Syllabus: Forensic Science

Unit I: Introduction Fundamentals of Forensic Science

• Forensic Science: Definition, History & Development, Scope, Ethics in Forensic Science

• Physical Evidence: Nature, Types, Search methods, Collection, Preservation, Packing & Forwarding of Physical & Trace evidence for forensic analyses, Chain of Custody

• Crime Scene: Nature, Types, Preservation of Scene of Crime

• Criminal Investigations: Unnatural deaths, Criminal assaults, Sexual offences, Poisoning, Vehicular accidents

• Courts: Types, powers and jurisdiction, Admissibility of evidence in Courts, Definition of Experts, Court Procedures pertaining to Expert Testimony & Witness Forensic aspects of new laws: Bharatiya Nagrik Suraksha Sanhita (BNSS), Bharatiya Sakshya Adhiniyam (BSA), Bharatiya Nyay Sanhita (BNS).

• Organization of Forensic Science Laboratories of Centre and State, NCRB and NICFS, Police Organizations, Roles and Responsibilities

• Fundamental Rights: Right of Equality (Articles 14 to 18) and Right of Freedom (Articles 19 to 22) as per Constitution of India

• Criminal Profiling: Profile of victim and culprit, its role in crime investigation, Lie detection (Polygraphy), Narco-analysis, Brain mapping, scope and limitations

Unit II: Chemical Science

• Instrumental Techniques: Microscopy: Polarizing, Comparison, Stereoscopic, Fluorescent and Electron Microscopes

• Spectrophotometry: UV, Visible, IR, Raman, Atomic absorption, Emission, Neutron Activation Analysis,
• X – rays and x-ray-based techniques such as XRD, XRF

• Mass Spectroscopy based techniques HRLC-MS, HRGC-MS

• Chromatographic Techniques: TLC, GLC, HPLC, HPTLC, Ion Exchange Chromatography

• Hyphenated Techniques: GC-MS, LC-MS, IR-MS and ICP-MS

• Electrophoresis: High and Low voltage electrophoresis, Immunoelectrophoresis, Capillary Electrophoresis

• Immunoassays: Principle, Types, Techniques and applications (RIA, EMIT)

• Forensic Chemistry: Liquor analysis: Analysis of Ethyl alcohol in beverages, and illicit liquor, Analysis of Methanol and Denaturants, Analysis of Chemicals in Trap Cases

• NDPS: Narcotics Drugs and Psychotropic substances, Introduction and Classification of Control Substances, Precursor Chemicals, Forensic Examination of NDPS, Syllabi for Ph.D. Entrance Test Page 5

of 33 Mandatory Provisions of NDPS Act, Classification of NDPS Drugs, Drug Dependence and Drug Tolerance, Forensic examination of NDPS substances by various methods.

• Explosive Chemistry - Introduction, Classification and Chemistry of Explosives, Various Types of IEDs and their reconstruction, Mechanism of Explosion, Processing of Explosion Scene of Crimes –Forensic examination of high explosives by various methods

• Petroleum Chemistry- Physical Properties of Petroleum Products, Forensic examination of petroleum products as per BIS.

• Fire Chemistry- Chemistry and thermodynamics of fire, Forensic Investigation of Fire, Analysis of fire debris

• Forensic Toxicology: Introduction to Poisons, Classification of poisons, methods of administration of poisons, Mode of action of Poisons, Collection and Preservation of Biological evidence and circumstantial evidence in fatal and survival cases, & Extraction, Clean-up procedures, Identification of common poisons from viscera, tissues and body fluids (Drugs, Insecticides & Pesticides, Plant poisons, Metallic Poison)

• Basic principles of pharmacology, pharmacokinetic and pharmacodynamic

• Quality Management: Overview of ISO 9001 & ISO 17025:2017 requirements. Quality Control, Quality Assurance and Total Quality Management. Reference Standards & Certified Reference Material, Traceability, validation of the new methods and verification measurement of uncertainty, maintenance and calibration of instruments. Proficiency testing, Quality Audit, Management Review Meeting, Importance of Accreditation of Forensic Science Laboratories.

