SYLLABUS
OF
FACT - 2018

LNJN National Institute of Criminology & Forensic Science
Ministry of Home Affairs, Govt. of India
DELHI
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SECTION : A

APITUDE IN FORENSIC SCIENCE

SECTION : B

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ELECTIVE II : FORENSIC CHEMICAL SCIENCES

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ELECTIVE V: FORENSIC PHYSICS

ELECTIVE VI: CYBER FORENSICS
SECTION : A

APTITUDE IN FORENSIC SCIENCE

a) General knowledge, general English, aptitude and reasoning.

b) Fundamentals of basic sciences as applied to forensic investigation.

i. Principles of the forensic science, disciplines of forensic science and their functions. Developments in forensic science in India and abroad. Scope of analysis in forensic science laboratories/institutions. Legendries and their contributions in the field of forensic science.

ii. Types of evidence materials in different type of crimes, source and significance of evidence material, tools and techniques in crime scene search, sketching, measurement, photography and videography. Identification, collection, preservation, packaging and forwarding of evidence materials. reconstruction of scenes of crime, lifting, developing and preserving fingerprints, footprints and tyre impressions and pattern evidence, Sampling, Chain of custody. Safety measures at the scene of crime and in laboratory.

c) Quality Control and Quality Assurance in the analysis of evidence materials, Proficiency Test.


SECTION : B

ELECTIVE I : FORENSIC BIOLOGICAL SCIENCES

1) FORENSIC MEDICINE, HUMAN ANATOMY & PHYSIOLOGY


adrenals urinary bladder, rectum external genitalia, muscles, bones and joints.

c) Structure and function of the major organ systems: digestive, respiratory, endocrine, nervous, excretory, reproductive, cardiovascular and neuromuscular. Microorganism responsible for food poisoning. Times of digestion of foods. Collection, preservation and forwarding of samples – vomit, stool, stomach wash and residual food etc.


e) Introduction to body function: External and internal environment, homeostasis. Negative and positive feedback mechanism. Essential body function- procuring and ingestion of food, respiration, excretion of waste products. Need for movement. Mode of communication within the body. Importance of electrolytes, acids and alkalis, carbohydrates, proteins and fats in the body.

g) Skin and its appendages- structure and functions, pigmentation, blood and nerve supply. Structure of hair and hair follicle, hair cycle-anagen, catagen, telogen. Arrector pilli, muscles, sebaceous glands, nails, sweat gland. Muscle- skeletal, striated, non-striated, voluntary, involuntary. Organization of muscle fibres in muscle. Tendons. Nerves tissues- neuron structure, type of neurons, synapse, grey and white matter, peripheral nerves, ganglia.

2) FORENSIC OSTEOLOGY AND ODONTOLOGY


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.

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.

3) **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.

4) FORENSIC BOTANY, ENTOMOLOGY, WILD LIFE FORENSICS & MICROBIAL FORENSICS


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) Various types of poisonous plants-abrus precatorius, Aconitum, Anacardium occidentale, argemone Mexicana, calotropis, cannabis sativa, claviceps purpuria, cinchona, croton tiglium ,atropa belladonna, erythroxylum coco, gloriosa superb,jatropha curcas, lathyrus sativus, manihot utilissima, nerium indicum, nicotiana tabacum, plumbago, ricinus communis, semicarpus anacardium, strychnos nux vomica, thevetia nerifolia, Types of plants yielding
drugs of abuse – opium, cannabis, coco, tobacco, dhatura, Psilocybin mushrooms.

d) 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.

e) 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.

f) Microorganism encountered in biological warfare

5) **FORENSIC GENETICS AND BIOINFORMATICS**


6) 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 ABO, Rh, Mn and other systems. Methods of ABO 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.

Red cell enzymes: Genetics, polymorphism and typing of PGM, GLO-I, ESD, EAP, AK, ADA etc. and their forensic significance. Serum proteins: Genetics, polymorphism and typing of - Hb, HP, Tf, Bf, C3 etc. and their forensic significance

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.

7) 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, double helical structure of DNA, alternate forms of DNA

c) Concept of sequence variation - VNTRs, STRs, Mini STRs, SNPs. Detection techniques - RFLP, PCR amplifications, 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.

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.

Isolation, quantification and quality assessment of DNA from hard and soft tissues, Touch and trace DNA. Collection, preservation and packaging of exhibits for DNA analysis
ELECTIVE II : FORENSIC CHEMICAL SCIENCES

1) FORENSIC CHEMISTRY-I

a) 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 Excise Act.

b) Metals and alloys their composition; Importance of analysis, purity of metals, trace elements, asht dhatu and their analysis


d) Fire and Arson ; Examination of crime scene ,collection of exhibits, cause of fire and origin of fire, method of identification of inflammable material

e) 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. Photo and videography and voice recording as supporting evidence.

f) Dyes: Role of dyes in crime investigation, comparison of dyes in fibres and different inks by TLC and UV-VIS Spectrophotometer.

