UNIVERSITY OF DELHI

MASTER OF SCIENCE
(FORENSIC SCIENCE)

M.SC IN FORENSIC SCIENCE
(Two year full time Programme)

[Rules, Regulations and Course contents]

(Four-Semester Course)

DEPARTMENT OF ANTHROPOLOGY
FACULTY OF SCIENCE
UNIVERSITY OF DELHI
DELHI-110007

MASTER OF SCIENCE
(FORENSIC SCIENCE)
TWO YEAR FULL-TIME PROGRAMME
AFFILIATION

The proposed programme shall be governed by the Department of Anthropology, Faculty of Science, University of Delhi-110007.

ELIGIBILITY

Any student who has completed B.Sc Chemistry, Physics, Botany, Zoology, Anthropology, Bio-Chemistry, Bio-Physics, Mathematical Sciences, Bio-Tech, Genetics, Microbiology or B.Pharma, B.Tech, MBBS, BDS or life sciences with minimum 55% marks from a UGC recognized University.

PROGRAMME STRUCTURE

The M.Sc. Programme is divided into two Parts as under. Each Part will consist of two Semesters.

<table>
<thead>
<tr>
<th>Part</th>
<th>Semester-Odd</th>
<th>Semester-Even</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part I</td>
<td>First Year</td>
<td>Semester – 1</td>
</tr>
<tr>
<td>Part II</td>
<td>Second Year</td>
<td>Semester – 2</td>
</tr>
</tbody>
</table>

The schedule of papers prescribed for various semesters shall be as follows:

**Part I – Semester 1**

**Theory**

Paper 1: Forensic Science, Photography, Crime Scene Management
Paper 2: Criminology, Criminal Law and Police Administration
Paper 3: Forensic Physics
Paper 4: Forensic Dermatoglyphics and other impressions

**Practical**

Paper I Crime scene management and criminology
Paper II Forensic physics and forensic impressions

**Part I – Semester 2**

**Theory**

Paper 5: Forensic Chemistry and Toxicology
Paper 6: Forensic Ballistics
Paper 7: Instrumental Techniques
Paper 8: Questioned Documents

**Practical**

Paper III Forensic Chemistry and Instrumentation
Paper IV Ballistics and Questioned Documents
Part II- Semester III

Theory

Paper 9: Forensic Anthropology
Paper 10: Forensic Biology and DNA profiling
Paper 11: Forensic medicine and psychology
Paper 12: Digital Forensics and Cyber crime

Practical

Paper V Anthropology, Biology and DNA
Paper VI Digital Forensics

Part II – Semester IV

1. Dissertation
2. Project Work
3. Field visits
4. Out-house training

SCHEME OF EXAMINATION

1. English shall be the medium of instructions and examination.
2. Examination shall be conducted at the end of each Semester as per the Academic Calendar notified by the University of Delhi.
3. Each course will carry 100 marks and will have two components:
   (i) Internal Assessment 30 marks
   (ii) End Semester Examination
        (a) Theory Examination 70 marks
        (b) Practical Examination 100 marks
   (iii) Dissertation 150 marks
   (iv) Project work 150 marks
   (v) Field Visit Evaluation 150 marks
   (vi) Out-house Training/ Attachment with any FSL, CFSL and crime branch etc. 150 marks

PASS PERCENTAGE

Minimum marks for passing the examination in each semester shall be 40% in each paper and 45% in aggregate of a semester.
M.Sc (FORENSIC SCIENCE)

SEMESTER –I

Paper 1: Forensic Science, Photography, Crime Scene Management

Unit 1

Forensic Science Unit


Unit 2

Tools and techniques in Forensic Science


Unit 3

Forensic Photography

Basic principles of Photography, Techniques of black & white and color photography, cameras, lenses, shutters, depth of field, film; exposing, development and printing techniques; Different kinds of developers and fixers; UV, IR, fluorescence illumination guided photography; Modern development in photography- digital photography, working and basic principles of digital photography; Surveillance photography. Videography and Crime Scene &laboratory photography.

Unit 4

Crime Scene Management

Crime scene investigations, protecting and isolating the crime scene; Documentation, sketching, field notes and photography. Searching, handling and collection, preservation and transportation of physical evidences. Chain of custody and Reconstruction of scene of crime. Report writing.
Suggested Readings


2. Sharma, B.R; Forensic Science in Criminal Investigation & Trials, Universal Publishing Co., New Delhi, 2003


Paper 2: Criminology, Criminal Law and Police Administration

Unit 1

Crime
Definition, concept and scope of crime. Types of crime. Causes, effects, control and prevention of crime. Recent developments.

