SYLLABUS

OF

FACT AND FACT PLUS

NICFS National Forensic Sciences University
Delhi Campus,
Ministry of Home Affairs,
Government of India, Delhi

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SECTION: A

APTITUDE IN FORENSIC SCIENCE

For specialization subjects of Forensic Ballistics and Physical Sciences, Forensics Document Examination, Forensic Chemical Sciences, and Digital Forensics

General Aptitude

General Knowledge
General English
Quantitative Aptitude
Logical Reasoning

Fundamentals of basic sciences as applied to forensic investigation.

Foundations of Forensic Science

Principles and scope of forensic science, Various disciplines of forensic science and their functions, Developments in forensic science in India and globally, Role and scope of forensic science laboratories and institutions, Contributions of eminent forensic scientists (global and Indian pioneers)

Crime Scene and Evidence Management

Types of crimes and corresponding evidence materials, Sources, significance, and classification of evidence, Crime scene management: search methods, documentation, sketching, measurement, Photography and videography in forensic documentation, Identification, collection, preservation, packaging, and forwarding of evidence, Reconstruction of crime scenes , Development and lifting of fingerprints, footprints, tyre marks, and other pattern evidence, safety measures at the scene of crime and in laboratory

Quality Assurance in Forensic Science

Quality Control (QC) and Quality Assurance (QA) practices in the analysis of evidence materials, Proficiency testing and inter-laboratory comparisons

Instrumentation and Analytical Techniques

Class and individual characteristics of evidence, Principles and applications of analytical techniques- Electromagnetic radiation and interaction with matter, Microscopy Spectroscopy and spectrophotometry, Chromatography, Electrophoresis, Basics of computer systems and digital evidence, Imaging and authentication of digital evidence, Forensic photography, Concepts of precision, accuracy, error rate, and standardization

Basic Statistical Tools in Forensic Science

Probability concepts, Measures of central tendency: Mean, Median, Mode

Hypothesis testing:

F-test, Chi-square test. Measurement of uncertainty, Systematic and random sampling

Legal Framework and Ethics in Forensic Science

Role of expert testimony in courts of law, Admissibility of evidence, Bharatiya Nyaya Sanhita (BNS), Bharatiya Nagarik Suraksha Sanhita (BNSS), Bharatiya Sakshya Adhiniyam (BSA) relevant to forensic science, Digital evidence laws and cyber forensics provisions, Data protection and privacy considerations (e.g., emerging Digital Personal Data Protection framework in India), Ethics in Forensic Science.

For specialization subject of Forensic Psychology

Basics of Criminology
Fundamentals of Psychology
Logical reasoning and analytical ability
Introduction to Forensic Science

SECTION: B

1.FORENSIC BALLISTICS & PHYSICAL SCIENCES

Forensic Physics

1) Crime Scene & Physical Evidences

Crime scene management: Types of crimes: Blue collar crimes and white-collar crimes, property crime, and public order crime. Introduction to the crime scene, Types of crime scene, Evaluation and processing of crime scene, Securing the scene of crime, Documenting the crime scene (Note making, Sketching, Photography, videography of crime scene), role of the first arriving officer at the crime scene. Searching techniques of crime scenes, Processing of physical evidence-discovering, recognizing and examination of physical evidences Collection, Safety measures for evidence collection Preservation, Packaging, sealing, labelling and forwarding of physical evidences, Maintaining the chain of custody, Probative value of physical evidences, Reconstruction of scene of crime.

Introduction to physical evidence: Types of physical evidence: Pattern Evidences, Track evidences and Trace evidences, Classification and Role of physical evidences in Criminal Investigations.

Glass: Introduction to glass, Types of glass and their compositions, Forensic examination of glass fractures under different conditions, determination of direction of impact: hackle marks, backward fragmentation, Physical measurements of glass, colour and fluorescence, physical

matching, density comparison, physical measurements, refractive index by refractometer, elemental analysis, and interpretation of glass evidence.

Paints: Introduction, Composition, Manufacture of Paint, types of paint, Forensic Examination of Paints and Coatings: macroscopic and microscopic techniques for the characterization of Paint Fragments, Physical, Chemical & Instrumental analysis of paint.

Soil: Soil and its composition, Classification of soil, Collection and preservation of soil as an evidence, Physical, Chemical & Instrumental analysis of soil samples.

Lip print: Introduction to Cheiloscopy and history of lip prints, Classification of lip prints, Collection, Development, Identification and Comparison of lip prints.

Tool mark Evidences: Introduction to tool marks, Types of tool marks, Class characteristics and individual characteristics of tool marks, Collection and Preservation of tool marks, Forensic examination of tool marks.

Restoration: Methods of making marks, Restoration of erased numbers, methods used for removal of serial numbers, theory behind number restoration, restoration of marks on cast iron, Aluminium, brass, wood, leather etc., chemical methods of restoration (etching), reagents used for various metals, recording of restored marks.

Bite marks: Objectives and forensic importance of bite-marks examination, the typical bite marks morphology, types of bite marks.

Ear Prints: Introduction to ear prints, Morphology of the ear, Procedure of taking standards from the suspects, Identification and comparison of ear prints.
Tyre Impressions: Introduction to tire impressions, Collection and Preservation of the tire impression evidence, Forensic Significance of skid marks, Forensic Examination for identification and comparison.

Footprints & Shoe impression examination: Introduction to footprints & Shoe impression, locating impressions at the scene of crime, Evidence collection: Collection, Lifting/Casting and Preservation of foot/footwear impressions, importance of Gait pattern, Forensic Identification and Methods of comparison.

Fibers analysis: Forensic significance, Classification, Textile Fibers, Yarns, Fabric construction, Fabric characteristics, Microscopic, Chemical and instrumental methods of examination.

2) Analytical Instruments & Techniques of Forensic Physics

Microscopy: Microscope, Compound Microscope, Polarized Light Microscopy, Fluorescence Microscopy, Comparison Microscope, Stereo-zoom Microscope, Transmission Electron

Microscope, Scanning Electron Microscope – Energy Dispersive X-Ray (EDX), Atomic Force Microscope.

Spectroscopy: Introduction to spectrophotometry, Interaction of electromagnetic radiations with matter: phenomena of absorption, emission, reflection, fluorescence, phosphorescence. **Detection of radiations:** Photographic detectors, thermal detectors, photoelectric detectors. Basic concepts of atomic spectra, energy levels, quantum numbers, designation of states, selection rules, atomic spectra, rotational, vibrational and electronic spectra, spectra of polyatomic molecules.

Ultraviolet and visible spectrophotometry: sampling devices, Lambert and Beer's Law, calibration of instrument.

