



**Ph.D. FORENSIC SCIENCE**  
**ENTRANCE EXAMINATION**  
**JAIN (DEEMED-TO-BE UNIVERSITY)**  
**Ph.D. in FORENSIC SCIENCE**  
**Entrance Examination Syllabus**

**Unit 1: General Forensic Science & Crime Scene Investigation**

**Introduction to Forensic Science:** Forensic Institutions in Indian Context, Scope and Need for Forensic Science, Principles of Forensic Science

**Expert evidence and Court Testimony:** Presentation of Expert Evidence, Examination in the Court, Expert Testimony, Court Testimony: Pre-court preparations, Examination-in-chief, Cross-examination, Re-examination – IEA:137, leading questions [(IEA Sec) – 141,142,143], prosecution and defence lawyers, Ethics in Forensic Science.

**Expert Evidence and Court Testimony:** Introduction to crime scene investigation, Definition and causation of Crime, Modus Operandi,

**Crime scene management:** Collection, Packaging and preservation of the evidence, Documenting the crime scene and its importance, Note taking in the crime scene after discussion, Photography, videography of the scene of crime and the evidence.

**Collection, Packaging and preservation of the evidence:** Respective Methods of collection, Packaging and preserving of evidence. Collection, Labelling, Packaging and sealing of the evidence. Examination of the evidence. Role in the court of law and importance of Chain of custody, Crime Scene Reconstruction

**Quality and Laboratory Management:** Introduction to Quality (ISO/IEC 17025) and Laboratory Management, Quality System, Document Control, Review of requests, Tenders and contracts, Sub-contracting of tests and calibration, purchasing services and supplies, Method validation, Equipment measurement, Traceability, Sampling, Handling of Test and calibration items, Assuring the quality of test and calibration results.

**Unit 2: Forensic Biology & Serology**

**Introduction to Forensic Biology and Serology:** Serology, Recognition of biological Evidences, Introduction to cell, Sources of DNA evidence, Antibody Reactions, Primary Binding assays- ELISA, Immunochromatographic Assays, Secondary Binding assays- Precipitation based and Electrophoretic methods- IEP, CRIE, CIE, Agglutination Based Assays, Species Identification- Titration of Antibodies, identification of Human Hb Protein and Human Glycophorin A Protein, Ring assay, Ouchterlony assay, Crossed over electrophoresis.

**Forensic examination of blood:** Blood - Composition, Hb Structure, Blood, Groups Inheritance of blood groups. Erythrocytes Isoenzymes- Polymorphism and typing of PGM, GLO-I, ESD, EAP, AK, ADA etc. Isoelectric focusing, Serum Protein Profiling, Forensic Examination of Blood: Presumptive Assays, Oxidation-reduction reactions, Chemiluminescence and Fluorescence Assays, Factors affecting Presumptive assays, Confirmatory Assays- Microcrystal assays, Forensic Blood Group Typing.

**Forensic examination of Semen, Saliva and Urine:** Semen: Male Reproductive System, Production and Composition of Seminal fluid, Spermatozoa, Protein and Enzymes- AP, PSA and SVSA, Forensic Examination for Identification of semen – Presumptive assays, UV light, Acid Phosphatase Test, Saliva – Human Salivary Glands, Composition of Saliva, Amylase –  $\alpha$  and  $\beta$  and its activity, Forensic examination for saliva identification, Urine – Formation and Composition, Urea and Creatinine, Forensic examination of urine.

**Biological materials and Microbial Forensics:** Menstrual Blood and Vaginal Secretions – Female Reproductive System, Composition of Vaginal secretions, Menstrual Blood Composition, Forensic Examination of Vaginal secretions – Locating Stains, Lugol's iodine and Periodic Acid-Schiff tests, Confirmatory assays – RNA based RT-PCR for HBD1 and MUC4. Other Biological Materials: Compositions, Microscopic examination, Microbial Forensics- Forensic aspects of biological toxins, Sample handling, collection and preservation, Methods for biological signatures, Genetic analysis of threatening pathogens.

