt DNA), Interpretation of DNA typing results, DNA database the FBI Codis system, codis success stories, case studies.

Forensic hair examinations, introduction: Growth of hairs, Microanatomy, human vs, non human hairs, body area determination, ancestral estimation, damage, disease and treatments, comparison of human hairs, DNA and hairs, case studies.

Suggested Readings
11. Chadha, PV; Handbook of Forensic Medicine & Toxicology, Jaypee Brothers, New Delhi, 2004
Semester-I, Paper V  
M.Sc. Forensic Science  
FS-105 Practical : Simulated crime scene exercise & Laboratory analysis of pattern evidence  
L-0,T-0,P-4,S-0 CREDITS-2

**Simulated Crime Scene Exercise on:**
1. Development of latent finger prints, lifting, preservation and comparison of finger prints.  
2. Handling & marking of documents for examination.  
4. Lifting of footprints from different surfaces.  
5. Determination of direction of impact on glass.  
6. Comparison of soil samples by microscopic and density gradient measurements.  
7. To identify whether firearms are country made or factory made.  
8. Lifting of gun-shot residues on shooter’s hand.  
9. To open and draw the diagram of given cartridge & mark it’s components for identification.  
10. Identification of various components of firearm.

**Laboratory Analysis of Pattern Evidence:**
2. Photography and sketching of crime scene.  
5. Cases involving firearms
Semester-I, Paper VI
M.Sc. Forensic Science
FS-106 Practical: Laboratory Analysis of Chemical & Biological Evidence
L-0,T-0,P-4,S-0 CREDITS-2

1. Field test for narcotic drugs
2. TLC of drugs
3. TLC of pesticides
4. Test for ethanol and methanol
5. Preliminary test for explosives
6. Preliminary tests for:
   (a) identification of bloodstain
   (b) identification of seminal stain
   (c) identification of saliva stain.
7. Microscopic examination of semen.
Specialization – Forensic Ballistics
Unit - I
Basic concepts-Atomic and molecular spectroscopy
What is spectroscopy, Electromagnetic spectrum, sources of radiations, their utility and limitations-conventional sources for UV, visible and infrared rays, sources for shorter wavelength radiations(X-ray tubes), α-rays and gamma rays, laser (He, Ne, Argon, dye laser, semi-conductor laser) as source of radiation, resolution of radiations, monochromators and wavelength selection.
Interaction of radiation with matter and its consequences. Reflection, absorption, transmission, scattering, emission, fluorescence, phosphorescence.
Detection of radiations: photographic detectors, thermal detectors, photoelectric detectors, PMT and semiconductor detectors.

Unit - II
Molecular spectra: Qualitative discussion of molecular binding, molecular orbital, types of molecular energies, qualitative discussions of rotational, vibrational and electronic spectra, spectra of polyatomic molecules, Beer-Lambert’s law, derivation and deviations from the law, errors in photometric measurements, photometric accuracy, high precision measurements, calibration of instruments.
Ultra violet and visible spectrophotometry: Types of sources and stability, wavelength selection, filters-cells and sampling devices, detectors, resolution, qualitative detection and quantitative measurement, applications.
Atomic spectra: Qualitative discussion of atomic spectra, energy levels, designation of states, selection rules.
Atomic Absorption Spectrometry (AAS): Instrumentation and techniques, interference in AAS, background correction methods, quantitative analysis.
Atomic Emission Spectrometry (AES): Instrumentation and techniques, arc/spark emission, ICP-AES, comparison of ICP vs AAS methods, quantitative analysis, applications.
Unit - III
Fluorescence and phosphorescence spectrophotometry: Types of sources, structural factors, instrumentation, comparison of luminescence and UV-visible absorption methods.
Infrared spectrophotometry: Dispersive and Fourier transform spectrophotometry (FTIR). Sample handling, quantitative analysis and interpretation of IR spectra, applications.
Raman spectroscopy: Theory, instrumentation and sample handling, correlation of IR and Raman Spectroscopy, applications.

Unit – IV
X-ray spectroscopy: X-ray absorption and fluorescence methods, X-rays diffraction, EDX, Auger Emission Spectroscopy (AES), electron spectroscopy for Chemical analysis (ESCA)
Thermal Analysis Methods: Basic principles and theory, differential scanning colorimetry and differential analysis, thermogravimetry.
Nuclear Magnetic Resonance spectroscopy: Basic principles, theory and instrumentation, applications.

Suggested Readings

Semester-II, Paper VIII
M.Sc. Forensic Science
FS-212: Firearms, Ammunition and Evidentiary Clues
L-4,T-1,P-0,S-1 CREDITS-6

Unit - I
History and development of firearms, their classification and characteristics, various components of small arms, bore and caliber, relation between bore number of shoguns and internal cross sectional diameter of their barrels, choke-purpose, degrees and types, different automatic mechanisms used in small arms – blow back, retarded blow-back, short-recoil operated, long- recoil operated and gas operated mechanisms; rifling, various class characteristics of rifled bore, purpose of rifling, types of rifling, methods to produce rifling, trigger and firing mechanisms, trigger pull, accidental discharge of firearms, cartridge firing mechanism, Projectile-velocity determination, determination of velocity of shot-charge, techniques of dismantling / assembling of various types of firearms, identification of origin- various marks on firearms, improvised/ Country-made/ imitative firearms, and their constructional features, comparative merits of different bores of shotguns, silencers, Headspace and its importance.

Unit - II
Types of ammunition, classification and constructional features of different types of cartridges, types of primers and priming compositions.
Propellants and their compositions-black, smokeless and semi-smokeless powders, various additives in propellants like stabilisers, chemicals for reducing flash, non- hygroscopic agents, chemicals for conversion of propellants into progressive burning, etc, velocity and pressure characteristics under different conditions.
Use of brass/copper for manufacture of cartridge cases, different shapes of cartridge cases and their heads-rimmed, rimless, semi rimmed, belted and rebated.
Various types of bullets and compositional aspects, Jacketed, non-jacketed bullets, round nose, sharp-pointed , boat-tailed, streamlined, soft point, hollow point and other expanding bullets, dum-dum, pencil-point, armour- piercing, tracer and incendiary bullets, latest trends in their manufacture, various types of wads loaded in shot-gun cartridges, shotgun ball ammunition. Identification of origin, head stamp markings on cartridges, improvised ammunition, safety aspects for handling of firearms and ammunition.
Unit - III

Manufacture of firearms, barrel steels, proving of guns, proof-marks. Various processes associated with manufacture of ammunition – both shotgun and all metal-drawing, cleaning, cutting, heading, washing etc. Physical, ballistic and functional test of ammunition- velocity, accuracy, pressure, water and ignition tests, calculation of figure of merit for various standard ammunitions, various defects in cartridge cases produced as a result of firing.

Unit – IV

Crimes committed by firearms, Various types of visible/invisible physical evidence available in crime involving firearms, Photography/Videography/sketching of crime scene; location, documentation, collection, preservation and forwarding of physical evidence, maintaining the authenticity and integrity of physical evidence, various legal requirements in the handling of clue materials, various precautions to be taken while handling the physical evidence, various problems including medico-legal problems arising in crime involving firearms, chain of custody.

Suggested Readings

10. Wilber; Ballistic Science for the Law Enforcement Officer, Charles C. Thomas, USA, (1977)
11. Hayes, T.J; Elements of Ordnance, John Wiley & Sons, Inc, London,
18. Muller and Olson; Smallarms Lexicon & Encyclopedia, Shooter’s Bible Inc. NJ, (1968)
Semester-II, Paper IX  
M.Sc. Forensic Science  
FS-213 Internal Intermediate and External Ballistics  
L-4,T-1,P-0,S-0 CREDITS-5

**Unit - I**
Thermochemistry of propellants- Calculation of heat of explosion, specific heats of propellant gases, explosion temperature, pressure and volume of gases produced by burning of single-base and double- base propellants.

**Unit - II**
Internal Ballistics of Firearms: Definition, ignition of propellants , shape and size of propellant grains, degressive and progressive shapes, degressive and progressive burning, manner of burning, all-burnt position, Force constant-energy equation, various factors affecting internal ballistics, lock time, ignition time, barrel time, Erosion, corrosion and gas cutting, theory of recoil, methods of measurement of recoil, internal ballistics of 12-bore guns.
Intermediate Ballistics: Definition, effects on the motion of projectile and firearm, gas flow field near the muzzle, flash, blast, silencers

**Unit - III**
External Ballistics: Equations of motion of projectile, principal problem of exterior ballistics, vacuum trajectory- calculation of various elements, effect of air resistance on trajectory, points of difference between trajectories in air and vacuum, Nature of air-resistance phenomena, base –drag, yaw, cross-wind force, over-turning moments, stability-fin stabilization and gyroscopic stability, stability factor, nutation and processional motions of bullets, drift, Magnus effect, Greenhill formula, shape of projectile – form factor, ballistic coefficient, calculation of trajectories of various small arm bullets, calculation of trajectories of shotgun projectile, use of Ballistics tables, Automated system of trajectory computation. Falling bullets- limiting velocity, drop, use of lead as bullet material.

**Unit – IV**
High speed photography- various techniques, micro-flash photography, sparks source, photography, flash radiography, Doppler effect.

**Suggested Readings**
2. Sharma, B.R.; Firearms in Criminal Investigation & Trials, Universal


4. Wilber; Ballistic Science for the Law Enforcement Officer, Charles C. Thomas, USA, (1977)

5. Hayes, T.J; Elements of Ordnance, John Wiley & Sons, Inc, London,


Unit - I

Tool -marks: Types of tools marks, compression marks, striated marks, combination of compression and striated marks, repetitive marks, class characteristics, individual and pertinent characteristics.

