

# Syllabus for M.Sc Forensic Science Entrance Test

## Introduction to Forensic Science

### **Unit 1: History of Development of Forensic Science in India**

Functions of forensic science. Historical aspects of forensic science.

Definitions and concepts in forensic science. Scope of forensic science. Need of forensic science. Basic principles of forensic science.

Frye case and Daubert standard.

### **Unit 2: Tools and Techniques in Forensic Science**

Branches of forensic science. Forensic science in international perspectives, including set up of INTERPOL and FBI.

Duties of forensic scientists. Code of conduct for forensic scientists. Qualifications of forensic scientists.

Data depiction. Report writing.

### **Unit 3: Organizational set up of Forensic Science Laboratories in India**

Hierarchical set up of Central Forensic Science Laboratories, State Forensic Science Laboratories, Government Examiners of Questioned Documents, Fingerprint Bureaus, National Crime Records Bureau, Police & Detective Training Schools, Bureau of Police Research & Development, Directorate of Forensic Science and Mobile Crime Laboratories. Police Academies. Police dogs. Services of crime laboratories. Basic services and optional services.

## Crime and Society

### **Unit 1: Basics of Criminology**

Definition, aims and scope. Theories of criminal behavior – classical, positivist, sociological. Criminal anthropology.

Criminal profiling. Understanding modus operandi. Investigative strategy. Role of media.

### **Unit 2: Crime**

Elements, nature, causes and consequences of crime. Deviant behavior. Hate crimes, organized crimes and public disorder, domestic violence and workplace violence. White collar crimes

Victimology. Juvenile delinquency. Social change and crime. Psychological

Disorders and Criminality. Situational crime prevention.

### **Unit 3: Criminal Justice System**

Broad components of criminal justice system. Policing styles and principles. Police's power of investigation.

Filing of criminal charges. Community policing. Policing a heterogeneous society. Correctional measures and rehabilitation of offenders.

Human rights and criminal justice system in India.

## **Criminal Law**

### **Unit 1: Law to Combat Crime**

Classification – civil, criminal cases. Essential elements of criminal law. Constitution and hierarchy of criminal courts.

Criminal Procedure Code. Cognizable and non-cognizable offences. Bailable and non-bailable offences.

Sentences which the court of Chief Judicial Magistrate may pass.

Indian Evidence Act – Evidence and rules of relevancy in brief. Expert witness. Cross examination and re-examination of witnesses.

## **Forensic Psychology**

### **Unit 1: Basics of Forensic Psychology**

Definition and fundamental concepts of forensic psychology and forensic psychiatry. Psychology and law. Ethical issues in forensic psychology.

Assessment of mental competency. Mental disorders and forensic psychology. Psychology of evidence – eyewitness testimony, confession evidence. Criminal profiling.

### **Unit 2: Psychology and Criminal Behavior**

Psychopathology and personality disorder. Psychological assessment and its importance.

Serial murderers. Psychology of terrorism.

Biological factors and crime – social learning theories, psycho-social factors, abuse.

### **Unit 3: Detection of Deception**

Tools for detection of deception – interviews, non-verbal detection, statement analysis, voice stress analyzer, hypnosis.

Polygraphy – operational and question formulation techniques, ethical and legal aspects, the guilty knowledge test.

Narco analysis and brain electrical oscillation signatures – principle and theory, ethical and legal issues.

## **Forensic Dermatoglyphics**

### **Unit 1: Basics of Fingerprinting**

Introduction and history, with special reference to India.

Biological basis of fingerprints. Formation of ridges. Fundamental principles of fingerprinting. Types of fingerprints. Fingerprint patterns. Fingerprint characters/minutiae.

Plain and rolled fingerprints.

Classification and cataloguing of fingerprint record. Automated Fingerprint Identification System.

Significance of poroscopy and edgeoscopy.

### **Unit 2: Development of Fingerprints**

Latent prints. Constituents of sweat residue.

Latent fingerprints' detection by physical and chemical techniques. Mechanism of detection of fingerprints by different developing reagents. Application of light sources in fingerprint detection.

Preservation of developed fingerprints. Digital imaging for fingerprint enhancement.

Fingerprinting the deceased. Developing fingerprints on gloves.

### **Unit 3: Other Impressions**

Importance of footprints. Casting of foot prints, Electrostatic lifting of latent foot prints. Palm prints.

Lip prints - Nature, location, collection and examination of lip prints. Ear prints and their significance.

Palm prints and their historical importance.

## **Technological Methods in Forensic Science**

### **Unit 1: Instrumentation**

Sample preparation for chromatographic and spectroscopic evidence.