Unit 2

Criminology and criminal anthropology

Unit 3

Criminal Law
Indian Penal Code: sections-23, 24, 25,39,44,52,76-79,84-86.
NDPS Act, Food and Adulteration Act, Drugs and Cosmetic Act, Arms Act, Explosives Act.

Unit 4

Police Administration
History and development of police administration; Police duties, responsibilities and powers. Organization and structure of police station; maintenance of crime records and accountability of police to law. People and society. Custodial deaths, Police and Human Rights.
Suggested Readings


**Paper 3: Forensic Physics**

**Unit 1**
**Soil, Cement and Concrete**

**Unit 2**
**Paint and Fibre**
Types of paint and their composition, macroscopic and microscopic analysis of paint pigments, pigment distribution, micro-chemical analysis- solubility test, pyrolysis gas chromatography, TLC, colorimetric analysis, IR spectroscopy and X-ray diffraction, elemental analysis, mass spectrometer, interpretation of paint evidence.
Types of fibres, forensic aspects of fibre examination- fluorescence, optical properties, refractive index, birefringence, dye analysis. Physical fit and chemical testing. TLC, IR-micro spectroscopy, Py-MS. Difference between natural and man-made fibres.

**Unit 3**
**Glass**

**Unit 4**
**Toolmarks**
Types of toolmarks- 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. Restoration of erased / obliterated marks- Method of making-cast, punch, engrave; methods of obliteration, method of restoration- etching (etchings for different metals), magnetic, electrolytic etc., recording of restored marks – restoration of marks on wood, leather, polymer etc.
Suggested Readings


Paper 4: Forensic Dermatoglyphics and other impressions

Unit 1
Fingerprints and Palm prints

Unit 2
Biometrics
Biometric evidences such as finger impressions, retina, iris pattern, voice, gait pattern, face recognition, 3D face recognition, automatic forensic dental identification, hand vascular pattern technology, Multibiometric systems, Recent developments, biometric databases.

Unit 3
Foot/ Footwear/Tyre impressions
Importance, Gait pattern, Casting of footprints in different medium, electrostatic lifting of latent footprints. Taking of control samples.Collection, tracing, lifting, casting of impressions, enhancement of footwear impressions, analysis and comparison of foot impressions, moulds, identification characteristics.

Unit 4
Lip prints, Ear prints and their significance
Nature, location, collection and evaluation of lip prints. Forensic Significance, photography, location, collection and evaluation, taking of control samples of footprints, lip prints and Ear prints for comparison. Modern techniques and developments.
Suggested Readings


3. Chatterjee, S.K; Speculation in Fingerprint Identification, Jantralekha printing Works, Kolkata, 1981.


Practical- I

Paper 1: Crime scene management and criminology
1. Descriptive study of organizational structure of a forensic science laboratory.
2. To carry out photography of indoor and outdoor crime scenes
3. Crime scene photographic processing and development in different light sources and using different filters.
4. To carry out digital photography of various forensic evidences
5. Mock crime scene investigation and writing a report on evaluation of crime scene.
6. Interpretation of crime scene notes, photos, sketches and reconstruction of crime scene
7. Microscopy of various physical evidences
8. Study the theories of crime
9. Criminal profiling
10. Portrait parley

Paper II: Forensic physics and impression
1. Preliminary examination of glass, soil, fibre, paint and cloth evidences.
2. Examination of physical properties of glass, soil, fibre and paint evidences.
3. Develop latent fingerprints using different powder and chemical methods.
4. Comparison of fingerprints and palm prints by individual and class characteristics.
5. Restoration techniques of tool mark impressions and casting footprints.
6. Comparison and identification of individuals from lip print evidence.
7. Gait pattern recognition
Semester - II

Paper 5: Forensic Chemistry and Toxicology

Unit 1  
**Forensic Chemistry**  
Introduction to Forensic chemistry, sampling of chemical evidences, presumptive, screening (colour/spot test), inorganic analysis. Detective dyes- cases and importance in trap cases. Arson Chemistry of fire, searching of fire scene, collection, preservation and examination of arson evidences. Adulteration in Petroleum products. Examination procedures involving standard methods and instrumental techniques, analysis of beverages- alcoholic and non-alcoholic, country made liquor and medicinal preparations containing alcohol as constituents. Significance of alcohol in breath and breath screening devices. Forensic analysis of Fertilizers/insecticides/pesticides/biocides.