Principles and practice of identification of firearms, ammunition and their components, how different parts of firearms acquire individual characteristics during their manufacture, types of marks produced during firing process on cartridge cases-firing-pin marks, breech-face marks, chamber marks, extractor and ejector marks, marks on bullets, striation marks of lands and grooves, various factors affecting nature of these marks, measurement of rifling details, i.e., number /direction of lands and grooves, pitch of rifling etc, imprinted on fired bullets, determination of make/ model of the suspected firearm, techniques of obtaining test materials from various types of weapons and process of their linkage with fired ammunition, photomicrography, non-submission of photomicrographs along with report, presence of matching and non-matching characteristics on evidence and test cartridge cases and bullets, source correspondence, number of matching points, furnishing of opinion-definite positive, definite negative, no definite etc., writing of reports, automatic bullet and cartridge comparison systems, linkage of fired shots with suspected shot gun, effects of erosion, corrosion etc., effect of human decomposition on bullet striations.

Unit - II

Determination of range of firing, burning scorching, blackening, tattooing, metallic fouling, GSR distribution and dispersion of pellets, factors affecting these phenomena, the stringing of shots, effect of stringing on pattern, cartwheel pattern, balling, determination of range of firing in case of country- made firearms, characteristics of contact shots, distinction between blackening and lead/ dirt ring, abrasion, back scatter effect, Walker’s test around gun-shot holes in clothes, tests of presence of tattooing around gun-shot holes in skin /head, IR photography of tattooing around gun-shot holes in dark-coloured clothes, use of various instrumentation techniques for estimation of range of firing, effective, killing and extreme ranges.
Unit - III

Testing of barrel wash, chemical tests for testing of lead/ copper around gun-shot holes in clothes, skin and other objects, use of instrumentation techniques in identification of gun-shot holes.

Determination of time elapsed since firing, usefulness, different methods employed and their limitations, attempts based on analysis of residue inside the barrel left after the firing of cartridges loaded with black/smokeless powders, attempts based on analysis of CO, CO2, nitrogen oxides, etc., reasons for not being able to estimate time elapsed since firing.

Use of instrumentation techniques for analysis of propellant particles found on hands of shooter, fired cartridge case, barrel and target.

Unit – IV

Restoration of erased numbers, methods of marking-cast, punch and engraved, methods used for removal of serial numbers, theory behind number restoration, restorations of marks on cast iron, aluminum, brass, wood, leather etc. , chemical methods of restoration (etching), reagents used for various metals, electrolytic methods of restoration-reagents used, ultrasonic cavitation for restoration, magnetic particle method for restoration, other methods of restoration, laser etched serial numbers and bar codes and their restoration, recording of restored marks.

Gun-handling tests-Introduction, Ferrozine test.

Ballistics Data Measurement System.

Suggested Readings

9. Wilber; Ballistic Science for the Law Enforcement Officer, Charles C. Thomas, USA, (1977)
10. Lucas ; Forensic Chemistry and Scientific Criminal Investigation, London, (1945)
1. To separate different components of shotgun cartridges, identify them and record their different measurements.

2. To separate different components of all-metal cartridges, identify them and record their different measurements.

3. To dismantle and assemble various components of firearms.

4. To study the characteristics of firearms-caliber, choke, proof marks etc., to prepare sulphur casts of bore.

5. To study the locks of various firearms, measurement of trigger pull, liability of accidental discharge of firearms.

6. To determine shot number from size and weight of shots

7. To determine/ measure rifling details on fired bullets, determination of make/model of suspected firearm firing the bullet.

8. Determination of velocity and energy of bullets.

9. Examination of air guns / rifles/ handguns as per Arms Act.
1. Photography and sketching of crime scene involving firearms

2. Collection, packing and forwarding of physical clues related to crème involving fire arms.

3. Restoration of erased serial number on firearms

4. Chemical tests of propellants

5. To perform chemical tests for powder residues. (Walker’s test) around gun-shot holes in fabrics.

6. To perform chemical tests for powder residues around gun-shot holes in hard targets.

7. To perform spot test around holes suspected to have been caused by passage of jacketted /non-jacketted projectiles.

8. To perform chemical tests of firearms for detection of firearm discharge residues – to find out whether a given firearm has been fired or not.

9. Comparison of compression/ striated tool marks - to prepare cast/sample for study of compression and striated tool-marks.

10. Opening of parcels received in Lab, precaution to be taken and making of records of the exhibits received.

11. To determine whether given ammunition/ components of ammunition are fired or not.
Semester-III, Paper XIII
M.Sc. Forensic Science
FS-311 Chemical Methods of Analysis
L-4,T-1,P-0,S-0 CREDITS-5

Unit - I
Microscopy: Basic principles, simple and compound microscope, comparison microscope, phase-contrast microscope, stereoscopic microscope, polarizing microscope, fluorescent microscopy, infrared microscopy, scanning electron microscope (SEM) & transmission electron microscope.

Electrochemical Techniques: principles, electron transport processes, ion-selective electrodes (ISE) and gas sensors, oxidation-reduction (Redox) potentials, bio-sensors, anodic stripping voltammetry, applications in analysis of firearm discharge residue.

Radiochemical Techniques: Basic principles and theory, introduction about nuclear reactions, neutron sources, neutron activation analysis (NAA), Applications in Forensic Ballistics.

Unit - II
Chromatographic Techniques: General principles, paper chromatography, column chromatography, TLC, adsorption chromatography, partition chromatography, gas chromatography, gas-liquid chromatography, ion-exchange chromatography, exclusion chromatography, affinity chromatography, HPLC, HPTLC, capillary chromatography, Interfacing GC with IR spectrometry. Applications in analysis of firearm discharge residues.

Unit - III
Mass Spectrometry: Sample flow, ionization methods, mass analyzer, vacuum systems, data handling, correlation of mass spectra and molecular structures, Fourier transform mass spectrometry, tandem mass spectrometry, inductively coupled plasma MS (ICP-MS), ion microprobe mass analyser (IMMA), HR GCMS, LCMS, secondary mass spectrometry, laser mass spectrometry, fast atom bombardment and liquid secondary ion mass spectrometry, high performance liquid chromatography, electrospray ionization mass spectrometry. Applications in analysis of firearm discharge residues.

Unit – IV
Computer-Aided Analysis: Introduction, Computer organization, hardware, circuits for interfacing computers to instruments, computer organisation, software, Data representation, the automated laboratory.

Measurements, Signals and Data: Introduction, signal-to-noise ratio, sensitivity and detection limit, sources of noise, signal-to-noise enhancement, evaluation and measurement, accuracy and instrument calibration.
Suggested Readings

1. Lindsay S; High Performance Liquid Chromatography, Wiley & Sons Ny(1992)
Semester-III, Paper XIV
M.Sc. Forensic Science
FS-312 Terminal Ballistics
L-4,T-1,P-0,S-1 CREDITS-6

Unit - I
Anatomy of human body-overview of organ systems, cavities and planes, skeleton system, naming of all bones of axial and appendicular skeleton.


Unit - II
Physics of shock waves, shock waves within the body, pressure waves in blood vessels. Analysis of gun –shot wound production, physical aspects , behaviors projectile over dense medium-both spherical and elongated, duration of pulsation of temporary cavity, pressure changes as a result of temporary cavity pulsations when the bullet passes through various organs of human body, factors affecting pressure changes, bone fractures in the vicinity of shooting channel.

Quantitative description of temporary cavity, instability of projectile in dense medium and its influence on temporary cavity, dependence of medium resistance upon impact velocity, dependence of length of narrow channel upon angle of incidence at the time of impact, dependence of length of narrow channel upon projectile data (projectile length, transverse moment of inertia, influence of sectional density on the shape of temporary cavity, behaviour of different projectile designs in a target medium, effect of heating of projectile when it moves in side the barrel and when it strikes the target, theoretical consideration – equations for penetration depth in gelatin and muscle tissues ( handgun bullets), penetration capacity of handgun bullets in bones.

Unit - III
Preparation of gel block, penetration of projectiles in gel-block and other targets, methods of measurement of various wounds ballistics parameters, drag coefficient, diameters of temporary and permanent cavities and their volumes
as a result of energy lost in wound production, stopping power, relative stopping power, relative incapacitation index, power index rating, effectiveness of rubber projectiles, fluid jets and gas jets as projectiles.

**Unit – IV**

Nature of wounds of entry, exit and track with various ranges, velocities, various types of projectiles, and in different regions of human body, explosive wounds, Billiard Ball ricochet phenomena, evaluation of injuries caused by shotguns, rifles, handguns, self-inflicted wounds, postmortem and ante-mortem injuries.

Body armour- bullet proof materials, necessary tests.

**Suggested Readings**

11. Wilber; Ballistic Science for the Law Enforcement Officer, Charles C. Thomas, USA, (1977)
Semester-III, Paper XV
M.Sc. Forensic Science
FS-313 Gunshot Residue and Reconstruction
L-4,T-1,P-0,S-0 CREDITS-5

Unit - I
Gunshot residue: Identification of shooter-dermal nitrate test and its abandonment, Harrison and Gilroy test, Price test, mechanism of its formation, plume, morphology and size of GSR particles-regular, nodular and unique, source of GSR in different types of firearms, specific areas of GSR deposition, collection of GSR-various methods, characterization of different matrices by instrumental techniques and use of appropriated matrix to collect GSR, GSR retention, analysis by AAS, NAA, SEM/EDXA, ICP-MS, ASV, Environmental contaminants in GSR considerations, interpretation of results, terminal velocity of GSR particles, time taken for GSR particles to remain airborne, and its importance in crime investigation, collection of GSR from inanimate objects.