Chromatographic methods. Fundamental principles and forensic applications of thin layer chromatography, gas chromatography and liquid chromatography.

Electrophoresis – fundamental principles and forensic applications.

### **Unit 2: Microscopy**

Fundamental principles. Different types of microscopes. Electron microscope. Comparison Microscope. Forensic applications of microscopy.

### **Unit 3: Forensic photography**

Basic principles and applications of photography in forensic science.

3D photography. Photographic evidence. Infrared and ultraviolet photography. Digital photography. Videography. Crime scene and laboratory photography.

## **Criminalistics**

### **Unit 1: Crime Scene Management**

Types of crime scenes – indoor and outdoor. Securing and isolating the crime scene.

Crime scene search methods. Safety measures at crime scenes. Legal considerations at crime scenes.

Documentation of crime scenes – photography, videography, sketching and recording notes.

Duties of first responders at crime scenes. Coordination between police personnel and forensic scientists at crime scenes.

### **Unit 2: Crime Scene Evidence**

Classification of crime scene evidence – physical and trace evidence. Locard principle.

Collection, labeling, sealing of evidence. Hazardous evidence. Preservation of evidence. Chain of custody. Reconstruction of crime scene.

**Unit 3: Forensic Physics**

Glass evidence – collection, packaging, analysis. Matching of glass samples by mechanical fit and refractive index measurements. Analysis by spectroscopic methods. Fracture analysis and direction of impact.

Paint evidence – collection, packaging and preservation. Analysis by destructive and non-destructive methods. Importance of paint evidence in hit and run cases.

Fibre evidence – artificial and man-made fibres. Collection of fibre evidence. Identification and comparison of fibres.

Soil evidence – importance, location, collection and comparison of soil samples.

Cloth evidence – importance, collection, analysis of adhering material. Matching of pieces.

Toolmark evidence. Classification of toolmarks. Forensic importance of toolmarks. Collection, preservation and matching of toolmarks. Restoration of erased serial numbers and engraved marks.

**Forensic Chemistry****Unit 1: Cases Involving Arson**

Chemistry of fire. Conditions for fire. Fire scene patterns. Location of point of ignition. Recognition of type of fire. Searching the fire scene. Collection and preservation of arson evidence.

Analysis of fire debris. Analysis of ignitable liquid residue. Post-flashover burning. Scientific investigation and evaluation of clue materials. Information from smoke staining.

**Unit 2: Explosives**

Classification of explosives – low explosives and high explosives. Homemade explosives. Military explosives. Blasting agents.

Synthesis and characteristics of TNT, PETN and RDX. Explosion process. Blast waves. Bomb scene management.

Searching the scene of explosion. Mechanism of explosion. Post blast residue collection and analysis.

Blast injuries. Detection of hidden explosives.

**Questioned Documents****Unit 1: Nature and Scope of Questioned Documents**

Definition of questioned documents. Types of questioned documents. Preliminary examination of documents.

Basic tools needed for forensic documents' examination – ultraviolet, visible, infrared and fluorescence spectroscopy, photomicrography, microphotography, visible spectral comparator, electrostatic detection apparatus.

Determining the age and relative age of documents.

**Unit 2: Comparison of Documents**

Comparison of handwriting. Development of individuality in handwriting. Natural variations and fundamental divergences in handwritings. Class and individual characteristics.

Merits and demerits of exemplar and non-exemplar samples during comparison of

handwriting. Standards for comparison of handwriting.

Comparison of paper, ink, printed documents, typed documents, Xeroxed documents.

### **Unit 3: Forgeries**

Alterations in documents, including erasures, additions, over-writings and obliterations.

Indented and invisible writings. Charred documents.

Examination of counterfeit Indian currency notes, passports, visas and stamp papers.

Disguised writing and anonymous letters.

## **Forensic Biology**

### **Unit 1: Biological Evidence**

Nature and importance of biological evidence.

Significance of hair evidence. Transfer, persistence and recovery of hair evidence. Structure of human hair. Comparison of hair samples. Morphology and biochemistry of human hair. Comparison of human and animal hair.

Identification of wood, leaves, pollens and juices as botanical evidence. Diatoms and their forensic significance.

### **Unit 2: Wildlife Forensics**

Fundamentals of wildlife forensic. Significance of wildlife forensic. Protected and endangered species of animals and plants. Illegal trading in wildlife items, such as skin, fur, bone, horn, teeth, flowers and plants. Identification of physical evidence pertaining to wildlife forensics. Identification of pug marks of various animals.