Elements of X-ray spectrometry: Energy Dispersive X-ray Analysis (EDX), Wavelength Dispersive X-ray analysis (WDX), X-ray diffraction, Auger emission spectroscopy and applications.

Radiochemical techniques: Basic principles and theory, introduction about nuclear reactions and radiations, neutron sources, neutron activation analysis, basics of electrostatic. Effect of chemical structure and solvent on absorption spectra, qualitative and quantitative analysis and limitations, applications in forensic chemistry and toxicology.

Infrared spectrophotometry: Basic principle, components, sample handling, dispersive and Fourier Transform spectrophotometry (FTIR), qualitative analysis and interpretation of IR spectra, correlation of infrared spectra with molecular structure and applications in forensic chemistry and toxicology.

Raman Spectroscopy: Basic principles, instrumentation, sample handling and illumination, structural analysis, polarization measurements, dispersive and FT Raman, applications in forensic chemistry and toxicology, advantage of Raman over IR and vice versa, role of microscope.

Atomic Absorption Spectroscopy (AAS): Instrumentation, interference in AAS, background correction methods, graphite furnace quantitative analysis, detection limit and sensitivity, applications.

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

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

Nuclear Magnetic Resonance: Basic principles, theory, instrumentation and applications.

3) Forensic Photography & Videography

Forensic Photography: Definition of photography, Cameras and its working, types of camera lenses. Digital photography, Working of SLR & DSLR Cameras, Image sensors, software for digital photography, Image File format, Laboratory photography.

Crime Scene Photography: Overall, Midrange, Close-up photographs of the crime scene. Equipment required in Crime Scene Photography. Reprovit unit, photography of fingerprints and documents, IR and UV photography

Videography: types of video cameras, crime scene videography, high speed videography, Aerial Videography, court representation, and admissibility of photographs in the judicial system.

4) Forensic Audio and Video Analysis

Audio: Basics of sound, human ear anatomy and voice, sound recording and reproduction, and forensic significance of voice.

History of voice analysis, Voice production theory, uniqueness in person's voice, interspeaker and intraspeaker variations, text-dependent and text-independent speaker recognition. Introduction to voice identification/speaker recognition and its forensic importance Discriminating tests: closed test, Open test, collection of standards for comparison Handling of audio recording evidences & its physical examination, marking of speakers,

Speaker profiling: Segregation of Speech samples, auditory analysis/listener's approach, spectrographic approach or voiceprint analysis, automatic speaker recognition technique. Enhancement and normalization techniques, establishing the authenticity and integrity of audio recordings, Speech signal processing, Fourier analysis, frequency & time domain representation of speech signal, analogue to digital conversion, Principle and working if various instruments: hardware, software used for audio analysis, report writing, related case studies, admissibility of audio evidences in court proceedings

Forensic Linguistics: Phonetics, Morphology, Syntax, Semantics, Stylistics, Pragmatics, Script, orthography and graphology.

Forensic video examination: Definition, scope and significance in crime investigation, technical aspects of the video, collection, handling and preservation of video files, video analysis: frame extraction, frame by frame analysis, shot by shot analysis. Video processing and

enhancement, Video authentication, Metadata analysis, hash value generation. Biometric Analysis for personal identification, facial biometrics, related case studies.

CCTV Forensics: Basics of CCTV, scope recognizing CCTV evidence & its nature, types of DVRs, DVR recording, evidence, best practices of CCTV evidence retrieval and storage at scene of crime and laboratory. Introduction to CCTV Forensics, Acquisition of CCTV footages from the scene of crime, Handling and preservation of CCTV footage, hash value generation, extracting the data from DVR/NVR, maintaining the chain of custody. Authentication and enhancement of CCTV footages, extraction of frames, vehicle registration plate image enhancement, foreign object detection, Authentication of Video evidence, video source identification techniques Forensic tools for Enhancement and authentication of CCTV footages, legal admissibility of CCTV evidence.

5) Essentials of Mathematics & Statistics in Forensic Physics

Number systems and their Representations, Units of measurement and their conversion, Dealing with Uncertainties in measurement. Types of Data, Basic concepts of frequency distribution, Measure of Central Values – Mean, Median and Mode, Measures of Dispersion, Range, Mean Deviation and Standard Deviation, Correlation and Regression Analysis.
Variance – Coefficient of variation, Moment, Coefficient of Regression, Correlated Measurements.

Probability Theory: Overview and Basic terms – Events, Trials, Mutually Exclusive events, Favourable Events, Exhaustive Events etc., Bayes theorem, Addition and Multiplication theorem, Conditional Probability, Binomial Probability distribution, Normal Distribution, Hyper-geometric distribution, Applications – Matching of hair evidence, Uniqueness of Fingerprints,

Tests of Hypothesis – Test of Significance of attributes, sample test, t-test and comparison of datasets, Paired Test, Chi-Square test, F-test for equality of variance, Large sample test, Normal Test, Pearson's χ^2 test. Discriminating Power and Evidence Significance: Derivation, Evaluation of evidence, Transfer of evidence – Likelihood Ratio, Probability of guilt, Correspondence probabilities, Weight of Evidence.

6) Forensic Nanotechnology

Nano-science & Nano-technology: introduction to nanoparticles, synthesis of nanoparticles, nanotubes, utilization of nanotechnology in analysis of physical evidences, selectivity of nanoparticles with compatibility and feasibility, Application of nanotechnology in forensic evidence analysis

7) Forensic Engineering, Collision Investigation and Accident Reconstruction

Cement: Cement and other constituents of Building materials and their properties, Identification of adulterated cement and adulterants, Sampling of evidence materials, Physical and chemical analysis of cement, cement mortar and cement concrete,
Methods of analysis of different constituents of Building materials, Steel bars and metal physics

Collision Investigation: Road evidence, road engineering and design, Grit, Bitumen, soling and paving of cemented roads, identification and interpretation of road obstructions, defects, marks and damage, tyre marks, skid marks

Vehicle examination: Automobile common component and failure analysis, damage assessment, tires—types, speed and load rating, inflation and failures, brakes—types and brake systems, door lock and speed recording devices, safety restraint system—theory and examination of seat-belt child-seat and air-bag, vehicular fires

Speed analysis: vehicle and road kinematics, coefficient of friction and drag factor, methods of determining drag factor, influence on braking distance

Speed determination: skid marks measurement, speed from vehicle yaw, speed calculation on different road surfaces, falls, flips and vault speeds, special speed problem
Motorcycle accident investigation**:** types of motor cycle, and turning, acceleration and breaks, mechanical consideration and slide to stop speed determination

Hit-and-run investigation: examination of suspect vehicle, collection of evidence & control samples, inter-comparison of analytical result of physical evidence Reconstruction of accident using Computer Aided Designing.