Unit 2  
**Explosives**  
Classification of explosives, synthesis and characteristics of Tri-nitro toluene (TNT), Pentaerythritol tetranitrate (PETN) and Research and Development Explosives (RDX). Explosion process, blast waves, searching of scene of explosion. Post blast residue collection and analysis, blast injuries and detection of hidden explosives. Improvised explosive devices.

Unit 3  
**Forensic Toxicology and Pharmacology**  
Definition, classification of poisons- organic, inorganic, metallic, non-metallic etc. Acute and chronic poisoning, Accidental, homicidal and suicidal poisoning. Extraction and identification of commonly used poisons. Dosage, Frequency, Route of administration, Absorption, distribution and metabolism and factors affecting metabolism and excretion. Toxicological techniques.

Unit 4  
**Drugs of Abuse**  
Suggested Readings

1. Niesink, RJM; Toxicology- Principles and Applications, CRC Press,1996
3. Chadha, PV; Handbook of Forensic Medicine & Toxicology, Jaypee Brothers, New Delhi,2004
4. Parikh, C.K; Text Book of Medical Jurisprudence, Forensic Medicine & Toxicology, CBS Pub. New Delhi,1999
7. Working Procedure Manual on Chemistry ; Directorate of Forensic Science MHA Govt. of India
12. Essential Commodity Act, 1955
Paper 6: Forensic Ballistics

Unit 1

Forensic Ballistics-I
History and background of Firearms, their classification and characteristics, various components of small arms, smooth bore and rifled firearm, different systems and their functions, rifling – various class characteristics, types 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 of firearm. Types of ammunitions, classification and constructional features of different types of cartridges, types of primers and priming composition, propellants and their compositions, velocity and pressure characteristics under different conditions, 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. Identification of origin, improvised/country-made/imitative firearms and their constructional features.

Unit 2

Internal and External Ballistics
Definition, ignition of propellants, shape and size of propellants, manner of burning, various factors affecting the internal ballistics: lock time, ignition time, barrel time, erosion, corrosion and gas cutting, equation of motion of projectile, principal problems of exterior ballistics, vacuum trajectory, effect of air resistance on trajectory, base drag, yaw, shape of projectile and stability, trajectory computation, ballistics coefficient and limiting velocity, Ballistics tables, measurements of trajectory parameters, introduction to automated system of trajectory computation and automated management of ballistics data.

Unit 3

Terminal Ballistics
Effect of projectile on hitting the target: function of bullet shape, striking velocity, striking angle and nature of target, Tumbling of bullets, effect of instability of bullet, effect of intermediate targets, influence of range, Cavitation – temporary and permanent cavities, Ricochet and its effects, stopping power, Wound Ballistics; Threshold velocity for penetration of skin/flesh/bones, preparation of gel block, penetration of projectiles in gel block and other targets, nature of wounds of entry, exit, initial track with various ranges and velocities with various types of projectiles, explosive wounds, evaluation of injuries caused due to shot-gun, rifle, handguns and country made firearms, methods of measurements of wound ballistics parameters, post-mortem and anti-mortem firearm injuries.

Unit 4

Examination and identification
Firearms, ammunition and their components identification and examination, 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 lands and grooves, identification of various parts of
firearms, techniques for obtaining test material from various types of weapons and their linkage with fired ammunition, class and individual characteristics, determination of range of fire- burning, scorching, blackening, tattooing and metal fouling, shots dispersion and GSR distribution, time of firing – different method employed, and their limitations, stereo & comparison microscopy, automatic bullet and cartridge comparison system.

GSR analysis: Mechanism of formation of GSR, source 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 defence cases.

Suggested Readings


Paper 7: Instrumental Techniques (Physical, Chemical, Biological)

Unit 1

Atomic & Molecular Spectroscopy

Spectroscopy, electromagnetic spectrum, sources of radiation, their utility and limitations. Conventional sources for UV, visible and infrared rays, sources for shorter wavelength radiations (X-ray tubes), radioactivity, Laser (He, Ne Argon, ion, dye lasers, semi conductor lasers) a source of radiation, interaction of radiation with matter:- reflection, absorption, transmission, fluorescence, phosphorescence and their forensic applications, radiation filters. Detection of radiations; photographic detectors, thermal detectors, photoelectric detectors etc. 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.