Unit - II
Blood Spatter: Blood stains and blood spatter at shooting scenes, classification of blood stains-low velocity, medium-velocity, high velocity impact blood spatter, blood characteristics-viscosity, surface tension, specific gravity, Drop formation and travel, shape of falling drop blood spatter associated with gun-shot injuries, blood on and in weapons, blood on hands of shooter, blood on objects at shooting scene, non-gunshot dynamics that resembles high-velocity impact spatter blood, angle of impact.

Unit - III
Types of glass and their composition-plate glass, safety plate glass, tempered glass, radial and circumferential cacks, forensic examination of glass fractures under different conditions, determination of direction of impact and sequence of shots; cone-fracture, rib marks, hackle marks, backward fragmentation.

Bullet ricochet and its effects, mathematical treatment, establishing critical angle, ricochet angle, deflection angle, establishing position of shooter.

Unit – IV
Reconstruction of sequence of events involved in a shooting case, theory and practice of shooting reconstruction, scientific method of shooting reconstruction, suicide, murder, accident, self-deface, encounter cases. All considerations during direct investigation of shooting incident or without the
benefit of original crime scene investigation- the scene of occurrence, photography of crime scene, sketching of crime scene, medico-legal report, basic ballistic facts, laboratory examination reports, firearms and ammunition, clothes of victim etc.

On scene evidence-evaluation and documentation, off-scene evaluation and investigation, limitations of shooting reconstruction, simple mathematics involved in shooting reconstruction.

Documentation & evaluation of bullet holes, ricochet marks, pellet patterns, estimation of angle of impact, bullet holes in tires and other plastic materials determination of bullet path-use of lasers, cartridge case ejection pattern.

Plotting of gun-shot injuries on body-diagrams, evaluation of gun-shot injuries, to determine wounds of entry/exit, direction of firing, number of rounds fired etc., reconciliation of bullet holes in clothes with underlying wounds, use of blood spatter in reconstruction.

Determination of number of participants/firearms involved, their location, position, orientation at the moment of firing, discussion of some important and complicated cases.

**Suggested Readings**

7. Wilber; Ballistic Science for the Law Enforcement Officer, Charles C. Thomas, USA, (1977)
12. Caddy, B; Forensic Examination of Glass and paint Analysis and Interpretation, 2001
Semester-III, Paper XVI  
M.Sc. Forensic Science  
FS-314 Application of statistics, report writing and Arms Act  
L-4,T-1,P-0,S-1 CREDITS-6

Unit - I  
Probability-theory, classical definition of probability, Basic terms-  
events, trials, mutually exclusive events, favourable events, exhaustive events  
etc. Baye’s theorem of probability, addition theorem, multiplication theorem,  
conditional probability, coincidence probabilities, Binomial distribution,  
normal distribution, hyper geometric distribution, correlated measurements.

Unit - II  
Discriminating power- derivation, evaluation of evidence by  
discriminating power, combination of independent systems, correlated  
attributes, transfer of evidence, likelihood ratio, probability of guilt,  
correspondence probabilities, direction of transfer.  
Tests of hypothesis-tests of significance of attributes, Z-test of  
significance and coefficient of correlation, small sample test, T-test, paired  
test, chi-square test, F-test for equality of variance, large sample test, normal  
test.

Significant figures, precision indices, statistically reliable differences,  
rejection of individual readings, probable error.

Applications of statistics in Forensic Ballistics, Statistical evaluation of  
data regarding Forensic Ballistics obtained by instrumental methods.  
Mathematical considerations of striation matching, etc.

Unit - III  
Report writing and evidence evaluation, Components of reports, report  
formats in respect of crime scene and laboratory findings.

Court testimony, admissibility of expert testimony, pre-court  
preparations and court appearance, examination- in chief, cross-examination  
and re-examination, Discussion of complicated cases.

Unit – IV  
ARMS ACT, Arms Rules, prohibited and Non-prohibited firearms &  
ammunition – All Sections of Arms Act. Examination and reporting of cases  
under Arms Act. Various court ruling relevant to Forensic Ballistics.

Suggested Readings

1. Aitken and Stoney; The Use of Statistics in Forensic Science, Ellis  
Horwood, NY, (1991)
Semester-III, Paper XVII  
M.Sc. Forensic Science  
FS – 315 Practical: Use of Instrumentation Techniques  
L-0,T-0,P-4,S-0 CREDITS-2

1. TLC/ HPTLC of propellants loaded in shotgun, rifle and handgun cartridges.

2. IR spectra of propellants loaded in shotgun, rifle and handgun cartridges

3. FTIR analysis of propellant loaded in shotgun, rifle and handgun cartridges

4. Experiments on GC Analysis of propellants

5. Experiments on HPLC Analysis of propellants

6. FTIR analysis of propellants particles found inside the fired cartridge

7. case, barrel and on the target around gun-shot hole- comparison of results

8. Identification of shooter: gun-shot residue analysis by AAS

9. Identification of suspected gun-shot holes in garments, walls, furniture etc. by AAS
Semester-III, Paper XVIII
M.Sc. Forensic Science
FS – 316 Practical: Identification of Firearms, Reconstruction
L-0,T-0,P-4,S-0 CREDITS-2

1. Linkage of evidence cartridge cases with suspected firearms-examination under comparison Microscope

2. Linkage of evidence bullets with suspected firearms-examination under comparison Microscope.

3. Preparation of gel block and study of wound ballistic parameters for bullets fired from handguns and .22-rifle – determination of entry, exit and path of the bullet on fired gel block.

4. Measurement of spread of pellets fired from shot-guns and determination of range of firing

5. Given an evidence shotgun-pattern, suspected firearms and ammunition- to conduct test firings and estimate range of firing.

6. Given evidence pattern of tattooing, suspected firearms and ammunition recovered -to conduct test firings and estimate range of firing.

7. Plotting of gun-shot injuries on body diagrams

8. Reconstruction of sequence of events in shooting incidents.

9. To study glass fractures, determination of direction of firing and sequence of shots.
Semester-IV, Paper - XIX
M.Sc. Forensic Science
Lab Work and Dissertation

FS- 411 Practical work in-house lab
L-1, T-0, P-8, S-0, CREDITS-5

Semester-IV, Paper - XX
M.Sc. Forensic Science
Lab Work and Dissertation

FS- 412 Attachment at designated lab outside
L-1, T-0, P-8, S-0, CREDITS-5
1. Range determination from spread of pellets fired from country made firearms.

2. To study the effect of range on spread of pellets fired from 12 Bore shot gun using ammunition loaded with power-piston.

3. To study the pattern of tattooing in case of firings from country-made firearms

4. To develop an appropriate method of GSR collection in Indian conditions.

5. Study of GSR using various instrumentation techniques.

6. Study of wound ballistics bullets fired from rifles and handguns.

7. Determination of number of rounds fired.

8. Reconstruction of sequence of events in crime involving firearms.


11. Linkage of suspected cartridge case, firearm with bullet hole.

12. Study of reasons of acquittals of firearm cases & remedies.

13. Study of mechanisms of country-made pistols manufactured in different parts of the country.

14. To study the effects of variations in bullet weight and propellant weight on interior ballistics of small arms.

15. Determination of position of firer.

16. To study the shot-gun ammunition manufactured by various private companies and their ballistics.

17. Study of IR/FTIR spectra of propellants.

18. Any other problem on Forensic Ballistics.
Semester-II, Paper VII  
M.Sc. Forensic Science  
FS – 221 : Instrumentation  
L-4,T-1,P-0,S-1 CREDITS-6

Unit - I  
Lenses, magnifiers, measuring instruments, Principle and working of Simple - Microscope, Stereo microscope, Zoom stereo microscope, Comparison microscope, light sources - UV, IR, transmitted, oblique light, spot light.

Unit - II  

Unit - III  
Principle & working of TLC, HPLC, HPTLC, Electrophoresis, FTIR with ATR and Electrostatic Detection Apparatus.

Unit – IV  
Principle & working of SEM-EXDA, Raman Spectrophotometer, GC-MS, Neutron Activation Analysis.

Suggested reading:

12. Working manual of VSC-5000
Semester-II, Paper VIII  
M.Sc. Forensic Science  
FS – 222 : Techniques of Analysis/Examination  
L-4,T-1,P-0,S-1 CREDITS-6

**Unit - I**
Luminescence, Fluorescence, Phosphorescence, types of paper and Inks, techniques used in the analysis of paper & inks- raw materials, ingredients, tagging materials etc. including NAA techniques.

**Unit - II**
Examination of mechanical impressions - examination of indentation marks, secret writings, examination of rubber stamp and seal impressions, embossed impressions.

**Unit - III**
Determination of sequence of intersecting strokes – all types, examination of creases and folds, determination of sequence of writings over creases & folds.

**Unit – IV**
Reconstruction and examination of torn documents, stabilization and examination of charred documents, case studies.

**Suggested reading:**
8. Cornelis R Ronda, Luminescence: From Theory to Application, 2007
Semester-II, Paper IX  
M.Sc. Forensic Science  
FS – 223 : Document Photography  
L-4,T-1,P-0,S-1 CREDITS-6

**Unit - I**
Basic principles and techniques of black & white and colour photography, cameras and lenses, filters, films, exposing, development and printing, different kinds of developers and fixtures, Reprovit unit, dark room.

**Unit - II**
Specialized photography - UV, IR, transmitted light and side light photography, close up photography, trick photography, contact photography.