### **Unit 3: Forensic Entomology**

Basics of forensic entomology. Insects of forensic importance. Collection of entomological evidence during death investigations.

## **Forensic Ballistics**

### **Unit 1: Firearms**

History and development of firearms. Classification of firearms. Weapon types and their operation. Firing mechanisms of different firearms.

Internal ballistics – Definition, ignition of propellants, shape and size of propellants, manner of burning, and various factors affecting the internal ballistics: lock time, ignition time, barrel time, erosion, corrosion and gas cutting.

External Ballistics – Vacuum trajectory, effect of air resistance on trajectory, base drag, drop, drift, yaw, shape of projectile and stability, trajectory computation, ballistics coefficient and limiting velocity, Measurements of trajectory parameters, introduction to automated system of trajectory computation and automated management of ballistic data.

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. Ricochet and its effects, stopping power.

**Unit 2: Ammunition**

Types of ammunition. Constructional features and characteristics of different types of cartridges and bullets. Primers and priming compounds. Projectiles. Headstamp markings on ammunitions. Different types of marks produced during firing process on cartridge – firing pin marks, breech face marks, chamber marks, extractor and ejector marks.

**Unit 3: Firearm Evidence**

Matching of bullets and cartridge cases in regular firearms. Identification of bullets, pellets and wads fired from improvised, country made firearms. Automated method of bullet and cartridge case comparison. Determination of range of fire and time of fire.

Mechanisms of formation of gunshot residues. Methods of analysis of gunshot residues from shooting hands and targets, with special reference to clothings.

Identification and nature of firearms injuries. Reconstruction with respect to accident, suicide, murder and self-defense.

**Forensic Toxicology****Unit 1: Basics of Toxicology**

Postmortem Toxicology. Human performance toxicology.

Dose-response relationship. Lethal dose 50 and effective dose 50.

**Unit 2: Poisons**

Classification of poisons. Physico-chemical characteristics and mode of action of poisons. Accidental, suicidal and homicidal poisonings.

Signs and symptoms of common poisoning and their antidotes. Collection and preservation of viscera, blood and urine for various poison cases.

Identification of biocides and metal salts in body fluids. Metabolism and excretion of poisons. Application of immunoassays in forensic work.

Animal poisons. Snake venom. Mode of action. Carbon monoxide poisoning. Vegetable poisons. Poisonous seeds, fruits, roots and mushrooms.

Beverages. Alcoholic and non-alcoholic illicit liquors. Analysis and identification of ethyl alcohol. Estimation of ethyl alcohol in blood and urine.

**Unit 3: Narcotics, Drugs and Psychotropic Substances**

Definition of narcotics, drugs and psychotropic substances. Broad classification – Narcotics, stimulants, depressants and hallucinogens. General characteristics and common example of each classification. Natural, synthetic and semi-synthetic narcotics, drugs and psychotropic substances.

Designer drugs. Tolerance, addiction and withdrawal symptoms of narcotics, drugs and psychotropic substances

Testing of narcotics, drugs and psychotropic substances.

Isolation techniques for purifying narcotics, drugs and psychotropic substances – thin layer chromatography, gas-liquid chromatography and high performance liquid chromatography.

Presumptive and screening tests for narcotics, drugs and psychotropic substances. Microcrystalline testing of drugs of abuse.

## **Forensic Anthropology**

### **Unit 1: Significance of Forensic Anthropology**

Scope of forensic anthropology. Study of human skeleton. Nature, formation, and identification of human bones. Determination of age, sex, stature from skeletal material.

### **Unit 2: Personal Identification – Somatoscopy and Somatometry**

Somatoscopy – observation of hair on head, forehead, eyes, root of nose, nasal bridge, nasal tip, chin, Darwin's tubercle, ear lobes, supra-orbital ridges, physiognomic ear breadth, circumference of head. Scar marks and occupational marks.

Somatometry – measurements of head, face, nose, cheek, ear, hand and foot, body weight, height.

Indices - cephalic index, nasal index, cranial index, upper facial index.

### **Unit 3: Facial Reconstruction**

Portrait Parle/ Bertillon system. Photofit/identi kit. Facial superimposition techniques. Cranio facial super imposition techniques – photographic super-imposition, videosuperimposition, Roentgenographic superimposition. Use of somatoscopic and craniometric methods in reconstruction. Importance of tissue depth in facial reconstruction. Genetic and congenital anomalies – causes, types, identification and their forensic significance.

## **Forensic Medicine**

### **Unit 1: Death Investigations**

Fundamental aspects and scope of forensic medicine.