### **Unit 3: Forensic Physics & Ballistics**

**Glass & Soil analysis:** Types of glass and their composition, Determination of the direction of impact, Examination of glass: colour, fluorescence, physical matching, Density comparison, Refractive index, Collection and preservation of glass evidence, Types and colour of soil, Forensic examination of soil, Collection and preservation of soil evidence, Interpretation of soil evidence.

**Paints:** Types of paint and their composition. Forensic examination of paints, Analytical tools used in paint comparison. Interpretation of paint evidence, **Fibre:** Types, Identification and comparison of manufactured fibres, Significance of match, Analytical techniques used for examination; Collection and preservation of fibre evidence. Forensic examination of cloth and cloth fibres, **Tool marks:** Types of tool marks, Restoration of erased numbers, Methods Used for Removal of Serial Numbers, Theory behind Number

**Introduction to Forensic Ballistics:** Background of firearms- classification and class characteristics, Purpose and types of rifling, Methods to produce rifling, Shotguns: Classification, choking, determination of bore, Types and classification of ammunition, Constructional features and characteristics of different types of cartridges, Types of primers and priming composition, Various types of bullet, improvised firearms and ammunition and safety aspects for handling firearm and ammunition.

**Internal, External and Terminal Ballistics:** Definition, ignition of propellants, shape and size of propellants, manner of burning, various factors affecting the internal ballistics, Principal problems of exterior ballistics, Effect of a projectile on hitting the target, Statistical evaluation of data regarding Forensic Ballistics obtained by instrumental methods.

#### **Unit 4: Forensic Psychology**

**Forensic Psychology:** Sub-specializations of forensic psychology, Relationship between forensic psychology, criminology and criminal psychology, Ethical issues in forensic psychology, Daubert's standard and Frye standard, Mc'Naughten rule, Insanity definition in Indian Penal Code (IPC section 84): Legal and medical insanity, Stages of mind.

**Psychobiology of crime:** Introduction- Inhibitive and disinhibitive systems in the brain, Frontal controlling functions and response inhibition, Eye witness Testimony: Assessment of false memory, Interrogation and Confession: Reid Techniques in Interrogation of Suspects and PEACE Model

**Violence and aggression:** Causes of violence, The Criminal Psychopath, Antisocial Personality Disorder, Sociopathy and Psychopathy, Criminal Homicide Sexual Assault and Rape, Typologies of Men Who Rape, The Massachusetts Treatment Centre Rapist Typology and The Groth Rapist Typology.

**Criminal Profiling:** Types of profiling: Inductive and Deductive profiling, Process of profiling, Polygraph, Brain Electrical Oscillation Signature Profiling (BEOS), Narco- Analysis, Legal status of forensic psychological test in India.

#### **Unit 5: Forensic Toxicology**

**Forensic Chemistry:** Definition, Quantitative and qualitative forensic chemical analysis, Legal sections of relevant Acts, Drugs and Cosmetic Act, 1940 - Drugs and Cosmetics Rules, 1945 - Excise Act, 1944 - Amendments to the Acts.

**Petroleum products and Trace evidence:** Analysis of traces of petroleum products in forensic exhibits, Characterization of petroleum products in oil spills, Characterization of petroleum products in oil spills, Analysis of Trace Evidence: cosmetics, chemicals and plant material, chemical fertilisers, Trap related evidence materials.

**Introduction to Toxicology:** Definition & Historical development, Role of forensic toxicologists, Poison- Types of poisoning, Dosage & classification on the basis of their origin, Physiological action and analytical procedure, Salient features of Poisons Act 1919, Modes of administration of poisons. Techniques used in toxicology - Thin Layer Chromatography (TLC), Gas Chromatography (GC) and Immunoassays - Significance of toxicological findings

**Drugs and Crime:** Classification of drugs of abuse, Field testing kits, Signs and symptoms of addiction, Forensic problems in drug addiction and their de-addiction, the role of drug recognition expert, Interpreting drug findings, Expert testimony and report formation.