**Unit - III**
Digital photography, software for digital photography, file formats for digital photographs – jpg, gif, bmp, tiff, mpeg etc., digital watermarking and digital imaging, photogrammetry, radiography.

**Unit – IV**
Photomicrography, microphotography, photography using scientific equipment, juxtapose charts and demonstrative photographs, photographs as secondary evidence, case studies.

**Suggested reading:**

Semester-II, Paper X  
M.Sc. Forensic Science  
FS – 224 : Document Examination - Overview  
L-4,T-1,P-0,S-1 CREDITS-6

Unit - I  

Unit - II  
Document consciousness, writing instruments, care, handling, preservation, packing and marking of documents - Dos and Don’ts, forwarding of documents.

Unit - III  

Unit – IV  
Development of handwriting, classification of handwritings, different vernacular Indian languages & scripts, Classification of forensic documents.

Suggested reading:

1. Laboratory Equipments: - Working and handling of Stereo Zoom Microscopes, Comparison Microscope, Video Spectral Comparator, Electrostatic Detection Apparatus, UV – Vis, TLC.

2. Examination of Charred Documents.

3. Reconstruction of torn sheets of paper.

4. Examination of creases and folds and determination of sequence of strokes.

5. Examination of paper.

6. Examination of inks.
1. Document photographic techniques – Close up photography, UV, IR, Transmitted and oblique light photography.

2. Contact and trick photography.


4. Photography of Watermarks and wire marks.

5. Photography of secret writings.
Semester-III, Paper XIII  
M.Sc. Forensic Science  
FS – 321 : Principles of Handwriting Examination  
L-4,T-1,P-0,S-1 CREDITS-6

**Unit - I**  
Various writing features— terminology and definitions, observation tests and their applications, general characteristics of handwriting and their estimation, individual characteristics of handwriting and their estimation.

**Unit - II**  
Natural variations in handwriting, disguise in writing, principle of handwriting identification, comparison of like with like, process of comparison – suitability of standards for comparison.

**Unit - III**  
Simon New Comb theory of probability, examination of vernacular scripts, effect of mother tongue on foreign language, effect of age, illness, posture, emotions and writing instrument on handwriting.

**Unit – IV**  
Preliminary examination of documents- various points to be considered during examination, examination of alphabets and numerals, case studies.

**Suggested reading:**

13. Andrea Mc Nichol, Jeffrey A Nelson; Handwriting Analysis Putting it to work for you, Jaico Books, Delhi (1994)
14. Morris (2000); Forensic Handwriting Identification (fundamental concepts & Principals)
Semester-III, Paper XIV  
M.Sc. Forensic Science  
FS – 322 : Document Forgery and Alterations  
L-4,T-1,P-0,S-0 CREDITS-5

**Unit - I**  
Corporate frauds, forensic accounting and auditing, forgeries & their detection, examination of signatures – characteristics of genuine & forged signatures examination of built-up documents, identification of writer of forged writings/signatures. Importance of tremor in identification of writings and signatures, difference between tremors of fraud and genuine tremors in writings and signatures.

**Unit - II**  
Examination of anonymous letters and identification of the writer of anonymous letter, linguistics, stylistics, application of Forensic Stylistics in the identification of writer, application of forensic stylistics in different vernacular languages.

**Unit - III**  
Anachronistic features and their importance, detection and decipherment of alterations and erasures including additions , over writings , obliterations , examination of carbon copies and carbonless copies.

**Unit – IV**  
Use of computers in document examination, automated Signature verification system, determination of age of documents- relative and absolute age of documents, case studies.

**Suggested reading:**  
13. Andrea Mc Nichol, Jeffrey A Nelson; Handwriting Analysis Putting it to work for you, Jaico Books, Delhi (1994)
14. Morris (2000); Forensic Handwriting Identification (fundamental concepts & Principals)
18. Quirke AJ; Forged Anonymous & Suspect Documents- 1930, Reorge Rontledge & Sons Ltd, London.
Semester-III, Paper XV  
M.Sc. Forensic Science  
FS – 323 : Mechanical Impressions & Security Documents  
L-4,T-1,P-0,S-0 CREDITS-5

Unit - I
Examination of type writings & their identification, working and examination of manual, electric and electronic typewriters, cheque writers, identification of typist of manual typewriters.

Unit - II

Unit - III
Examination of security documents including currency notes, travel documents - passports, visas, air - tickets, identity cards, lottery tickets, different types of security features and their examination including watermarks, security fibre/threads /Ghost/imitated marks/ security printing, holograms etc ,

Unit – IV
Examination of credit, debit and other plastic cards, examination of photocopies, scanned documents, Fax copies etc., case studies.

Suggested reading:
13. Andrea Mc Nichol, Jeffrey A Nelson; Handwriting Analysis Putting it to work for you, Jaico Books, Delhi (1994)
14. Morris (2000); Forensic Handwriting Identification (fundamental concepts & Principals)
19. Jeff Tyson : How Inkjet Printers Work
20. John Oldshue: The Credit Card Guidebook
Semester-III, Paper XVI
M.Sc. Forensic Science
FS – 324 : Advances in Document Examination & Quality Assurance
L-4,T-1,P-0,S-1 CREDITS-6

Unit - I
Advances in Forensic Document Examination, introduction to computer forensics, e-document, digital signature, recovery of deleted files & folders from storage media and their examination.

Unit - II

Unit - III
Final examination and report writing - opinion writing and writing of reasons for opinion, importance of no opinion / qualified opinion, marking of photographs and their presentation, preparation of juxtapose charts in support of reasons, case studies.

Unit – IV

Suggested reading:
11. Robert C Newman ; Computer Forensics: Evidence Collection & Management, Georgia Southern University Statesboro, USA.
13. R L Brunelle and K R Crawford; Advances in the Forensic Analysis and dating of writing Ink
Semester-III, Paper XVII
M.Sc. Forensic Science
FS – 325 Practical: Handwritings and Mechanical Impressions
L-0,T-0,P-4,S-0 CREDITS-2

1. Identification of normal / disguised writings.
2. Detection of Forgeries including freehand and traced forgery.
3. Detection of simulated forgery.
4. Detection of built-up documents.
5. Examination of anonymous letters
7. Effect of writing instruments, posture and emotions on handwriting.
8. Examination of alterations, additions, obliterations, overwritings and erasures.
9. Examination of rubber stamp impressions and other mechanical impressions.
10. Examination of typescripts and printed matters.
1. Examination of computer printouts.
2. Examination of photocopies and scanned documents.
3. Examination of fax copies.
5. Examination of Travel Documents – Indian Passports and Visas.
6. Examination of Plastic Cards.
7. Examination of Stamp Papers and Lottery Tickets.
8. Determination of Relative Age of documents.
Semester-IV, Paper - XIX
M.Sc. Forensic Science
Lab Work and Dissertation

FS- 421 Practical work in-house lab
L-1, T-0, P-8, S-0, CREDITS-5

Semester-IV, Paper - XX
M.Sc. Forensic Science
Lab Work and Dissertation

FS- 422 Attachment at designated lab outside
L-1, T-0, P-8, S-0, CREDITS-5
Basic light sources-use of scientific equipments and their handling; Examination of paper, examination of inks, Detection and decipherment of alterations including additions, overwriting, obliterations and mechanical/chemical erasures, Detection and decipherment of secret writings/indentations, charred documents & torn documents, Examination of Disguised/distorted writings/signatures, Identification of writing and signatures, Detection of forgery and fixing the authorship of forged writings/ signatures. Examination of anonymous letters, Application of forensic stylistics & linguistics in personal identification, Identification of type writings (Standard/electric/electronic typewriters), Identification of computer printouts and printers, Examination of photo copies (Black & White, colour), scanned documents and FAX messages, Identification of mechanical impressions (rubber stamp/seal impressions), Identification of printed matter, determination of age of documents, Forgery in credit cards and their examination, Examination of security documents including currency notes, passports and other travel documents, Computer forensics-recovery of deleted files/folders from storage media, e-mail tracking and documentation, Recent advances in forensic document examination. Opinion writing-reasons for opinion, Expert evidence in trial courts, Moot court & XX-examination.

Suggested reading:

5. Jan Seaman Kelly & Brian S Lindblom; Scientific Examination of Questioned Documents-Taylor Francis Group London and New York.
8. Robert C Newman ; Computer Forensics: Evidence Collection & Management, Georgia Southern University Statesboro, USA.
9. R L Brunelle and K R Crawford; Advances in the Forensic Analysis and dating of writing Ink
Specialization – Forensic Chemistry and Toxicology
Semester-II, Paper VII
M.Sc. Forensic Science
FS – 231 : Forensic Chemistry – I
L-4,T-1,P-0,S-0 CREDITS-5

Unit - I
• Analysis of alcohols, alcoholic and non-alcoholic beverages.
• Analysis of country made liquor, illicit liquor and medicinal preparations
• Analysis of various denaturants of alcohol
• Analysis as per BIS specifications, detection and determination of Ethanol, methanol, furfural acetate aldehyde, ester by colour test and instrumental technique,
• Relevant sections of Excise Act.

Unit - II
Petroleum products and their adulterations: Analysis of petrol, kerosene, diesel, lubricants, grease and other fractions by BIS methods and ASTM methods. Detection of adulterants of gasoline, diesel and engine oils.
Essential Commodity Act relevant to petroleum product. Petroleum Act 1919.
Marketing Disciplinary Guidelines 2005 for method of taking samples of petrol diesel. Packing and forwarding of samples to laboratories for examination, procedure for re-examination. Mobile Field Units for testing at the site.