Unit 2

Physical instrumentation techniques

IR spectroscopy- correlation of infrared spectra with molecular structure, fourier transform, infrared (FTIR) and Raman spectroscopy, fluorescence and phosphorescence spectrophotometry, Ultra violet and visible spectrophotometry: Types of sources, filters-cells and sampling devices, detectors, resolution, qualitative and quantitative methods for detection. Fluorescence and phosphorescence spectrometry: Types of sources, structural factors, instrumentation, comparison of luminescence and UV-visible absorption methods. Atomic absorption spectrometry: Instrumentation and techniques, interference in AAS, background correction methods, quantitative analysis. Atomic emission spectrometry: Instrumentation and techniques, arc/spark emission, ICP-AES, comparison ICP vs AAS methods, quantitative analysis, applications.

Unit 3

Radiochemical and Nuclear techniques

Unit 4

**Biochemical techniques**


**Suggested Readings**


Paper 8: Questioned Documents

Unit 1

Introduction to Document Examination

Nature and problems of document examination, classification of forensic documents, Specimen/Admitted writings/type writings etc: handling, preservation and marking of documents, importance of natural variations and disguise in writing, various types of forensic documents- genuine and forged documents, holographic documents, principles of handwriting identification, basic tools needed for Forensic Document Examination & their use, analysis of paper and inks.

Unit 2

Handwriting and Signature examination

Various writing features and their estimation, general characteristics of handwriting, individual characteristics of handwriting, ethnic and gender variability of handwriting, various types of forgeries and their detection, examination of signatures – characteristics of genuine and forged signatures, identification of forger, identification of writer of anonymous letters and application of Forensic Stylistics/Linguistics in the identification of writer, examination of built-up documents and determination of sequence of strokes.

Unit 3

Typewritten and Printed Documents

Identification of typescripts-identification of typist, various types of printing processes, identification of printed matter including printing of security documents and currency notes, identification of electronic typewriters, dot matrix, inkjet and laser jet printers, examination of black and white and color photocopies, fax messages and carbon copies.

Unit 4

Forgery Detection

Determination of age of documents by examination of signatures, paper, ink etc., Examination of alterations, erasures, over writings, additions and obliterations, decipherment of secret writings, indentations & charred documents, physical matching of documents, examination of seal, rubber and other mechanical impressions, examination of counterfeit currency notes, Indian passport/visas, stamp papers, postal stamps etc., examination of fake credit cards, e-documents, digital signatures, an introduction of computer forensics, preliminary examination of documents, opinion writings and reasons for opinion.
Suggested reading:


Practical

**Paper III: Forensic Chemistry and Instrumentation**

1. TLC and spot test of alkaloids of drugs of abuse and toxic substances.
2. Isolation and instrumental analysis of different toxic substances and drugs.
3. Thin layer chromatography of explosive substances
4. Examination of petroleum products as per BIS standards.
5. Detection and identification of doping drugs from- hair, blood, saliva, urine and other body fluid and estimation of alcohol from breath, urine and blood.
6. UV-Visible Spectroscopic analysis of Drugs
7. Fourier transform infrared spectroscopic (FTIR) analysis of physical evidences
8. Gas chromatography (GC) and High performance liquid chromatography (HPLC) analysis of poisons, explosives, amino acids and proteins

**Paper IV: Ballistics and Questioned Documents**

1. Forensic identification of class and individual characteristics of handwriting
2. Analysis of signature forgery
3. Examination of anonymous letters and disguised writing
4. To detect and decipher alterations in a document
5. To decipher secret writings, indentations and charred documents
6. To study the handwriting of ethnic and population groups
7. To examine forgery in currency notes, passports and credit cards under Visual Spectral Comparator
8. Linkage of suspected bullet and cartridge case with the firearm on the basis of class and individual characteristics.
9. Classification and designation of ammunition using physical measurements
10. GSR collection and analysis of various components of GSR.
12. Determination of velocity and energy of projectiles.
Semester - III

Paper 9: Forensic Anthropology

Unit 1
Personal Identification
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 2
Human Growth and Development
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 3
Forensic Morphometry of Skeletal Remains

Unit 4
Forensic Odontology
Suggested Readings


7. Shubhra, G; Introduction to forensic examination, Selective Scientific Books, New Delhi, 2008


Paper 10: Forensic Biology and DNA Profiling

Unit 1

Serology and Immunology
Cell structure and functions. Structure and function of carbohydrates, fats and proteins, serum proteins, haemoglobin and its variants, haptoglobins, HLA, polymorphic enzymes, blood groups-history, biochemistry and genetics of ABO, Rh, Mn and other systems, Methods of ABO blood grouping from fresh blood and biological stains, body fluids, determination of secretor status, polymorphic enzyme typing, serogenetic markers, determination of origin of species, immunology, immune response, antigens, haptens and antibodies, function and rising of antisera, lectins.