Forensic Ballistics

Firearms and Ammunitions, their classification, details of various small arms used in crime – shotguns, rifles, revolvers, pistols, carbines, improvised firearms, Handmade/Countrymade Firearms Bore and calibre, choke, action mechanisms employed in small arms, rifling – class characteristics of rifled bore, purpose of rifling, types of rifling, methods to produce rifling, various locks used in small arms. Head-space.
Various types of primers/ priming mixtures, propellants, shotgun ball ammunition, various kinds of bullets, head-stamp markings, Types and functions of wads in shotgun ammunition. Various physical, ballistic & functional tests of ammunitions.

Physical evidence and other clues Handling of evidence, various precautions.

a) **Internal Ballistics**: Ignition and burning of propellants, degressive, progressive and constant burning powders, shape of propellant grains rate of burning propellants, factors affecting internal ballistics of projectiles, internal ballistics of firearms, recoil.

b) **External Ballistics**: Equations of motion of projectiles, 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, overturning moments, stability 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 ballistic tables, projectile velocity determination, determination of velocity of shot-charge, Chronograph, Doppler-radar method Automated system of trajectory computation. Falling bullets – limiting velocity, drop, use of lead as bullet material.

c) **Terminal Ballistics**: Interaction and penetration of various small arm projectiles in various tissues. Threshold velocity for penetration of skin, flesh and bones, threshold energy/ casualty criteria, energy density, ricochet, various aspects of wound ballistics including wounds of entrance/ exit/ track of projectile, gunshot injuries caused by different types of firearm ammunitions. Temporary and permanent cavities, materials simulating human body, gunshot wound as a function of shape of nose of bullet, striking velocity, nature of target, tumbling of bullet, effect of instability of bullet, effect of intermediate target. Influence of range, identification of gunshot injuries, motion of projectile in dense medium.

d) Class and Individual characteristics of fired bullets and cartridge cases and their linkage with the suspected firearms, comparison microscope, photomicrography, source correspondence, linkage of fired shots with shotguns.

e) Determination of range of firing in cases of firing by smooth-bore and rifled firearms, factors affecting range of firing, stringing of shots, effect of string on pattern, Cart-wheel pattern, balling, Walkers' Test, Griess Test, Modified Griess Test, Sodium Rhodizonate Test and IR photography. Bullet resistant glass and bullet resistant armour.

f) Chemical tests for examination and identification of gunshot holes in various targets. Gunshot residue. Identification of shooter.

g) Scientific methods of shooting reconstruction, suicide, murder, accident, self-defence and encounter cases. –medico-legal report, basic ballistic facts, laboratory examination reports, Documentation and evaluation of bullet holes in various materials, ricochet marks, pellet pattern in various targets

h) **Instrumentation techniques**: AAS, NAA, SEM/EDXA, ICP-MS, ASV, EDXRF, IR Photography and their application in ballistic examination.

i) Arms Act and Arms Rule, 2016.

2.FORENSIC DOCUMENT EXAMINATION

Equipment/Instrumentation: – Working & features of High Resolution Video Spectral Comparators and Electrostatic Detection Apparatus. Working & application of Stereo Zoom Microscope, Crossline Examination System, HPTLC, Raman Spectroscopy and ATR-FTIR in Forensic document examination (FDE).

History of Forensic Document Examination, terminology used in FDE, Document Consciousness/ Standard literature/Books on FDE. Care, handling, preservation, packing, marking and forwarding of forensic documents. Analysis of paper & inks. Determination of sequence of intersecting strokes. Preliminary examination of documents. Comparison of alphabets and numerals. Examination of Document under various light sources.

Document Photography - Basic principles and techniques of black & white and colour photography. Specialized photography - UV, IR, transmitted light and side light photography close-up photography, trick photography, contact photography, Photomicrography & Microphotography. Demonstrative and juxtaposed charts. Digital photography, file formats for digital photographs, digital watermarking and digital imaging. Application of Photogrammetry & Radiography in FDE.

Nature & scope of Forensic Document Examination and its limitations: Classification of forensic documents. Various writing features. Natural variations, **master pattern and fundamental differences** in handwriting, Principle of handwriting identification. Procurement of standards for comparison. Comparison of like with like, suitability of standards for comparison. Effect of intrinsic & extrinsic factors on Handwriting. **Disguised Writings and Examination of Disguised Writings.**

General and individual writing characteristics- definition, **study, assessment, evaluation and their role** and their estimation. Simon Newcomb's Theory of probability and its application in document examination. Determination of the absolute and relative age of documents. Examination of anonymous letter. Applications of Forensic Linguistics & Stylistics in Document Examination. **Charred Documents and Examination of Charred Documents.**

Types of forgeries and their detection, characteristics of genuine & forged signatures. The Difference between tremors of fraud and genuine tremors in writings and signatures. Examination and Identification of manipulations in written, typed and computer printouts, Examination of digitally manipulated documents. Transplanted /Transposed writings/signatures, Digital signature. Detection and decipherment of alterations, including additions, overwriting, obliterations, erasures and secret writings. Analysis of Paper, Ink & Toner. Determination of Intersecting Strokes. Determination of the Sequence of Intersecting Strokes.

Principle, working and identifying features of various printers, Various conventional printing processes- their identifying features. Examination of Photocopies and scanned documents.

Security documents and security features, ICAO standards. Examination of genuine & counterfeit - Indian Bank Notes, MRTDs and Plastic Cards

Quality management system, Introduction to ISO/IEC 17025: 2017**,** NABL guidelines for accreditation of Forensic Science laboratories. **S**afety management in document laboratories

Various Indian Laws with reference to the New Criminal Laws 2023**:** Sections of BNS - 2(8), 2(39), 3(5), 61(2), 178 to 182, 316(5), 318(4), 318(1), 318(4), 319(1), 335, 336(1, 3), 337, 338, 340(1), 340(2), 341 (1, 3), etc. and relevant sub-sections and BSA sections- 2 ,39, 41, 57, 58, 62, 63,72, 119, etc. and relevant sub-sections. Final examination and report writing –different types of opinion writing and writing of reasons for opinion, importance of no opinion / qualified opinion. Demeanor of expert and preparation for presentation of evidence in trial courts, examination-in-chief, and cross-examination. Advances in Forensic Document Examination.