Unit - III
Analysis of trap case:- Mechanism of colour reaction, factor affecting the colour, detection of phenolphthalein and alkali used, method of detection of degraded product on conversion of pink colour to colourless solution by TLC and UV visible spectrophotometer. Photo and videography and voice recording as supporting evidence.

Dyes: Different type of dyes, role of dyes in crime investigation, food colours (edible and non-edible dyes), dyes used in cosmetic and pharmaceutical. Chemical analysis and instrumental methods of analysis of dyes.
Unit – IV

Fertilizers: Introduction to fertilizer, different type of fertilizers and classification, substandard and sub-standard adulterated fertilizers, common adulterants. Chemical and instrumental methods of analysis of fertilizers.

Pesticides: Different types of pesticide, formulation, identification of pesticide, standard or sub-standard or substituted pesticides. Determination of purity by analysis by chemical test, thin layer chromatography, ultra visible spectro-photometry and gas liquid chromatography.

Determination of level of pesticide in water, cold drinks, milk, food materials.

Miscellaneous chemical and Industrial solvent.

Suggested Reading:

5. Working Procedure Manual on Chemistry ; Directorate of Forensic Science MHA Govt. of India
6. Tewari , S.N : Liquor and Narcotic Drugs
11. Essential Commodity Act 1955
15. Tuli Satya Prakash etal ; Advance Inorganic Chemistry, S. Chand Co.(2006)
20. Slack A V ; Chemistry and Technology of Fertilizers , Inter Science Publ. (1996)
21. Laboratory Procedure Manual Forensic Toxicology, Directorate of Forensic Science, MHA, Govt. of India (2005)
Semester-II, Paper VIII  
M.Sc. Forensic Science  
FS – 232 : Forensic Toxicology  
L-4,T-1,P-0,S-0 CREDITS-5

**Unit - I**

Forensic Toxicological examination and its significance.

Branches of Toxicology: Introduction & Scope, Classification of poisons, based on their origin, mode of action, chemical nature, poisons and poisoning in India, Classification of poisoning: accidental, homicidal, suicidal and miscellaneous, sign and symptoms of poisons and antidotes. Factors affecting the intensity of poisoning. Importance of post-mortem examination in poisoning cases, management and medico legal aspect of poisoning cases.

Information to be collected by Investigating Officers and precautions to be adopted while searching crime scene and collecting evidence material in poisoning cases.


**Unit - II**

Classification of matrices- Biological, non-biological and Viscera

Different methods of extraction for volatile poisons of organic and inorganic nature: Solvent extraction, distillation /steam distillation, micro diffusion, dialysis, dry ashing, wet digestion, modified star-otto method, ammonium sulphate method.

Isolation and clean up procedure, separation of poisons and drugs using chromatographic and electro phoresis techniques identification of and estimation of poisons and drugs using chromatographic and spectrophotometric and other instrumental methods, significance of analytical studies with forensic examination.

**Unit - III**

Analysis of Gases and volatile poisons: Analysis of volatile poisons, alcohols, aldehydes, ketones, hydrocyanic acid, chlorinated hydrocarbon, benzene nitro benzene, turpentine in Biological fluids.

Analysis of gaseous poisons carbon dioxide, carbon monoxide, ammonia phoshine, sulfur dioxide, hydrogen sulphide, chlorine in Biological fluids.

Analysis of toxic metals: Arsenic, antimony, mercury, bismuth, lead, thallium, zinc, copper, aluminum, barium, chromium, nickel etc. by dry ashing method and wet digestion method.

Analysis of non metallic (Anions): halides, nitrate, nitrite, sulphite and sulphates, sulphide, phosphates.

Analysis of pesticides : Organo chlorinated, organo phosphoro, carbamates and pyrethroids, aluminum phosphide and zinc phosphide


**Unit – IV**

Method of analysis of acidic/ neutral drugs and poison in viscera: salicylic acid, benzoic acid, cannabinoids aspirin, meprobamate, barbiturates and methaqualone etc.

Method of analysis of basic drugs and poisons from viscera: opium and its alkaloids, atropine, strychnine, brucine, cocaine amphetamines, benzodiazepines, LSD, ketamine etc.

Mechanical poisons-glass, diamond and hair.

Extraction of poisons from blood, urine, stomach wash and vomit, cold drink, food material, toxicological analysis of decomposed materials.

Interpretation of toxicological finding and preparation of reports, limitation of method and trouble shooting in toxicological analysis, disposal of analysis samples, some interesting and their importance in view of specific approach in examination

**Suggested Readings**

8. Steward And Stolman : Toxicology Vol.1 and Vol. 2
Semester-II, Paper IX  
M.Sc. Forensic Science  
FS – 233 : Explosives & Explosion  
L-4,T-1,P-0,S-1 CREDITS-6

Unit - I  
Explosives : Introduction, Assessment of explosives, Thermo chemistry of explosives, Oxygen balance, Explosive power and power index, Temperature of chemical explosion, Force and pressure of explosion, Kinetics of explosive reactions.

Unit - II  
Types of Explosions : Atomic explosion, Physical explosion, Chemical explosion, Explosion and effects, Type of hazards, Effect of blast wave on structures and human etc.  
Classification of explosive materials: Primary explosive material, High or secondary explosion, Detonators and explosives, Pyro technics, Propellants, IEDs and the firing mechanisms of IEDs

Unit - III  
Ignition, initiation and thermal decomposition  
Combustion and deflagration Detonation.  
Development of explosives : Black powder, Nitro Cellulose, Nitro Glycerine, Dynamite, Ammonium nitrate, Commercial explosives (permitted explosives, ANFO and slurry explosives), Military explosives (picric acid, tetry TNT, Nitro guanidine, PETN, RDX, HMX and polymer bonded explosives)

Unit – IV  
Role of Forensic scientist in Post blast investigation, Disposal of bombs, Explosions effects, Collection of samples, Technical report frame work, Home made crude bombs, Evaluation and assessment of explosion site and reconstruction of sequence of events., General methods of manufacture of explosives,  
Analysis of explosive: Methods for extraction of explosive from post blast material/ debris, Qualitative analysis of explosives and explosion residue by colour test, TLC/HPTLC and High Performance Liquid Chromatography and FTIR, GC-mass. X ray diffraction, ICP for metallic component analysis, equipment used for Detection of explosives and explosive devices
Suggested Readings

2. Saferstein R : Criminalistics : An Introduction to forensic Science
6. Cooper PW and Kurowski S R; Introduction to the Technology of Explosive VCH publisher
Unit - I
Basic concepts-Atomic and molecular spectroscopy

Interaction of electromagnetic radiation with matter and its consequences. Reflection, absorption, transmission, scattering, emission, fluorescence, phosphorescence.

Detection of radiations: photographic detectors, thermal detectors, photoelectric detectors, PMT and semiconductor detectors. Atomic spectra, energy levels, quantum, numbers and designation of states, selection rules, qualitative discussions of atomic spectra. Elements of X-ray spectrometry-fluorescence, energy Dispersive X-ray analysis (EDX), wavelength Dispersive X-ray analysis (WDX), X-ray diffraction, Augur effect.

Molecular spectra: Qualitative discussion of molecular binding, molecular orbital, types of molecular energies, qualitative discussions of rotational, vibrational and electronic spectra, spectra of polyatomic molecules, IR spectroscopy-correlation of infrared spectra with molecular structure, Fourier Transform, infrared and Raman spectroscopy, florescence and phosphorescence spectrophotometry.

Unit - II
Ultra violet and visible spectrophotometry: Types of sources and stability, wavelength selection, filters-cells and sampling devices, detectors, resolution, Lambered and Beers Law, effect of Chemical Structure on absorption spectra, qualitative and quantitative analysis Application in forensic chemistry and toxicology.


Atomic Emission Spectrometry (AES): Instrumentation and techniques, arc/spark emission, ICP-AES, comparison of ICP vs AAS methods, quantitative analysis, ESCA and its applications.

Fluorescence and phosphorescence spectrophotometry: Types of sources, structural factors, instrumentation, comparison of luminescence and UV-visible absorption methods and applications.

Infrared spectrophotometry: Basic principle, components, Sample handling, Dispersive and Fourier transform spectrophotometry, (FTIR). Qualitative analysis and interpretation of IR spectra, applications.
Unit - III
pH metry, Potentiometry, Conductometry.
Electrochemical Techniques: Principles, Electron transport processes, Ion-selective electrodes (ISE) and gas sensors, Oxidation-reduction (Redox) potentials, Biosensor, Polarography, Anodic stripping Voltammetry.
X-ray spectroscopy: X-ray absorption and fluorescence methods, X-ray diffraction, Auger emission spectroscopy and applications.

Unit – IV

Suggested Readings

17. Tebbet I; Gas Chromatography in Forensic Science (1992)
1. Analysis of liquor as per, BIS specifications.

2. Analysis of country liquor and denatured spirit by Gas Liquid Chromatography.

3. Detection and identification of phenolphthalein and other constituents in trap cases by colour test, TLC and UV - visible spectrophotometry.

4. Analysis of petrol, kerosene and diesel by chemical physical and gas liquid chromatograph for detection of adulteration of petrol and diesel with kerosene

5. Qualitative analysis of explosives and explosive residue by colour test and TLC/HPTLC and HPLC

6. Identification and comparison of explosives by FTIR.

7. Detection and identification of pesticide in a given formulation by colour test, TLC and UV-visible spectrometer/GLC

8. Analysis of dyes by TLC and UV-visible spectrometer.

9. Comparison of component of cosmetic stain from crime scene and suspect is clothing by spectrophotometry method UV/FTIR.