Unit III: Biological Science

• Serology and Immunology: Blood Group Systems, Determination of Species of Origin, tools and techniques for blood, physiology and biochemical properties of various body fluids (semen, saliva, menstrual blood, urine). Presumptive and confirmatory tests for body fluids, modern techniques for qualitative and quantitative analysis of body fluids, proteomics for body fluids identification, cell and organs of the immune system, type and properties of antibodies,

• DNA Forensics: Structure and functions of nucleic acids, Various DNA Extraction techniques – organic extraction, silica based and magnetic based techniques and kits, Various DNA quantification techniques – UV-Visible Spectroscopy based, Real Time PCR, Fluorometry. Polymerase Chain Reaction (PCR) and its variants for forensic applications, DNA markers for human identification – STRs, Y-STRs, X-STRs, Dloop, SNPs, Various commercial kits for STR (autosomal, Y- and X-) Profiling, Automated DNA Sequencing by Sanger Method, Next Generation Sequencing Technologies (Ion Torrent, Illumina MiSeq, Oxford Nanopore etc.) and its applications in DNA Forensics for paternity, identification, ancestry and phenotyping. Basic Principles of population genetics, allele frequency and genotype frequency, calculations for Random Match Probability (RMP) and Likelihood Ratio (LR) for Syllabi for Ph.D. Entrance Test Page 6 of 33 matching statistics and paternity testing, non-human identification through DNA barcoding and related markers

• Forensic Anthropology and Medico-Legal Analysis: Modes & Manner of deaths, Sexual offences and its medicolegal importance, Amendments in law related to sexual offences, Postmortem examination and Postmortem changes, Estimation of time since death, Injuries & Wounds: Types, Medicolegal importance, Gunshot wounds, Determination of Species of Origin, Sex , Age, Stature, and individual identification through skeletal remains, Identification through Skull superimposition and facial reconstruction, Human dentition, Type of teeth, determination of Age, Bite marks

• Forensic Entomology: Introduction, Insects of forensic importance, Insects on Carrion, Forensic applications,

• Forensic Biology: Pollens and Diatoms, Wildlife forensics - Wildlife Acts, evidence and identification methods

Unit IV: Physical Science

• Firearms: Types, Classification, Ammunition and their Compositions Forensic examination of Firearms, Ammunition, Firearms' projectiles (Bullets, Shots, Slug etc.), Shell case Gunshot residues analysis Identification of Origin, Range of Fire, Basics of Internal, External and Terminal Ballistics, Instrumental Analysis

• Basic concepts of physical evidence: Evidence and its type, Glass, Tyre Marks, Bite Marks, Footprints, Soil, Fiber, Paint, Lip Print, Ear Prints, Tool Marks, Cement and Concrete examination. Forensic significance, collection, packaging and forensic examination.

• Photography: Types, application in criminal investigation & Forensic evidence examination. Reproduction of documents through photographic and mechanical means and their examination

• Biometric Systems of Identification: Introduction to Biometrics, Types of Biometrics, Biometric applications, Palm prints, Gait pattern, Iris scan, Retinal scan, Voice prints, keystroke analysis, etc.

• Fingerprints: History, Characteristics, Types, Classification, Collection, Preservation, Development, Lifting and Comparison, Examination of Chance Prints, Computerization of Fingerprints, AFIS

• Documents: Definition, Types, Preliminary examination of documents, basics of handwriting and signature examination, types of forgeries and their detection, examination of Alterations in the document, Indentations, Secret writings and Charred documents, estimating the age of Inks and Papers, examination of typescripts, printed documents, computer printouts, scanned documents, seal and stamp impressions.

Unit V: Digital, Cyber and Multimedia Forensics

• Basic components of a computer: input devices, output devices., storage devices, the central processing unit (CPU), binary, octal, decimal, and hexadecimal number system, Syllabi for Ph.D. Entrance Test Page 7 of 33 their conversions and operations, representation of information in binary and hexadecimal formats

• Understanding the role of an operating system (OS), the booting process, introduction to process and memory management, Windows OS architecture.

• Fundamentals of computer networks, the protocols and functions of each layer, types of network connections, and various networking devices.

• Introduction to multimedia evidence, handling, collection and preservation of audio/video/image evidence, speaker profiling, audio authentication and enhancement techniques, Video and Image enhancement, authentication and facial comparison.

• Device source identification, metadata analysis, detection of deepfake audio, video or Image and compression artifacts. File structure analysis, steganography, and watermark detection.

• Concepts of artificial intelligence: search algorithms, knowledge representation, and reasoning, supervised, unsupervised, and reinforcement learning, decision trees, SVMs, k-means, and ensemble methods.

• Basic concepts of neural networks, CNNs, RNNs, GANs, and transformers, along with training strategies, optimization techniques, and regularization. Basics of computer vision, natural language processing, and ethical issues of AI in real-world applications.

• Latest tools and techniques used in Digital Forensics and Multimedia Forensics