3. DIGITAL FORENSICS

Computer Forensics

Introduction to Computer Hardware - Various Components of a Computer, Motherboard, Processor, Memory, Storage Devices- Storage devices – Hard Disk Drives (HDD), Solid State Drives (SSD), USB/Flash drives, CDs, DVDs, etc., their working, data storage mechanisms, types of data, disk structure, partitioning methods (MBR, GPT), file allocation methods, and metadata (timestamps) and Networking components. Understanding Computer Operating Systems (OS), Booting process of computers. Introduction to File Systems and types of File System.

Cyber Crime – Forms of Cyber Crime**,** Internal and External Attacks, Crimes related to Social Media, ATM and Banking Frauds**,** Phishing, Ransomware, Malware attacks (virus, worm, Trojan), Identity theft, Online frauds**,** Data Privacy issues, Packet sniffing, Spoofing**,** Man-in-the-Middle attacks, SQL Injection, Cross-site Scripting (XSS), Cyberstalking, Cyberbullying, Insider threats, Email scams, Social Engineering attacks**,** Web security.

First Responder – Role and toolkit. Procedure for search and seizure of digital evidences. Search and Seizure of Volatile and Non-volatile Digital Evidence. Order of volatility, Evidence Handling, Destination disk sanitization, Data acquisition and duplication – Forensic Imaging, Use of write blockers, Verification using hashing, Disk cloning, Capture of memory dumps, Ensuring chain of custody. Imaging and Hashing Digital Evidence. Analysis and Recovery of Deleted, Hidden and Altered files. Handling encrypted data, recovering data from formatted drives, and documenting evidence for legal admissibility.

Windows Systems Artifacts: File Systems, Registry, Event logs, Shortcut files, Executables, Prefetch files, Recycle Bin, LNK files, Shellbags, System Restore Points, Page file and Hibernation files,etc Alternate Data Streams (ADS), Hidden files, Slack Space. Linux System and Artifacts: Linux file system – Ownership and Permissions, Hidden Files, User Accounts and Logs, bash history, cron jobs, syslog, auditd logs, temp files, mounted devices, symbolic links. Mac OS X systems and Artifacts: System Startup and Services, Network Configuration, Hidden Directories, System Logs, User Artifacts, plist files, Keychain, Terminal history, Time Machine backups, Safari/Chrome browser artifacts.

Web Browsers: Cookies, Favourites or Bookmarks, Cache, Session Data, and Plugins. Email: Types of Email and Protocols. Analysing the Header details and tracking the email, Email protocols, Spoofed Mails**.** Virtual Machine and Cloud Technology Forensics.

DVR/NVR Forensics: Search and Seizure, Surveillance System Architecture, Types of Storage Devices, RAID in NVR, Data Acquisition Protocols, System Logs and Their Importance, Proprietary File System Analysis, Video Compression and Codecs, Data Recovery and Carving, Metadata and Temporal Analysis, Authentication and Integrity, Forensic Challenges.

Network Forensics

Computer Networking – Digital and Analog Signalling Methods, Network Types and Topologies, Overview of OSI Model and TCP/IP Protocol. Different types of IP Addresses and Classes, Subnet Masks, Subnetting and Supernetting. Network Hardware Devices and Client/Server Computing. Types of Networks – LAN, MAN and WAN. Routers and Routing Protocols. Switching methods, VLANs, MAC addressing, Wireless networking standards (Wi-Fi 4/5/6), Network bandwidth and latency.

Network threats and vulnerabilities, Types of network attacks – eavesdropping, spoofing, modification, Cross-site scripting, DNS Spoofing, Routing Table Poisoning, ARP Poisoning, Web Jacking. Attacks on Wireless Networks. Social Engineering Attacks and its types. Packet Sniffing, Types of authentication, Attacks on WEP, WPA and WPA-2 Encryption, fake hotspots. Denial-of-Service (DoS/DDoS) attacks, Man-in-the-Middle (MITM) attacks, SQL Injection over networks, OWASP top web application security risk, Phishing over network channels, Zero-day exploits, Rogue access points.

IP security architecture, Security protocols, IPSec, Web Security – Firewalls, IDS, IDPS. Network Security Applications, Authentication Mechanisms: Passwords, Cryptographic authentication protocol, Kerberos, X.509 LDAP Directory. Digital Signatures. Web Security: Secure Socket Layer (SSL) Encryption, Transport Layer Security (TLS), Secure Electronic Transaction (SET) and Virtual Private Networks (VPN)**.** Network Access Control (NAC), IPv4, IPv6Multi-factor Authentication (MFA), Public Key Infrastructure (PKI), Network segmentation, Security Information and Event Management (SIEM).

Monitoring of computer network and activities, Live Packet Capturing and Analysis. Searching and collection of evidences from the network. Network Intrusion Detection and Analysis. SQL Injection, Event Log analysis – tools and techniques. Investigating network attacks. Evidence collection from Routers and other networking devices. Traffic analysis, Deep Packet Inspection (DPI), Honeypots and Honeynets, Log correlation, Wireless network forensics, VPN traffic analysis.

Cloud Technology and its various components – Private, public and hybrid cloud. Cloud types: IaaS, PaaS, SaaS. Role of virtualization in enabling the cloud. Technologies and processes required when deploying web services. Cloud Security Architecture, Secure Cloud-based service, Identity and Access Management, Encryption and Key Management. Cloud Forensics – Importance, Challenges, and Scope. Cloud Evidence Identification, Preservation, Acquisition, and Analysis. Multi-tenant data issues, Cloud logging and monitoring, Virtual machine snapshot analysis, API forensics, Cloud storage and database forensics, Cloud incident response, Legal and jurisdictional considerations.

Malware Forensics: Malware Types – Virus, Worm, Trojan, Ransomware, Spyware, Adware, Rootkits, Keyloggers. Malware Analysis Techniques – Static Analysis, Dynamic Analysis, Reverse Engineering, Sandbox Analysis. Indicators of Compromise (IoC), Registry and File System Artifacts, Memory Analysis, Network Behavior Analysis, Persistence Mechanisms,

Payload Extraction, Hashing and Signature Analysis, Anti-Forensic Techniques, Evidence Preservation, Logging and Timeline Reconstruction, Legal and Ethical Considerations.

Mobile And Wireless Device Forensics

Introduction to Mobile Technologies – Asynchronous Transfer Mode (ATM), Wireless Application Protocol (WAP). Cellular technologies – Advanced Mobile Phone System (AMPS), i-Mode, Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA), and Global System for Mobile Communications (GSM) and relative strengths. Subscriber Identity Module (SIM), International Mobile Equipment Identity (IMEI). Mobile network architecture, 2G/3G/4G/5G overview, Mobile IP, Mobile network protocols (GPRS, EDGE, LTE), SIM cloning and fraud detection.