10. Chemical analysis of given fertilizer by chemical test and instrumental techniques.
1. Analysis of viscera for volatile poisons (Organic and Inorganic).

2. Detection and identification of metallic poisons in viscera and food material by chemical test and instrumental technique.

3. Analysis of non-metallic (anionic) poisons in viscera.

4. Analysis of viscera for organochloro, organophosphoro, carbamates and pyrethroids by colour test TLC/HPTLC and UV-visible spectrometry method.

5. Determination of alcohol in blood and urine sample.


7. Systematic extraction, and identification and non-volatile drugs and poisons by various techniques.

8. Analysis of blood, urine, stomach wash in emergency cases of poisoning.

Unit - I
Arson and Fire: Chemistry of fire, difference between Arson and Fire, Material and Chemicals use in initiating fire and arson

Examination of scene of fire/arson recognition and collection of evidence, packing labeling and forwarding of exhibits, cause of fire and origin of fire.

Methods of extraction from exhibit- direct extraction, distillation and micro diffusion methods, advantage and their limitations.

Methods and techniques used in identification colour tests, UV visible spectrophotometry, TLC and gas chromatography.

Laws related to fire and arsons.

Unit - II
Cement, Concrete and Mortar: Chemical compositions Portland cement, and other type of cements, building materials, Methods of samplings of cements, mortar and concrete

Common adulterant of cement and their detection.

Methods of analysis-Chemical analysis of cement, mortar and concrete, Instrumental method of analysis of by ICP, AAS and XRD.

Paint and pigments: General introduction of paints and pigments, types of paints and pigments-paints for building and automotive paint, and their chemical composition, forensic importance of paints and pigments especially in hit and run accidents, transfer on tools in burglary/dacoity, authenticity of brand of paint.

Method of collection of paint and preservation of evidence. Inorganic analysis of paint by chemical and microscopic examination and instrumental methods of analysis laser spectrograph IR spectrophotometer, X ray fluorescence, SEM- EDX and organic component analysis by pyrolysis gas chromatography coupled with mass spectrometer. Case- studies.

Unit - III
Metals and Alloys: Importance of analysis of metals and alloys, different types of metals and alloys commonly encountered for analysis.

Identification & composition of metals and alloys, purity of metals including precious metals such as gold, silver and platinum. Hall marking of precious metal according to BIS.

Trace element analysis: Trace analysis and its importance in forensic analysis, comparison of two pieces of metals, comparison of precious idols in
temples, museum in cases of theft & substitution of statues and idols. Trace element analysis for source correspondence, Analysis of metals and alloys, by chemical methods and instrumental technique, Atomic absorption spectrometer, ICP, XRF and laser spectrograph.

Fibre: Different types of fibres their chemical composition importance of fibre, matching of fibre from crime scene and from the suspect, matching of fibre by FTIR, spectrophotometer comparison of dye component and pyrolysis gas chromatography

Unit – IV

Chemical warfare agent: Classification, physical and chemical properties, toxic effects and detections and protection.

Environmental Pollutions:- Common air pollutant, water and soil pollutant, permissible limit.

Oils and fats: Different types of common oils and fats, their chemical composition, identification and purity determination. Detection of adulterants by chemical, TLC and other instrumental methods & analysis.

Acid Alkalies, soap and detergent miscellaneous chemicals.

Suggested Reading:

7. Caddy Brain ; Forensic Examination of Glass and Paint, Taylor and Francis (2000)
16. Sun Yin; Detection Technologies for Chemical Warfare Agent and Toxic Vapours
Unit - I

Modern methods of Extraction Isolation: Solid phase extraction, solid phase micro extraction techniques accelerated solvent extraction, ion – pair formation and extraction. Separation of poisons and drugs by chromatography and electro phoretic techniques including column chromatography, preparative TLC & HPLC and micellar technique and size exclusion Chromatography.

Hair analysis: Importance of hair for forensic examination of drugs and poisons, procedure of collection, storage preservation, method of extraction of drugs and poisons from hair and their identification using instrumental techniques.

Unit - II


Unit - III

Food poisons: What is food poison, Food poisoning due to chemical and bacterial, Sign and symptoms of food poisoning, collection and preservation of evidence material, extraction and isolation, from food material, Biological material, detection and identification by colour test, and Instrumental techniques.

Plant Poisons: Introduction, classification of plant poisons and their main active constituent and characterization, method of extraction of plant material from biological samples identification by microscopic, colour test, thin layer chromatography and other instrumental techniques TLC, GLC HPLC and UV-Visible spectrometric method, and mass spectrometer.

Animal Poisons: Commonly encountered poisonous animals, snake venom and insect bite, mode of ejection and transmission of venom, active constituents of venom, action of venom, sign & symptoms, Isolation of poisons from biological material and viscera. Analysis of snake venom for cholinesterase and thromboplastin in around bite, toxicity test, clot quality and precipitant test, gel diffusion and immunoassay, Cantharide and poisonous scorpion and lizard.
Common poisons used in animal poisoning including wild life animal poisoning cases.

**Unit – IV**

Radioactive Isotopes and compounds: Introduction nuclear energy and radioactive sources of exposure and contact, acute and chronic effect on the organs of the body methods of detection and measurements handling and disposal of body and tissues containing radioactive material. Medico-legal interpretation.

Environmental Forensic Toxicology: Introduction, principles and application, various pollutants, identification of biased environmental data, ground water characterization, soil, vapour survey, analytical methods. Forensic techniques in environmental litigation.

Quarter nary Ammonium drugs and poisons: Introduction, different type of quarter nary ammonium drugs pesticide and their pharmacological action problem associated with extraction from pharmaceutical products and biological material. Method of extraction using Ion pair (drug –dye complex) method. Isolation and Identification by TLC, and UV Visible photometry.

Ptomaine: Introduction, interference caused in analysis of poison, especially in putrefied viscera, poisoning cases due to ptomaine.

**Suggested Reading :**

1. Laboratory Procedure Manual Forensic Toxicology Directorate of Forensic Science MHA Govt of India (2005)
11. Chang L W ; Toxicology of Metals , Lews Publ.
13. Raychaudhry S P ; Environmental Pollution and Toxicology , Today & Tomorrow printer & Publ. (1979)
14. Caius J F ; Medicinal and Poisonous Plant of India Scientific Publisher (India)2003
Semester-III, Paper XV  
M.Sc. Forensic Science  
FS – 333 : Forensic Analysis of Drugs  
L-4,T-1,P-0,S-0 CREDITS-5

**Unit - I**
Narcotic Drugs and Psychotropic Substances and other Drugs of Abuse.  
Drug dependence, drug addiction and its problems.  
Sampling procedure and relevant notification, circular for collection of NDPS drugs. Laboratories authorized to conduct examination an expert authorized to report NDPS substances, disposal of case property.

**Unit - II**
Classification of Drugs, commonly encountered for analysis: Narcotic drugs, depressants, stimulants, hallucinogens, designer drugs, club drugs, drugs of sports.

**Unit - III**
Analysis of Drugs: Analysis of Narcotic drugs, opium and alkaloids, morphine, heroin and opioids.  
Depressants: Barbiturates, methaqualone, benzodiazepines  
Stimulants: Cocaine and amphetamines and related derivatives  
Hallucinogens: ganja, hashish (Charas), LSD, Mushroom and Cactile.  
Designer drugs, club drugs, sports drugs and precursors.  
Field test, colour test, micro crystal test, thin layer chromatography

**Unit – IV**
Detection of common adulterants and determination of percentage purity in seized samples, detection identification, quantitation of drugs in pharmaceutical products. Analysis of illicit drugs and search of clandestine laboratory, precursors and their analysis. Estimation of morphine in opium and heroin in smack.
Analysis of drugs in biological samples and their importance: Hair, urine, blood, viscera, methods of extraction of drugs/consultation of drugs.

Limitation of chemical analysis of drugs. Report writing and interpretation of drugs.

Court testimony in NDPS Act cases.
Case studies and ground for acquittal and grant of bail.

Suggested Reading:

15. Tebbet I ; Gas Chromatography in Forensic Science (1992)
Unit - I

Unit - II
Raman spectroscopy : Basic principles, applications, Instrumentation, sample handling and illumination, structural analysis, polarization measurements and Dispersive & FT analysis. Applications.
Nuclear Magnetic Resonance spectroscopy: Basic principles, theory and Instrumentation, Applications

Unit - III
Radio chemical techniques: Basic principles and theory introduction about nuclear reactions and radiations, Neutron sources, Neutron Activation Analysis (NAA)
Hyphenated techniques: Gas Chromatography coupled with FTIR, Gas Chromatography coupled with mass spectrometry, LC coupled with mass spectrometry, ICP coupled with mass spectrometry and their applications

Unit – IV
Immunological techniques: General principles, Production of antibodies, Precipitin reaction, Gel immune-diffusion, Immuno-electrophoresis, complement fixation, Radio Immuno Assay (RIA), ESISA, Fluorescence immune assay for detection and quantitation of drugs and poisons in biological materials.
Scanning Electron Microscope, (SEM): basic principles, components, SEM, coupled with Energy Dispersive X-ray, and applications in forensic science.
Suggested Readings:

1. Analysis of residue material in fire and arson cases by TLC/, UV-spectrophotometric and gas chromatography.

2. Analysis of paint and pigment by microscopic, chemical analysis, TLC/HPTLC, FTIR.

3. General analysis and identification of metal and alloys by chemical method and instrumental techniques.

4. Determinations of purity of method by atomic absorption spectrophotometer.

5. Comparison of fibres by chemical analysis, TLC/HPTLC/ FTIR

6. Detection of adulteration in oils and fats by chemical analysis and TLC/ HPTLC.

7. Identification of narcotic Drugs : opium and alkaloids, morphine and heroin, cannabis by colour test TLC, and instrumental techniques.