#### **Unit 6: Forensic Medicine & Entomology**

**Introduction to Forensic Medicine:** Medical certificates, Dying Declaration and Dying Depositions, Establishing the identity of alive and dead human beings, Medicolegal importance of age, Occupational stigmata, Death: Definition, Brain-death, Natural and Unnatural death, Sudden death, Modes of death, Coma, Manner of death, Determination of time since death.

**Medico-legal aspect of Death:** causes of death in asphyxia, starvation, electrocution and accidents deaths. Medicolegal autopsy, Legal requirements to conduct autopsy external and internal

examination, collection of specimens. Examination of decomposed bodies, mutilated bodies, fragmentary remains and bones.

**Death & Injuries:** Signs of death and changes following death – Algor mortis, Lividity, Rigor mortis, Stiffening, Cadaveric spasm, Putrefaction, Mummification, Adipocere. Time since death by body fluid analysis

**Injuries:** Legal definition and medical definition. Types of Injuries, Mechanical Injuries, Blunt weapon, Sharp weapon, Stab wounds, Firearm injuries, Defence injuries, Fabricated injuries. Thermal injuries, Chemical trauma, Transportation injuries, Biomechanism of injury formation. Role of virtual autopsy in legal issues.

**Sexual offences & Infanticide:** Fractures of the skull from direct & indirect impact, injuries of the brain and entire body Medico-legal aspects of drowning - Diatom test, Gettler's test, Chemical tests in drowning, Definition of infanticide, foeticide and stillbirth. Signs of intrauterine death, Signs of live birth, viability of foetus, age determination of foetus, Haase's rule, Hydrostatic test, maceration.

**Introduction to sexual offences,** Examination of accused and victim, preservation and dispatch of evidence in case of sexual offences. Handling of victims of sexual offences. POCSO Act.

**Forensic Entomology:** Principles, utility and relevance: insect body wall structure, cuticular outgrowths, colouration and special integumentary structures in insects. Embryonic and post-embryonic development; Types of metamorphosis, Insects of forensic importance, collection of entomological evidence during legal investigations; collection of meteorological data, specimens before body removal.

**Laboratory rearing of forensic insects:** Larval rearing, rearing containers, monitoring growth, larval dispersal in laboratory, adult emergence, rearing aquatic insects, unique species requirements, rearing beetles in the laboratory, factors that influence insect succession on carrion, effects of burial, bodies in water, bodies in vehicles, bodies in enclosed spaces, hanged bodies, burnt remains, wrapped remains.

**Role of aquatic insects in forensic investigations,** Estimating the post-mortem interval, Molecular methods for forensic entomology, determining whether the body has been moved, presence and position of wounds, 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, Challenges of Forensic Entomology in India, Immunological response of an insect bite.

## **Unit 7: Forensic Anthropology & Odontology**

**Genesis and development of forensic anthropology:** Bone surface anatomy & skeletal direction-terminology used in forensic reports. Human Skeleton- Axial and Appendicular Skeletal system, along with their anatomy. Histology and Chemistry of bones, Field and laboratory management of skeletal remains, Introductory bone maceration techniques, Comparative skeletal anatomy of human and non-human, non-metric skeletal variation, Introduction to Forensic Radiology (X-ray based).

**Instruments of importance in Forensic Anthropology:** Sliding & Spreading Calipers, Osteometric rod, Osteometric board, Cubic craniophore, Tubular craniophore, Goniometer, Skeletal age: Prenatal ossification. Postnatal appearance and union of centers ossification, cranial

suture closure, sexing skeletal remains: General consideration and age factors. Sex differences in skull, Pelvis and long bones, Calculation of stature of long bones: Studies on stature reconstruction in various population groups, Estimation of race from bones. Time since death from bones.