Functions of Bluetooth and security issues. Various Generation of Mobile Phone Technologies. Understanding of the mobile phone operating systems – Android, iOS, Windows. Understanding of SQLite Databases**.** Mobile app forensics, Mobile cloud integration, Mobile device encryption, Mobile device backups (iCloud, Google Drive), App permissions analysis.

Phone Phreaking, Call tampering, Wireless Hack Walkthrough and Man-in-the-Middle attacks. Overview of WEP attack. Attacks on WEP, WPA and WPA-2 Encryption, fake hotspots. Wireless Public Key Infrastructure. Securing WLAN, WEP Decryption script. Attacks on 4G/5G networks, SIM Swap attacks, NFC vulnerabilities, QR code based attacks.

Overview of Mobile Forensics, Seizure and Preservation of mobile phones and PDA. Types of Evidence present in mobile phones – Files present in SIM card, external memory dump, and evidences in memory card. Mobile phone evidence extraction process, Data Acquisition Methods – Physical, File System, Logical and Manual Acquisition, JTAG and Chip-off extraction**.** Mobile Forensic Investigation Toolkit. Tracking of mobile phone location. Analysis of call logs, messages, GPS/location data, Wi-Fi and Bluetooth connections, social media apps, deleted and encrypted data recovery.

IOT forensics Introduction to IoT Devices, IoT Architecture, Types of IoT Devices (Smart Home, Wearables, Industrial IoT), Data Sources in IoT Devices, Evidence Identification and Collection, IoT Communication Protocols (MQTT, CoAP, HTTP), Cloud Integration in IoT, Log and Network Data Analysis, Firmware and Memory Analysis, Data Acquisition Techniques, Security Issues in IoT, Encryption and Authentication, Forensic Challenges (Data Volatility, Heterogeneity, Limited Storage), Legal and Privacy Considerations.

Social Media Forensics And Cryptography

Introduction to Social Media, Security Issues in Social Media, Types of crimes of Social Media – Cyberbullying, Online Grooming, Cyberstalking. Social Media and its impact on Business, Politics, Law and Revolutions, Emerging Trends in social media, Fake accounts, Social Media phishing, Misinformation campaigns, Social Engineering via social media.

Sources for social media evidence, Types of Data Available on Social Networking Sites, Different evidence collection methods from social networking sites, Intelligence gathering from Social Media – Tools and techniques for intelligence gathering – indirect method, direct method with login, direct method without login, API-based data collection, Metadata extraction, Geolocation tracking, Analysis of deleted or edited posts.

Introduction to Cryptography, Symmetric and Asymmetric Cryptosystem Encryption Techniques – Substitutional Cipher and Transpositional Ciphers. Types of keys – Public Key and Private Key. Advanced Encryption Techniques and Security Issues. Various types of attacks including Cipher Text-Only attack, Known-Plaintext Attack, Chosen-Plaintext Attack, Chosen-Cipher Text Attack, Side-channel attacks, Brute force attacks, Replay attacks, Key management issues, Diffie Hellman key exchange, ElGmal Signature Scheme**.**

Symmetric Cryptosystem – AES, DES, RC4, Blowfish. Asymmetric Cryptosystems – RSA, DSA, Elliptic Curve cryptography. Introduction to Cryptanalysis – Differential and Linear Cryptanalysis. Hashing Algorithms – MD5, SHA-1, SHA-2, SHA-3, One-Way Hash, Hash Message Authentication Code**.** Digital Signatures, Certificate Authorities, Public Key Infrastructure (PKI), Hybrid Encryption Techniques**.**

Cloud Forensics – Social Media Data acquisition: Cloud Forensics – Social Media: Identification of accounts, Browser history, Saved credentials, Cookies, Session tokens, Email accounts, Installed apps, Keychain/credential stores, Password managers, App artifacts, Data acquisition via authorized credentials or APIs, Posts, Messages, Media files, Logs, Backups, Metadata, Evidence preservation, Hashing, Snapshots, Secure storage, Analysis of user activity, Deleted content, Interactions, Metadata, Legal and jurisdictional compliance.

4. FORENSIC CHEMICAL SCIENCES

Forensic Chemistry-I

Alcohols and alcoholic beverages, Analysis of alcohols, country made liquor, illicit liquor and medicinal preparations, Analysis of various denaturants of alcohol, detection and determination of ethanol, methanol, aldehyde, ester by colour test and instrumental technique, Relevant sections of Central Excise Act-1944.

Metals and alloys, their composition; Importance of analysis, purity of metals, trace elements, and their Physical and Chemical analysis

Petroleum products and their adulterations: Analysis of petrol, kerosene, diesel, lubricants by BIS methods and ASTM methods. Detection of adulterants of gasoline, diesel and engine oils. Analysis of residues in forensic exhibits, chromatographic analysis of petrol, kerosene, diesel and other solvents for detection of adulteration. Analysis of Paraffin's, Iso-Olefines, Olefin, Hydrocarbons, Naphthenes, Cycloparaffins or Aromatic Hydrocarbons, Sulphur compounds, Nitrogen compounds, Oxygen compounds, Organo-metallic hydrocarbons

Fire and Arson; Legal definition of Arson and its motives. Types and Chemistry of fire, fire triangle, thermodynamics of fire, NFPA 921 and NFPA1033, the chemistry and physics of combustion, Dynamics of fire, Development of fire, Separation and analytical techniques of ignitable liquid residues, Interpretation of data obtained from fire debris, Arson debris, burnt articles, flammable liquids, their collection, preservation and analysis, Dowry death cases: Investigation and Analysis. Quality Assurance in fire debris analysis report writing and Court testimony, Arson, Accidental, vehicular and electrical fire investigations. Role of Forensic Science in investigation of fire, cause of ignition and evidence collection.

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.

Dyes: Forensic significance of dyes in crime investigation, comparison of dyes in fibres and different inks by TLC and UV-VIS Spectrophotometer. Comparison of Dyes and their chemical behaviour.

Pesticides: Classification of pesticides, its formulation, identification of pesticide, standard or sub-standard or substituted pesticides. Determination of purity by chemical analysis, thin layer chromatography, ultra violet - visible spectrophotometry and gas liquid chromatography. Determination of level of pesticide in water, cold drinks, milk, food materials.

Forensic Nuclear Chemistry: Introduction to nuclear forensics, nuclear threats, Nuclear explosive devices. Radioactivity, Radioactive decay rates and Half-lives, Methods of detection

and measurement of radio actives (G.M Scintillation counter). Applications of Radioisotopes, Neutron activation analysis.

Chemical Warfare Agents: Classification, physical and biochemical properties, toxic effects of chemical warfare agents.