8. Identification of psychotropic drugs-Barbiturates, benzodiazepines and bhang, Ganja, charas, by colour test, TLC and instrumental techniques.

9. Determination of morphine in a given sample by UV-visible spectrometer / HPLC

10. Gas chromatography analysis of Ganja and charas

11. Experiment of FTIR spectra of benzodiazepines
1. Analysis of viscera and food material for in case of food poisoning by chemical microscopic and instrumental techniques.

2. Identification of common plant poisons Kaner, Dhatura and Nux Vomica, Aconite by colour test and instrumental techniques.

3. Analysis of animal and insect toxins


5. Systematic analysis of viscera & blood in case of plant poisoning and animal poisoning

6. Determination of phosphine in aluminum phosphide and zinc phosphide in viscera (simulated sample) by chemical and instrumental techniques.

7. Extraction of metallic, poison and drugs from hair samples

8. Detection and identification of major metabolites of ethanol and methanol, parathion, acetyl salicylate, carbaryl and heroin.
Semester-IV, Paper - XIX
M.Sc. Forensic Science
Lab Work and Dissertation

FS- 431 Practical work in-house lab
L-1, T-0, P-8, S-0, CREDITS-5

Semester-IV, Paper - XX
M.Sc. Forensic Science
Lab Work and Dissertation

FS- 432 Attachment at designated lab outside
L-1, T-0, P-8, S-0, CREDITS-5
Role of chemist at Crime, Scene Examination, Receipt and dispatch of cases in the Forensic Chemistry Division of FSL/CFSLs of the Country. Good laboratory practices based on NABL/ISO Guidelines. Significance of using control, reagent blank & reference standard in chemical analysis of Forensic Exhibits. Latest techniques used for extraction, isolation and clean up of the samples before analysis, Qualitative and quantitative analysis of chemical compounds including analysis of trace evidence present in different matrixes using state-of-the-art sophisticated equipments. Trouble shooting in chemical analysis at each level: Interpretation of technical/analytical data and forming of expert opinions for the law courts. Testimony of experts in the count.
Specialization- Forensic Biology, Serology and DNA Profiling
Unit - I

Unit - II
Introduction to body function: External and internal environment, homeostasis. Negative and positive feedback mechanism. Essential body function- procuring and ingestion of food, respiration, excretion of waste products. Need for movement. Mode of communication within the body. Importance of electrolytes, acids and alkalis, carbohydrates, proteins and fats in the body.

Unit - III

Unit – IV
Skin and its appendages- structure and functions, pigmentation, blood and nerve supply. Structure of hair and hair follicle, hair cycle- anagen, catagen, telogen. Arrector pilli, muscles, sebaceous glands, nails, sweat gland. Muscle- skeletal, striated, non-striated, voluntary, involuntary. Organization of muscle fibres in muscle. Tendons. Nerves tissues- neuron structure, type of neurons, synapse, grey and white matter, peripheral nerves, ganglia.
Suggested Readings


6. S. Wright, Applied physiology; Oxford University Press,(1961)


Semester-II, Paper VIII  
M.Sc. Forensic Science  
FS – 242 : Forensic Osteology and Odontology  
L-4,T-1,P-0,S-0 CREDITS-5

Unit - I


Unit - II

Exhumation, recovery of fleshed and burnt remains, packaging and storage of human skeletal remains. Distinguishing Humans from other non- human skeletal remains. Nonhuman Animal bones commonly confused with human bones. Laboratory Examination of skeletal and decomposition remains-maceration, skeleton analysis and trauma analysis.

Unit - III


Unit – IV

Other techniques of identifying skeletal remains : Facial reconstructions, Cranio facial superimposition, Video superimposition, Osteon counting, Bite mark analysis. Skeletal Trauma and identifying skeletal pathology- Anti-mortem, peri-mortem and post-mortem trauma and Pseudo trauma.

Suggested Readings

2. Fazekas, I Gy; Forensic m foetal Osteology, Akademiai Kiado(1978)


5. Marion, Krogman Wilton; Human skeleton in forensic medicine, Charles C Thomas, (1986)


8. Krogman, W.M.. The Human Skeleton in Forensic Medicine, Chalres C Thomas, Springfield, (1973)


Semester-II, Paper IX  
M.Sc. Forensic Science  
FS – 243 : Forensic Anthropology  
L-4,T-1,P-0,S-1 CREDITS-6

Unit - I  
Genesis and development of forensic anthropology. Personal identification of living persons- Identification through somatometric and somatoscopic observation, nails, occupation marks, scars, tattoo marks and deformities; handwriting and mannerisms. Genetic traits of forensic significance: Colour blindness, ear lobe, brachydactyly, polydactyly, widow’s peak, eye colour, hair colour, face form, frontal eminences, nasal profile, nasal tip, lips, chin form. Identification of the recently dead and decomposed bodies.

Unit - II  
Major stages of human growth and development- Prenatal growth, Postnatal growth and their characteristics, Factor affecting growth- Genetic and Environmental. Methods of studying Human Growth, Significance of age in growth studies Methods of assessing age-chronological age, dental age, skeletal age, secondary sex character age and morphological age.

Unit - III  
Techniques for recovering skeletonised human remains. Laboratory analysis of skeletal and decomposing remains; maceration, skeletal analysis. Trauma analysis and identifying skeletal pathology. Antimortem, perimortem, post-mortem and pseudo mortem trauma. Pathological changes in bone.

Unit – IV  
Morphology and biochemistry of human and animal hair, hair growth and development, microscopical examination-, determination of origin race, sex, site, Hair types and morphology- hair growth rate, hair distribution, hair growth pattern. Hair colour and its variation. Forensic and microscopic examination of human and non-human hair, common animal hair- wool type fibres, cat and dog hair. Microscopic features- diameter, pigment, cortex, cuticle, cross section. ABO grouping and isozyme typing from hair roots. Collection & preservation of hair samples.

Suggested Readings

1. Anil Mahajan & Surinder Nath; Application areas of anthropology, Reliance Publishing house,( 1992)
2. V.Rami Reddy; Dental Anthropology, Inter-India Publication, ( 1985)
7. Nirmal Kumar Bose; Anthropology, Narayan Press, (1972)
9. Robertson, James; Forensic examination of hair, Taylor & Francis, (1999)
Semester-II, Paper X  
M.Sc. Forensic Science  
FS – 244 : Forensic Botany and Wild Life Forensics  
L-4,T-1,P-0,S-1 CREDITS-6

Unit - I

General plant classification schemes. Sub specialisation of forensic botany- plant morphology, plant anatomy, plant systematic, palynology, plant ecology, limnology, Plant architecture- roots, stems, flowers, leaves. Practical plant classification schemes:- vegetables and herbs, fruits bearing trees and plants, landscaping plants: trees, shrubs and vines, grasses, plant cell structure and functions. Basic plant tissues

Unit - II

Various types of woods, timbers, seeds and leaves and their forensic importance. Identification and matching of various types of wood, timber varieties, seeds and leaves. Types of fibres – forensic aspects of fibre examination- fluorescent, optical properties, refractive index, birefringence, dye analysis etc . identification and comparison of man–made and natural fibres. Various types of Planktons and diatoms and their forensic importance Diatoms types morphology, methods of isolation from different tissue. Study and identification of pollen grains, Identification of starch grains, powder and stains of spices etc. Paper and Paper Pulp identification, Microscopic and biochemical examination of pulp material.

Unit - III

Various types of poisonous plants-abrus precatorius, Aconitum, Anacardium occidentale, argemone Mexicana, calotropis, cannabis sativa, claviceps purpuria, cinchona, croton tiglium ,atropa belladonna, erythroxylum coco, gloriosa superb, jatropha curcas, lathyrus sativus, manihot utilissima, nerium indicum, nicotiana tabacum, plumbago, ricinus communis, semicarpus anacardium, strychnos nux vomica, thevetia nerifolia, Types of plants yielding drugs of abuse – opium, cannabis, coco, tobacco, dhatura, Psilocybin mushrooms.

Unit – IV

Introduction and importance of wild life. Protected and endangered species of animals and plants. Sanctuaries and their importance. Relevant provision of wild life and environmental act. Types of wildlife crimes, different methods of killing and poaching of wildlife animals.