**Introduction to Craniometry**, Frankfurt Horizontal plane, Craniometric landmarks, Classification & identification of craniometric landmarks, Cranio-facial reconstruction: Forensic facial reconstruction Human facial anatomy including bones and muscles, anatomy of the facial features, facial tissue thickness with MRI and other methods,

**Cranio-facial superimposition:** Anthropological study of the skull, comparison of the facial features of the human skull and the antemortem photograph. Methods of Superimposition: Still photographic method, Video superimposition, and computerized technique of superimposition (Mention recent software used).

**Forensic Archaeology:** Introduction, Recovery of Forensic Evidence from individual graves, Forensic Geophysical survey (Global Positioning System, Ground Penetrating Radar Technology, Electrical resistivity Kit, Magnetometer, Geo-sensor technique) Legal matters.

**Forensic Odontology:** Development and scope, Human dentition- Terminology associated with human dentition, Tooth structure: structural variation in teeth (human and non-human), types of teeth and their functions. Determination of age by dentition: eruption sequence, Gustafson's method. Bite marks- Collection and Identification methods. GV Black's classification for dental caries and preventive measures.

**Ancient DNA Typing:** Introduction, Methods, strategies and applications, Ancient DNA markers, CCR5, Ancient DNA extraction: comparison of extraction methods, ancient DNA yield, ancient DNA preservation, ancient DNA degradation patterns, the age of ancient DNA, fragment lengths of ancient DNA, storage of ancient DNA extracts.

## **Unit 8: Question Document Examination & Fingerprint**

**Introduction to Document, terms and terminology:** Document- legal definition. Principle of handwriting examination, Forensic Document Examination, Classification of documents; Care, handling, preservation of documents, Ethics of questioned document experts. Preliminary examination of documents, Handwriting characteristics. Terminologies used in document examination.

**Examination of documents:** Tools used in document examination, Principle and working of Simple -Microscope, Stereo microscope, zoom stereo microscope, Comparison microscope, Light sources - UV, IR, transmitted light, oblique light, spotlight, Determination of sequence of intersecting strokes, examination of creases and folds, determination of the sequence of writings over creases & folds, Types of exemplars- request and non- request, comparison of like with like. Comparison of handwriting. Comparison of signature.

**Introduction to Fingerprints:** History and development of fingerprints, Principle of Fingerprint Identification, Friction Ridge Skin, Fingerprint as forensic Evidence, Types of fingerprint found at the scene of crime, Classification of Fingerprints for Comparison purposes: Pattern area, Core, Delta, Type lines, Poroscopy, edgeoscopy, ridge characteristics, Fingerprint Pattern Types, Ten Digit and Single Digit fingerprint classification.

**Collection, Lifting and Preservation of fingerprints:** Recording of fingerprints - From living and dead persons, different methods employed in development of latent prints both chemical and physical, Preserving and lifting of fingerprints. Automatic Fingerprint Identification System (AFIS), FACTS, Detailed explanation of different steps involved, Poroscopy.

### **Unit 9: Handwriting & Signature Analysis**

**Handwriting:** Definition & History of Handwriting, Development of Handwriting, Principles of handwriting identification Discrimination of Handwriting and Signature: General characteristics, Individual characteristics of Handwriting, Process of Comparison. Disguise writings and examination of anonymous letters and identification of their writer, Determination of sequence of intersecting strokes, determination of sequence of writings over creases and folds.

**Signature:** Definition and types of Signatures. Types of Signature Forgery. Trends in Forgery, Principles of examination of signature identification. Procurement of Standard/ Admitted/ Specimen Writings/signatures. Characteristics of Genuine and Forged Signatures. Difference between tremors of fraud and genuine tremors in writings and signatures and identification of forger. Digital signature fraud analysis, Automated Signature Verification System, Srihari's Individuality of Handwriting and various court rulings, Application of Likelihood ratio and Bayesian approach in handwriting examination.