Forensic Chemistry-II

Introduction of Explosives, Definition, History and Development of explosives, Oxygen balance, Explosive power and power index, Temperature Force and pressure of explosion, Kinetics of explosive reactions, physical and chemical aspects of combustion, Deflagration and Detonation, Classification of explosive materials, Low and High explosives Primary and Secondary charge: History of Development of Propellants, single base double base, triple base, degressive and progressive powders.

Commercial and military explosives, Initiating Devices, Safety fuse, Detonators, Pyrotechnics, Propellants shattering, Various types of IEDs, Circuit and electronics of IED device, their initiation mechanism and their reconstruction.

Role of Forensic scientist in Post blast investigation, Explosion effects, Collection of samples, technical report frame work, Homemade crude bombs, Evaluation and assessment of explosion site and reconstruction of sequence of events.

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, LC-Mass. X ray diffraction, equipment used for detection of explosives and explosive devices.

Narcotic Drugs and Psychotropic Substances: Sampling procedure and relevant notification, Laboratories authorised to conduct examination, an expert authorised to report NDPS cases.
NDPS Act 1985, Common terminology and Small quantity and commercial quantity and important sections pertaining to punishment.

Classification of Drugs commonly encountered: Narcotics and psychotropic substances (depressants, stimulants, hallucinogens, sedatives, hypnotics), Designer drugs and New Psychoactive substances.

Analysis of Drugs: Narcotic drugs, Depressants, Barbiturates, methaqualone, Benzodiazepines, Stimulants, Hallucinogens, Designer Drugs, Club drugs, date rape drugs and precursors by Field test kits for drugs and precursors using colour test, thin layer chromatography and further confirmation by HPTLC, UV-VIS spectrophotometry, Gas Chromatography, HPLC, GC-Mass Spectrometry and LC-Mass Spectrometry, Raman Spectroscopy and FTIR after extraction of drug from the seized sample. Detection of common adulterants and determination of percentage purity in seized sample

Forensic Toxicology - I

Forensic Toxicological examination and its significance, Branches of Toxicology: Introduction & Scope, Classification of poisons, based on their origin, mode of action, chemical nature, accidental, homicidal, suicidal and miscellaneous. Poisons and poisoning in India, signs and symptoms of poisons and antidotes. Factors affecting the intensity of poisoning. Importance of post-mortem examination in 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. Laws related to Poisons. Poison Act 1919, Drugs Act 1940 and 1955, Drug and Cosmetic Act 1940 and amendments

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 Stas-Otto method, ammonium sulphate method. Isolation and clean up procedure, separation of poisons and drugs using chromatographic techniques. Identification and estimation of poisons and drugs using spectrophotometric and other instrumental methods, significance of analytical studies with forensic examination.

Analysis of different Gases and volatile poisons, Analysis of toxic metals and anions
Analysis of pesticides: Organo- chlorinated, organo- phosphorous, carbamates, pyrethroids, aluminium phosphide and zinc phosphide

Methods of analysis of acidic/ neutral and alkaline drugs and poison commonly encountered for forensic analysis

Systematic methods of extraction of poisons both organic and inorganic from biological matrix and their detection, identification and quantitation by colour test, TLC, HPLC, HPTLC, GLC, UV –visible spectrophotometry FTIR, Mass spectrometry. Qualitative and quantity analysis of Inorganic poisons using instrument AAS, ICP, ion chromatography.

Forensic Toxicology - II

Modern method of extraction and Isolation: Solid phase extraction, solid phase micro-extraction, accelerated solvent extraction, preparative TLC and HPTLC

Extraction of poisons from blood, urine, stomach wash and vomit, cold drink, food material, toxicological analysis of nail, bones and bile in decomposed materials. Interpretation of toxicological finding and preparation of reports, limitation of method and trouble shooting in toxicological analysis, disposal of analysis samples

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

Metabolism: various path of metabolism of common poisons, their distribution and excretion and method of extraction, isolation and identification of metabolites.

Food poisons: Food poisoning due to common chemical and bacterial, signs and symptoms of food poisoning, collection and preservation of evidence material, detection and identification by colour test and instrumental techniques

Plant poisons: commonly encountered plant poisons, their classification and their main active constituents, method of extraction of plant material from biological sample, identification by colour test and TLC and UV- Visible spectrophotometer and other instrumental techniques

Animal Poisons: Commonly encountered poisonous and venomous animals, snake and other insects, sign and symptoms, isolation of poison from biological material. Identification of poison by various chemical constituents, precipitant test and gel diffusion and immunological test. Common poison used in animal poisoning including wild life animals

Instrumental Techniques - I

Basic concept of atomic and molecular spectra: Basics of Instrumentation, sample preparation, purification of sample before analysis standardization and calibration of instrument

Ultra violet and visible spectrophotometry: Basic principle and instrumentation, Lambert and Beers Law. Role in identification and quantitation in forensic chemistry and toxicology and its limitations. Fluorescence and phosphorescence and its application

Infrared spectrophotometry: Basic principle, components, Sample handling, Dispersive and Fourier transform spectrophotometry, (FTIR), ATR-FTIR. Qualitative analysis and interpretation of IR spectra, applications.

Atomic Absorption Spectrometry (AAS): Instrumentation and techniques, interference in AAS, background correction methods, graphite furnace quantitative analysis. Applications in forensic chemistry and toxicology

Atomic emission spectroscopy (AES)-Inductively Coupled Plasma and ICP-MS instrument for detection and quantitation of inorganic metals, alloys and poisons in biological materials. Advantage of ICP over AAS and vice –versa

Chromatography Techniques; General principles of paper chromatography, column chromatography, TLC, gas chromatography, HPTLC, HPLC, and UHPLC for identification and quantitation.

X ray spectroscopy- X ray absorption and fluorescence their application in forensic chemistry and toxicology

Instrumental Techniques - II

Mass spectrometry: Basic principle and component of Instrument sample chamber, ionization method, mass analyser, vacuum system, data handling. Tandem mass spectrometry. Interpretation of spectra. Application in Forensic chemistry and forensic toxicology

Raman spectroscopy: Basic principle, sample handling Application in Forensic chemistry and toxicology. Advantage of Raman Spectroscopy over IR/FTIR

Nuclear Magnetic Resonance (NMR): Basic principle and instrumentation, interpretation of spectra and application

Measurement of Radioactivity, carbon dating, Neutron Activation analysis and its application in forensic science

Scanning Electron Microscope Coupled with EDXRF, advantage of SEM over optical microscope. Application in Forensic Science

Hyphenated techniques- Gas Chromatography coupled with Mass Spectrometry, Liquid chromatography coupled with Mass spectrometry, GLC- FTIR.