Suggested Readings

1. Hosetti, B.B; Concept in wildlife Management, Daya Publishing
2. Linarce, Adrian; Forensic science in wildlife investigation, CRC Press, Taylor & Francis, (2009)
7. N. Clifford; Timber Identification, Leonard Hill Ltd., (1957)
10. R.W. moncrieff; Man made fibres, Newnes butter worth, (1975)
15. Gangulee, Hirendra Chandra; College botany, New Central Book Agency, (1972)
16. Esau, Katherine; Plant anatomy, Wiley Eastern Ltd, (1965)
Semester-II, Paper XI  
M.Sc. Forensic Science  
FS – 245 Practical: Forensic Anthropology  
L-0,T-0,P-4,S-0 CREDITS-2

1. Morphological & microscopic examination of hair.

2. Examination of blood stains: physical and chemical tests; spectroscopic examination.

3. Menstrual blood and its examination by microscopic and electrophoretic methods.

4. Identification of human bones and determination of their sides.

5. Determination of age from skull, teeth, sex from skull and pelvis


7. Examination of seminal stains: crystal tests, chemical, biochemical, microscopical and electro-immuno-diffusion test.

8. Examination of saliva and its stains: microscopical and chemical tests.

9. Examination of urine stains.

10. Faecal stains: chemical and microscopical examination, testing of urine and sweat.
Semester-II, Paper XII  
M.Sc. Forensic Science  
FS – 246 Practical: Forensic Botany  
L-0,T-0,P-4,S-0 CREDITS-2

1. Morphological & microscopic examination of fibres.
2. Microscopic and chemical comparison of paper pulp.
3. Identification of diatoms.
4. Identification of pollen grains.
5. Identification of starch granules.
6. Common staining techniques and laboratory exercises for identification of different plant cell types.
7. Microscopy of various plants fibres.
8. Differentiation of fibres including sisal, manila, jute and cotton based on ashing.
10. Section and cutting of plant material and their examination.
Semester-III, Paper XIII
M.Sc. Forensic Science
FS –341 : Forensic Medicine , Entomology and Microbial Forensics
L-4,T-1,P-0,S-0 CREDITS-5

Unit - I
Death : Signs of death and changes after death. Somatic death, molecular death ,early changes after death - Algor mortis, rigor mortis, cadaveric spasm, heat stiffening, cold stiffening, changes in blood, chemical changes in cerebrospinal fluid, changes in vitreous humour, post mortem lividity, fluidity of blood,. Late changes – putrefaction- external and internal changes. Adipocere, mummification, gastric content and bladder content and time of death from growth of hair and nails .destruction of body and tissues by maggots and other insects, rodents, fish and crabs, moulds . Sudden death, post-mortem demonstration of myocardial infarction Medico legal aspects of death- Asphyxia, syncope, coma, death by starvation, drowning, hanging and strangulation. Causes and mechanism of traumatic death, manner of death . Classification of traumatic deaths.

Unit - II

Unit - III
Forensic Entomology- History, significance, determination of time since death- Dipterean larval development & successional colonization of body, determining whether the body has been moved, body disturbance, presence and position wounds, linking suspect to the scene, identification of drugs and toxins from the insects and larvae feeding on the body, entomology as an evidentiary tool in child and senior abuse cases and animal abuse cases, collection of entomological evidence.
Unit – IV

Structure and function of the major organ systems: digestive, respiratory, endocrine, nervous, excretory, reproductive, cardiovascular and neuromuscular. Microorganism responsible for food poisoning. Times of digestion of foods. Collection, preservation and forwarding of samples—vomit, stool, stomach wash and residual food etc. Microorganism encountered in biological warfare.

Suggested Readings

1. B.V.Subrahmanyam; Modi’s Medical jurisprudence, Lexis Nexis butterworth, (1988)
2. WDS. Mclay; Clinical forensic medicine, Greenwich medical media, (1990)
4. R.Shepherd; Simpson’s forensic medicine, Oxford University press,(2003)
10. S.K. Lahiri; Elements of medical jurisprudence, Prabasi press, (1973)
14. Catts E.P & Haskell NH; Entomology & death- A procedural guide, Joyce’s print shop (1990)
Semester-III, Paper XIV  
M.Sc. Forensic Science  
FS –342 : Forensic Genetics and Bioinformatics  
L-4,T-1,P-0,S-0 CREDITS-5

Unit - I


Unit - II


Unit - III


Unit – IV

Suggested Readings

1. Goodwin, William; An Introduction to Forensic Genetics, John Wiley & Sons Ltd, (2007)
5. Lewin, Benjamin; Genes IX, Jones and Bartlett Publishers, (2008)
10. Strickberger, Monroe; Genetics, Prentice Hall of India Ltd., (2005)
12. Hedrick, Philip W; Genetics of populations, Jones and Bartlett publishers, (2005)
20. Griffith A.F. et al; An Introduction to Genetic Analysis, Freeman
Unit - I

Immune system, immune response, innate and acquired immunity, antigens, antibodies, haptens and adjuvants, immunoglobulin- types, physico-chemical properties and function, raising of anti-sera, Lectins - their forensic significance. Buffers and serological reagents, methods of sterilization employed for serological work..

Unit - II

Composition of blood, Formation of blood, Blood groups – history, biochemistry and genetics of ABO, Rh, Mn and other systems. Methods of ABO blood grouping (absorption-inhibition, mixed agglutination and absorption elution) from blood stains and other body fluids/stains viz. menstrual blood, semen, saliva, sweat, tear, pus, vomit, hair, bone, nail etc., blood group specific ABH substances. Secretors and non- secretors. Blood groups that make racial distinctions. Lewis antigen, Bombay Blood groups. HLA antigens and HLA typing . Role of sero-genetic markers in individualization and paternity disputes. Pitfalls in red cell typing .

Unit - III

Determination of human and animal origin from bones, hair, flesh, nails, skin, teeth body tissue, fluids/ stains viz. blood, menstrual blood, semen, saliva, sweat, tear, pus, vomit, etc., through immunodiffusion and immuno-electrophoresis, cross reactivity among closely related species. Individualization of blood stains: Determination of blood groups, sex age and racial origin from dried bloodstains.

Unit – IV

Red cell enzymes : Genetics , polymorphism and typing of PGM, GLO-I, ESD, EAP, AK, ADA etc. and their forensic significance. Serum proteins : Genetics , polymorphism and typing of - Hb, HP, Tf, Bf, C3 etc. and their forensic significance.

Suggested Readings

1. Wiener, Alexander S; Advances in blood grouping II, Grune & Stratton, (1965)
2. Boorman, Kathleen E,Churchill ; Blood group serology Livingstone,1977
6. Sussman, Leon N, Charles C Thomas; Paternity testing by blood grouping, 1968
Unit - I

Outline of genetic manipulations, enzymes in genetic manipulation, basic molecular cloning procedures, isolation of specific nucleic acid sequences – complementary DNA, genomic library construction, preparation of plasmid DNA, sub cloning, colony hybridization, Nick translation, Oligo nucleotide probes, expression of genes. Nucleic acid hybridization and DNA sequencing.

Unit - II


Unit - III

Concept of sequence variation - VNTRs, STRs, Mini STRs, SNPs. Detection techniques - RFLP, PCR amplifications, Amp-FLP, sequence polymorphism, Y-STR, Mitochondrial DNA. Evaluation of results, frequency estimate calculations and interpretation, Allele frequency determination, Match probability – Database, Quality control, Certification and Accreditation.

Unit – IV

History of DNA profiling applications in disputed paternity cases, child swapping, missing person’s identity, civil immigration, veterinary, wild life and agriculture cases. legal perspectives – legal standards for admissibility of DNA profiling – procedural & ethical concerns, status of development of DNA profiling in India & abroad. Limitations of DNA profiling. Population databases of DNA markers – STRs, Mini STRs, SNPs. New & Future technologies: Analysis of SNP, DNA chip technology- Microarrays Cell free DNA, Synthetic DNA.
Suggested Readings

2. Inman, Keith; An Introduction to Forensic DNA Analysis, CRC Press, (1997)
11. Robertson, J; DNA in forensic science, Ellis Horwood Ltd., (1990)
1. Determination of species of origin of blood, semen and saliva.

2. ABO grouping of bloodstains by absorption elution, absorption inhibition and mixed agglutination techniques.

3. ABO grouping from hair root

4. Rh grouping of bloodstains

5. MN grouping of blood stains

6. Determination of secretor status in saliva by inhibition techniques.

7. Experiments on electrophoresis of red cell isozymes viz. PGM, GLO, EsD, EAP, ADA, AK.

8. Experiments on electrophoresis of serum proteins Hp, Tf, C3, Bf, Gc etc.

9. Experiments on separation of SAP/VAP.

10. Preparation of lectins and testing their activities against body fluids and tissues.
1. DNA – isolation from blood and bloodstains.
2. DNA – Isolation from bones.
3. DNA – Isolation from teeth.
4. DNA – Isolation from organs/tissues.
5. DNA – Isolation from saliva stains.
6. DNA – Isolation from hair root.
7. DNA – Isolation from other seminal stains
8. DNA – Isolation from nails.
9. DNA – Isolation from vegetable material.
10. Quantity and quality assessment of DNA extracted by various methods from different biological samples.
11. PCR – amplifications and STR typing through vertical polyacrylamide gel electrophoresis and silver staining.
12. PCR – amplifications and STR typing with automatic DNA sequencer.
Semester-IV, Paper - XIX
M.Sc. Forensic Science
Lab Work and Dissertation

FS- 441 Practical work in-house lab
L-1, T-0, P-8, S-0, CREDITS-5

Semester-IV, Paper - XX
M.Sc. Forensic Science
Lab Work and Dissertation

FS- 442 Attachment at designated lab outside
L-1, T-0, P-8, S-0, CREDITS-5
Study of the latest techniques used in Forensic Biology and Serology including DNA profiling with their historical developments. Forensic applications of Anthropological, Botanical, Entomological, Diatom logical and Microbial studies. Identification and characterization of body fluids and tissues using microscopical, chemical, biochemical serological, electrophoretic and iso-electrophoretic techniques. DNA isolation from various biological samples of human, animal & plant origin and DNA profiling for forensically significant markers. Allele frequencies of serogenetic and DNA markers of forensic significance in population groups of India.

Project work on forensically significant and need based problems in the area of Forensic Biology/Serology/DNA Profiling viz. Osteological, Odontological, Physiognomical, Palynological, Diatomological, Entomological and anthrometric. Hair & Fiber characterization, generation of allele frequency data on serogenetic and molecular markers on human population groups. Studies on the stability of Serogenetic and DNA markers in aged and environmentally affected biological samples of human, animal and plant origin.
## M. Sc. FORENSIC SCIENCE- Forensic Ballistics

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