**Final examination and report writing:** Different types of 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,

**Standards related to Handwriting and signature examination:** ASTM and SWGDOC, European Network of Forensic Science Institutes – Best Practice Manual for the Forensic Examination of Handwriting

### **Unit 10: Forensic Computing & Cyber Crime**

**Introduction to computers:** Applications of computers in forensic science, The computer system and CPU – Types of computers (desktop, laptop, personal computers, Client and server) – The foundations of modern information technology - bits & bytes, CPU, the microprocessor.

**Computer organization:** Memory – ROM and RAM, Virtual memory, BIOS and firmware, input and output devices – keyboard – mouse – OCR bar codes, Concepts of hardware and software, Storage devices and media, storage characteristics – tracks and sectors, Increasing data storage capacity – backup devices - magnetic tape, The software: introduction – OS – OS types, Application software, major software issues – network computing.

**Forensic Computing:** Number systems Binary and Hexadecimal, Character encoding – Introduction to EBCDIC, ASCII, UNICODE. File System- FAT, NTFS, HFS (working)- MBR, VBR, MFT. Physical construction of hard disk. Working of hard disk. Data encoding methods- FM, MFM, RLL, ZBR. IDE and ATA (PATA and SATA), File signature, Cryptography: types of encryption and decryption – Password: Types of passwords, –Explanation of password keys and hashes, password breaking tools and techniques – Computer Security, CIA, Introduction to Internet – history and topology, Basics of networking, Types of network- LAN, MAN, WAN-OSI Reference model, TCP/IP Model.

**Cybercrime and Cyber laws:** Introduction to cybercrime and cyber forensic, Types of cybercrime – Provisions in Indian Law dealing with cybercrimes – IT Act 2000-Prohibition and offences under IT Act.

**Offences related to digital signature and electronic signature:** Statutory provisions, Establishment of authorities under IT Act and their functions and powers, Intellectual Property Rights, Amendments made in Indian Evidence Act, Indian Penal Code etc. – Cyber appellate tribunal - structure and function – Role of Intermediaries – Power of Police officers.

### **Unit 11: Criminology & Victimology**

**Criminology:** Crime, Criminology and Criminal Justice Administration, Differences between concepts: Sin, Crime, Vice & Wrong, Deviance and Delinquency, Schools of Criminology: Pre-classical, Classical, Neo-classical, Positive schools of criminology: Anthropological theories, Morphological theories, Cartographic School.

**Biological Theories:** Family-Genetics; Chromosomes and Genes- Study of twins and family trees, Differential Association Theory, Differential Opportunity Theory, Routine Activity Approach, Broken Windows Theory, Labelling Theory; Shame and Re-integrative Theory, Chicago School of Crime

**Police and Policing in Modern India:** Constitutional provisions regarding policing in India, Police Reforms in Independent India, National Police Commission Recommendations (NPC), Padmanabhaiah Committee Report, NH Vohra Committee Report, Types of Police Organization: Central Police Organizations, State Police and other branches, Executive powers and duties of police officers, International Criminal Police Organization

**Victimology:** Victim, Victimization and Victimology, Key Concepts in Victimology: Victimogenesis, Victim Precipitation, Victim Blaming, Victim Vulnerability, Victimization Proneness, Victim Response, Victimless crimes, Abuse of power, Victim Assistance, PTSD, Psychological Impact of victimization

**Typology of Victims:** Benjamin Mendelsohn- Hans Von Hantig; Selling and Wolfgang Typology of Victims: Primary Victimization- Secondary Victimization, Tertiary Victimization, -Mutual Victimization – No Victimization

**Theories of Victimology:** Victim precipitation Model- Routine Activity Approach – Situated Transaction Model. Provisions for victim assistance: Types of Victim Assistance; Restitution - Compensation for Victims of Crime and abuse of power - Victim Compensation - Sec 357 CrPC and its amendments; Solatium Fund.

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