Quality Management System: 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

5. FORENSIC PSYCHOLOGY

Psychology/ Forensic Psychology

General/Cognitive Psychology abnormal/ Clinical Psychology, Industrial/Organisational Psychology, Social Psychology, Criminal & Forensic Psychology, Neuropsychology, Application of Research in Forensic Psychology, Psychological Assessment, Personality Psychology, Developmental Psychology

Criminology

Introduction to Criminology, Crime & Deviance, Crime Prevention and Investigation, Schools of Criminology, Criminal Justice System and Penology, Criminal Law & Procedure, Criminological Research & Statistical Applications, Juvenile Delinquency, Victimology

Aptitude in forensic Science

Fundamentals of Basic Sciences as applied to Forensic Investigation, Quality Control and Quality Assurance in the analysis of evidence materials and Proficiency test, Techniques and Instruments for Evidence Analysis: Precision, accuracy, error rate and standardization, Expert testimony in the Court of Law, Admissibility of Evidence, Laws relevant to Forensic Science, Ethics in Forensic Science

Reasoning

Verbal and Non-Verbal Reasoning, Analogies, Similarities, Relationship Concepts, Arithmetical, Visual Memory, Discrimination, Reasoning, Differences Space Visualization, Problem Solving, Analysis, Judgement, Verbal and Figure Classification, Number Series Observation, Decision Making

6. CRIME SCENE MANAGEMENT

Law and Criminal Justice System

Constitutional foundations of criminal justice; structure and functions of police, prosecution, courts, and Central forensic Science Laboratory(CFSL), State Forensic Sciences Laboratory(SFSL), RFSL.Fundamentals of criminal law relevant to forensic science; Bharatiya Nyaya Sanhita, 2023, including general explanations, criminal liability, abetment, criminal conspiracy, attempt, offenses against the human body, offences against property, and other forensic-relevant provisions; Bharatiya Nagarik Suraksha Sanhita, 2023, including FIR, investigation, search and seizure, medical examination, police reports, witness examination, videography of proceedings, and powers of investigating agencies; Bharatiya Sakshya Adhiniyam, 2023, including relevance of facts, admissions and confessions, expert opinion, primary and secondary evidence, electronic records, admissibility of electronic evidence, examination and cross-examination, and production of documents; admissibility of forensic evidence, burden of proof, witness credibility, and role of forensic experts in court.

Basics of Forensic Science, Crime and Crime Scene

Definition, scope, need, and principles of forensic science; history and development of forensic science; forensic laboratories and institutions in India; ethics in forensic science; types of crime; classification of crimes including violent crimes, property crimes, white-collar crimes, public order crimes, organized crimes, cyber-related crimes, and victimless crimes; concepts of actus reus and mens rea; criminal behaviour, theories of crime causation; and basic criminological concepts; definition of crime scene; types of crime scene; first responding officer and initial scene assessment; scene safety, scene preservation, and scene entry protocols.

Crime Scene Management and Documentation

Crime scene management procedures; securing and cordoning the scene; assessment of scene boundaries and scene hierarchy; searching methods and search patterns; systematic recording of the scene; note-making, contemporaneous observations, chain of custody; crime scene sketching, rough sketch, scaled sketch, and scene mapping; photography of the scene, midrange and close-up photography, orientation and overall views; videography of the scene; use of CCTV and body-worn or mobile recording where relevant; evidence recognition, locating, collection planning; collection precautions for fragile, biological, latent, trace, and hazardous evidence; preservation, packaging, sealing, labeling, forwarding, and documentation of exhibits; maintaining chain of custody; scene exit procedures and handover.

Physical Evidence and Pattern Evidence

Definition and classification of physical evidences; class characteristics and individual characteristics; probative value of physical evidence; pattern evidence, trace evidence, and track evidence; glass evidence, fracture interpretation, direction of impact, physical matching, refractive index, density, and elemental analysis; paint evidence, paint layers, coating structure, macroscopic and microscopic examination, and instrumental analysis; soil evidence, composition, collection, comparison, and interpretation; fiber evidence, textile structure, yarns,

fabrics, microscopic and instrumental examination; tool mark evidence, types of tool marks, comparison principles, and collection methods; footwear, footprint, and tyre impression evidence; lift, cast, preservation, and comparison; lip prints, ear prints, and bite marks as impression evidence; restoration of erased numbers and marks; serial number restoration and chemical restoration methods. Accident Investigation & Hit-and-run investigation : Collision, Speed Determination, Vehicle Examination.

Crime Scene Reconstruction and Interpretation

Concept, aims, and principles of crime scene reconstruction; stages of reconstruction; physical and testimonial reconstruction; pattern evidence in reconstruction; bloodstain pattern interpretation; fire and burn pattern interpretation; glass fracture reconstruction; skid marks, tyre marks, and movement-related interpretation; trajectory and line-of-fire principles at scene level; reconstruction in assault, homicide, suicide, accident, sexual offence, explosion, and fire scenes; medico-legal interpretation of injuries and scene findings; integration of scene observations with laboratory findings; reconstruction, report writing; limitations, errors, and caution in interpretation.

Forensic Photography & Videography

Definition and principles of forensic photography; camera types, lenses, image sensors, and digital imaging basics; laboratory photography and scene photography; overall, midrange, and close-up photography; macro photography, photomicrography, UV photography, and IR photography; image file formats and digital image handling; videography principles and scene recording; high-speed videography and aerial videography; admissibility of photographs and video in legal proceedings; documentation standards for visual evidence.

Advanced Techniques in Crime Scene Investigation

Advanced crime scene detection and examination techniques; use of 3D scanning and 3D documentation systems for scene capture and reconstruction; handheld scanning devices and portable imaging tools for crime scene processing; advanced UV and IR light sources for locating latent evidence, body fluids, trace materials, and altered surfaces; laser-based and alternate light source techniques for detecting footwear impressions, biological stains, fibers, and trace evidence; use of AI-assisted tools in scene analysis, evidence recognition, pattern interpretation, and case management; digital scene mapping, photogrammetry, and virtual scene reconstruction; advanced microscopy and comparison systems for field and laboratory integration; portable forensic kits and mobile forensic devices used at the crime scene; use of drones and aerial imaging where relevant to large or inaccessible scenes; advanced digital enhancement tools for scene documentation and evidence interpretation; integration of emerging technologies in modern crime scene processing.

Medico-Legal Aspects

Forensic medicine/Medico legal investigation: Objectives of medico legal investigation, Inquest and types of Inquest, Thanatology, Death and its causes, types of death, signs of death, Post mortem changes, Mode and Manner of death, Custodial Death, Determination of cause of death, Autopsy, Post-mortem examination of dead body, Estimation of time since death.