Recording dying declaration.

Documenting the death scene. Processing evidence. Evaluation of injuries. Importance of canvass form. Indexing the death investigation.

Handling buried body cases – search for buried bodies, methods of exhumation.

Suicide cases – evaluating the type of injuries, gauging the psychological state of victim, suicide notes.

### **Unit 2: Autopsy**

Forensic pathology. Medico-legal aspects of death. Causes of death. Determination of time since death. Investigation of sexual offences. Death by drowning.

Injuries. Types and classification of injuries. Antemortem and post mortem injuries. Aging of injuries. Artificial injuries.

**Unit 3: Forensic Odontology**

Development, scope and role of forensic odontology in mass disaster and anthropology.  
Types of teeth and their comparative anatomy.

Bite marks. Forensic significance of bite marks. Collection, preservation and photography of bite marks evidence. Legal aspects of bite marks. Estimation of age from teeth.

Analysis of narcotics, drugs and psychotropic substances in breast milk, saliva, urine, hair and antemortem blood.

Drugs and driving. Dope tests.

Analysis of narcotics, drugs and psychotropic substances in postmortem blood.

**Digital Forensics****Unit 1: Fundamentals and Concepts**

Fundamentals of computers Hardware and accessories – development of hard disk, physical construction, Memory and processor. Methods of storing data. Operating system.

Software. Introduction to network, LAN, WAN and MAN.

**Unit 2: Computer Crimes**

Definition and types of computer crimes. Distinction between computer crimes and conventional crimes. Reasons for commission of computer crimes. Breaching security and operation of digital systems.

Computer virus, and computer worm – Trojan horse, trap door, super zapping, logic bombs.

Types of computer crimes – computer stalking, pornography, hacking, crimes related to intellectual property rights, computer terrorism, hate speech, private and national security in cyber space.

An overview of hacking, spamming, phishing and stalking.

**Unit 3: Computer Forensics Investigations**

Seizure of suspected computer. Preparation required prior to seizure.

Extraction of information from the hard disk. Restoration of deleted files. Password cracking and E-mail tracking. Encryption and decryption methods. Tracking users.

**Forensic Serology****Unit 1: Forensic Importance of Body fluids**

Common body fluids. Composition and functions of blood. Collection and preservation of blood evidence. Distinction between human and non-human blood. Determination of blood groups. Antigens and antibodies.

Forensic characterization of bloodstains. Typing of dried stains. Blood enzymes and proteins. Semen. Forensic significance of semen. Composition, functions and morphology of spermatozoa. Collection, evaluation and tests for identification of semen. Individualization on

the basis of semen examination.

Composition, functions and forensic significance of saliva, sweat, milk and urine. Tests for their identifications.

### **Unit 2: Genetic Marker Analysis**

Cellular antigens. ABO and Rh blood groups.

Extracellular proteins and intracellular enzymes.

Significance of genetic marker typing data. Sexual assault investigations.

## **DNA Forensics**

### **Unit 1: Basic Principles**

DNA as biological blueprint of life. Extraction of DNA for analysis.

Quantitation of DNA – yield gel quantitation and slot blot quantitation.

Mitochondrial DNA – sequence analysis.

### **Unit 2: Forensic DNA Typing**

Collection of specimens. Polymerase chain reaction – historical perspective, sequence polymorphisms, individualization of evidence.

Short tandem repeats (STR) – role of fluorescent dyes, nature of STR loci.

Restriction fragment length polymorphism (RFLP) – genetic markers used in RFLP, typing procedure and interpretation of results.

### **Unit 3: Parentage Testing**

Principles of heredity. Genetics of paternity. DNA testing in disputed paternity. Mendelian laws of parentage testing. Mathematical basis of parentage identification. Missing body cases. Reference populations and databases.

Allele frequency determination. Hardy-Weinberg law.

## **Handwriting Identification and Recognition**

### **Unit 1: Handwriting Identification**

Basis of handwriting identification. Characteristics of handwriting – scope and application.

Class and individual characteristics. Arrangement, alignment, margin, slant, speed, pressure, spacing, line quality, embellishments, movement and pen lifts. Factors influencing handwriting – physical, mechanical, genetic and physiological.

### **Unit 2: Handwriting Examination**

Basis of handwriting comparison. Collection of handwriting samples. Forgery detection. Counterfeiting. Examination of altered and erased documents. Tools used in handwriting examination.

### **Unit 3: Handwriting Recognition**

Basis of handwriting recognition. Off-line and on-line handwriting recognition.