Unit 2

Forensic Biology

Unit 3

DNA Profiling
Double helical structure of DNA, alternate forms of DNA double helix, denaturation and renaturation of DNA, DNA binding proteins, factors affecting DNA stability, types and structure of RNA. Chemical nature of DNA and RNA. Nature and structure of human genome and its diversity. mt-DNA, Y-Chromosomes and the peopling, migration, of modern humans.

Unit 4

DNA Polymorphism
Concept of gene – Conventional and modern views.
Concept of sequence variation - VNTRs, STRs, Mini STRs , SNPs. Detection techniques - RFLP, PCR amplifications, Amp-FLP, sequence polymorphism, Y-STR, Mitochondrial DNA. Disputed paternity cases. Missing person identity, population genetics and legal admissibility of DNA evidence.
Suggested Readings


Paper 11: Forensic Medicine and Psychology

Unit 1
Medico legal aspects of death

Unit 2
Injuries and investigations

Unit 3
Forensic Entomology
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 4
Forensic Psychology
Lie detection, brain fingerprinting, narco analysis, hypnosis, neuro-anthropological and psychological testing. Ethical issues in forensic psychology, mental disorders, eye witness testimony, memory recovery, psychological assessment, hypnosis, current research in detection of deception/truth finding mechanisms, legal and ethical aspects of human rights of individual.
Suggested Readings


3. Mant, A.K; Taylor’s principles & practice of medical jurisprudence, Wingking Tong company ltd., Hong Kong, 2003


Paper 12: Digital Forensic and Cyber Crime

Unit 1

E-data analysis

Principles of computer and data storage, Hardware, passwords and encryption techniques, seizure of computers, Preparations to be made before seizure, Actions at the scene, treatment of exhibits, bit stream of original media, Investigation on imaging methods, acquisition, collection and seizure or magnetic media, Legal and privacy issues, Preparing and verifying forensically sterile storage media

Unit 2

Types of cyber crimes

Definition and types of cyber crimes, Digital signal processing overview of several operating systems, html and other internet protocols, internet history, e-mail and header interpretation, virus and Trojan infections, different type of attacks, internet research and investigative tools

Unit 3

Audio-video examination

Forensic audio video analysis, voltage, decibels, audio line levels, frequency measurements, spectrum analysis, noise characteristics, digital filters and audio enhancement, authentication of recorded audio, speech spectrographic analysis, magnetic developing and optical methods Falsification in video recording, video frame sequence, method – waveform – vectroscope, videogrametry and photogrametry techniques, video image analysis, facial image recognition from video frame image

Unit 4

Speaker Identification

Basic factors of sound in speech, components of speech, analogue and digital speech signal, Fourier analysis, Fourier transforms, acoustic speech production, speech anatomy, mechanism of speech production, phonetic aspects of speech, principles of speaker recognition, methods of speaker recognition, various approaches in forensic speaker identification, concept of test and error in speaker identification, application in automatic speaker identification and verification system.
Suggested Readings

Practical

Paper V: Anthropology, Biology and DNA

1. Morphological and microscopic examination examination of hair and fibres
2. Examination of blood stains: Physical and Chemical tests; spectroscopic examination
3. Examination of body fluids (Saliva, vomit, urine, semen, sweat)
4. Identification of diatoms and pollen grains
5. Determination of age and sex from skull, teeth, pelvic girdle and long bones.
6. Stature estimation from long bones
7. Determination of species of origin from blood.
8. Blood grouping from fresh and dried blood stains
9. Determination of secretor status
10. Electrophoresis of polymorphic markers
11. DNA isolation from biological samples, quantitation and profiling

Paper VI: Digital Forensics

1. Recovery of data, copying and imaging
2. Tracking of IP address
3. Encrypting and decrypting files
4. Audio, video and image authentification
5. Speaker identification using voice spectrograph.
Semester IV

1. Dissertation based on field work or laboratory work (for 2-3 weeks) in a specialized field chosen by the student. Two hard copies of the dissertation to be submitted by the student for its evaluation by the end of month of April.

2. Project Work.

A student will submit a project report on the basis of forensic anthropology/ forensic physics/ forensic chemistry/ document examination pertaining to one case starting from police station to court room and final forensic analysis to be done by the student.

3. Field visits to crime scenes, police stations, FSLs, court rooms etc. and submit a specific report on the same for the evaluation.

4. Out house trainings at FSLs/ CFSLs/University and Research laboratories/ GEQD’s for 2-3 weeks and submit a brief report on the work done.