General and medico legal aspects of injuries: Injuries, types of injuries, Mechanical Injuries: Abrasions, Bruises, Lacerations, Incised wounds, Stab wounds. Firearm injuries, Electrical and Thermal Injuries, Regional Injuries and traffic injuries; self-inflicted injuries and examination.
Asphyxial deaths: Classification of asphyxia deaths, (Homicidal/Suidical/Accidental) Hanging, Strangulation, evidence collection and analysis, establishing manner of deaths Suffocation, Drowning and traumatic asphyxia, medico legal importance of diatoms, medico legal importance, manner of deaths.

7. FORENSIC BIOLOGICAL SCIENCES

Forensic Medicine

a) Death: Causes manner and mode of 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. Post mortem biochemistry, 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, strangulation, and suffocation. Causes and mechanism of traumatic death, manner of death. Classification of traumatic deaths.

b) Traumatology: Abrasions, Bruises, Lacerations, Incised wounds, Stab wounds, Firearm injuries, Defence injuries, fabricated injuries. Traffic accident injuries: vehicular injuries, railway injuries and aircraft injuries. Thermal injuries: Burn and scalds, Lightning, Electricity, Explosions. Chemical trauma. Injuries Accidental, self-inflicted, or inflicted by others. Ante -mortem and post-mortem, artificial injuries and aging of injuries. Fractures, Dislocations Secondary causes of death Regional injuries- wound of the scalp- incised, contusions, lacerations, firearm injuries. Fractures of the skull from direct & indirect impact, injuries of the brain, face, eyes, nose, ears, lip, teeth and alveoli, neck, spine and spinal cord, chest, rib, sternum, ribs, lungs, heart, blood vessels, diaphragm, oesophagus, abdomen, stomach, liver, intestine, pancreas, spleen, kidneys, adrenals urinary bladder, rectum external genitalia, muscles, bones and joints.

c) Death Scene Investigation: Suspect in custody — initial interrogation and searching for evidence. Miranda warning card. Assessing the crime scene. Request for forensic team. Importance of command post and logbook. Management of crowd and media. Importance of taking notes. Items to be a part of noting. 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.

Forensic Osteology and Odontology

a) Skeletal terminology used in forensic reports- Terminology associated with gross morphology of bone, bone features and skeletal direction. Basic adult human skeletal biology, The sub adult skeleton. Number and types of bones in human body. Human dentition- Terminology associated with human dentition, Dental numbering system.

Forensic Odontology: tooth structure and growth, estimation of age in young and adults, Population differences in size and morphology. Bite marks. Individualization of tooth pulp.

b) 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.

c) Skeletal age (Earlier years): Prenatal ossification. Postnatal appearance and union of centres ossification. Differences due to race. Skeleton age (Later years): Cranial suture closure, pubic symphysis. Sexing skeletal Remains: General consideration and age factors. Sex differences in skull, Pelvis and long bones. Calculation of stature of Ion [a] bones: Studies on stature reconstruction in various population groups. Use of fragmentary long bones in stature reconstruction. Racial differences in human skeleton.

d) 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, Pathological changes in bones

Forensic Anthropology

a) 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.

b) 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.

c) Techniques for recovering skeletonised human remains. Laboratory analysis of skeletal and decomposing remains; maceration, skeletal analysis.

d) 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. Collection & preservation of hair samples.

Forensic Botany, Entomology, Wild Life Forensics & Microbial Forensics

a) General plant classification schemes. Sub specialization 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

b) 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 fibers forensic aspects of fiber 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.

c) Forensic Entomology- History, significance, determination of time since death, Dipterean larval development, Life cycles of Blowfly, Flash fly and Housefly, successional colonization of body, Entomology as an evidentiary tool in child and senior abuse cases and animal abuse cases, collection of entomological evidence, Rearing of insects.

d) 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.

e) Microorganism encountered in biological warfare

Forensic Genetics And Bioinformatics

a) Elements of human genetics: Introduction, heritability, human genetic variations, human chromosomes (Normal chromosome set, chromosomal aberration, recent advances), Mendelian inheritances: Dominant inheritance, recessive inheritance, sex-

linked inheritances, polymorphic traits. Heritable human diseases. Metabolic/molecular basis and detection of inherited disease, gene mapping and genetic risk assessment.

b) Mendelian Population, gene pool, Hardy-Weinberg equilibrium, deviation from HW equilibrium, statistical assessment of deviation from HW equilibrium, consanguinity, inbreeding, inbreeding coefficient, genotypes, phenotypes, mutation, multiple alleles, genetic variants, biochemical genetics, gene structure, its frequency determination, gene mapping and gene Expression. Genetic markers and their forensic significance. Mutations and their causes, types of mutation, mutation rate, genetic load. Method of mutation detection, population structure and gene flow. Mutation — Classification, mechanism, repair, role of genetic analysis and evolution, FASTA and BLAST Algorithm. Major data basis in bioinformatics.

c) Gene identification and prediction- Introduction Basics of gene prediction, pattern recognition, gene prediction tools, Tools for microarray analysis and application,

Forensic Serology

a) Immune system, immune response, innate and acquired immunity, antigens, antibodies, haptenes 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.

b) Composition of blood, Formation of blood, Blood groups history, biochemistry and genetics of ABC), Rh, Mn and other systems. Methods of ABC) 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,
Antibody profiling in Forensic testing

c) 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.

d) Presumptive and confirmatory test for body fluids (Blood, Semen, Saliva, Urine, faecal matter), Blood stain pattern analysis and its forensic significance, Collection, preservation and packaging of Biological exhibits.

Forensic DNA Profiling

a) 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.

b) An overview of molecules involved in the flow of genetic information, doublc 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, RNA-DNA hybrid helices, DNA repair, direct and indirect evidences for DNA and RNA as the genetic material. Chemical nature of DNA and RNA. Replication of DNA in prokaryotes and eukaryotes, genetic code, degeneracy and universality of genetic code, transcription and translation machinery. Nature and structure of human genome and its diversity. mt-DNA, Y-Chromosomes and the peopling, migration, of modern humans. Concept of gene Conventional and moder n views. Fine structure of gene, split gene, pseudo non-coding gene, overlapping genes and multiple gene families.

c) Concept of sequence variation VNTRs, STRs, Mini STRs, SNPs. Detection techniques - RFLP, PCR amplifications, PCR inhibitors, Primcr Designing, 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. X-STR, Microbial DNA testing, Non-Human DNA testing, Plant DNA testing, STR kits, STR typing — Manual and Capillary electrophoresis (principle and instrumentation), RNA and its application in forensics.

d) 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, Touch DNA, LCN DNA.