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

2) **FORENSIC CHEMISTRY-II**

   a) Explosive and Explosion: Introduction, classification of explosives-primary ,secondary or High explosive , detonators pyro technique propellant IEDs and firing mechanism of IEDS

   b) Role of Forensic scientist in Post blast investigation, Explosions effects, Collection of samples, Technical report frame work, Home made crude bombs, Evaluation and assessment of explosion site and reconstruction of sequence of events.

   c) 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.

   d) Narcotic Drugs and Psychotropic Substances: Sampling procedure and relevant notification , Laboratories authorised to conduct examination , an expert authorised to report NDPS cases.

   e) Laws related to forensic interest, Common terminology and NDPS act Small quantity and commercial quantity and extent of punishment

   f) Classification of Drugs commonly encountered: Narcotics, depresants, stimulants ,hallucinogens designer drugs , club drugs and date rape drugs.

   g) Analysis of Drugs: Narcotic drugs, Depressants, Barbiturates, methaquolone, Benzodiazipines, 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.

h) Detection of common adulterants and determination of percentage purity in seized sample

i) Court testimony and case studies.

3) **FORENSIC TOXICOLOGY - I**

a) Forensic Toxicological examination and its significance. Branches of Toxicology: Introduction & Scope, Classification of poisons, based on their origin, mode of action, chemical nature, poisons and poisoning in India, Classification of poisoning: accidental, homicidal, suicidal and miscellaneous, sign 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

b) 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 of and estimation of poisons and drugs using chromatographic and spectrophotometric and other instrumental methods, significance of analytical studies with forensic examination.
c) Analysis of different Gases and volatile poisons., Analysis of toxic metals and anions

d) Analysis of pesticides : Organ chlorinated, organo phosphoro, carbamates, pyrethroids, aluminum phosphide and zinc phosphide

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

f) Systematic method 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 ion selective electrode.

4) FORENSIC TOXICOLOGY - II

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

b) 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

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

e) Food poisons: what is food poisoning, food poisoning due to common chemical and bacterial, sign and symptom of food poisoning, collection and preservation of evidence material, detection and identification by colour test and instrumental techniques

f) Plant poison: introduction, 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

g) Animal Poisons: Commonly encountered poisonous animals, snake and other insects, sign and symptoms, isolation of poison from biological material. Identity of poison by various chemical constituents, precipitant test and gel diffusion and immunological test

h) Common poison used in animal poisoning including wild life animals

i) Environmental pollutants- Inorganic and Inorganic and their identification and quantitation

j) Quaternary ammonium drugs and poisons Introduction and problems associated with their extraction from pharmaceuticals and biological materials. Method of extraction using ion pair and identification by TLC and UV visible spectrophotometry and other instrumental techniques

5) INSTRUMENTAL TECHNIQUES - I

a) Basic concept of atomic and molecular spectra.
b) Basics of Instrumentation, sample preparation, purification of sample before analysis standardization and calibration of instrument

c) 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

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

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

f) 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

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

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

6) INSTRUMENTAL TECHNIQUES - II

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

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

c) NMR basic principle and instrumentation, interpretation of spectra and application

d) Measurement of radioactivity, carbon dating, Neutron Activation analysis and its application in forensic science

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

f) Hyphenated techniques - Gas Chromatography coupled with Mass Spectrometry, Liquid chromatography coupled with Mass spectrometry, GLC- FTIR.
ELECTIVE III: FORENSIC DOCUMENT EXAMINATION


b) Care, handling, preservation, packing, marking and forwarding of forensic documents. Types of writing paper & inks and their analysis. Determination of all types of sequence of intersecting strokes. Determination of sequence of writings/type writings over creases & folds. Examination of documents under UV, visible and IR light sources. Preliminary examination of documents. Comparison of alphabets and numerals.


i) Various Indian laws with reference to IPC –29, 29A, 34, 120B, 409, 415, 416, 418, 420, 467,468, 470, 471, 489(A to E), Indian Evidence Act – Sec 3, 45, 45A, 47, 73 and 114 . Final examination and report
writing – different types of opinion writing and writing of reasons for opinion, importance of no opinion / qualified opinion. Debonair of expert and preparation for presentation of evidence in trial courts, examination-in-chief, cross examination by defense and cross examination by expert. Various court rulings on photocopies, unfamiliar scripts etc. and controversies.

**ELECTIVE IV: FORENSIC BALLISTICS**

a) History of Firearms and Ammunitions, their classification, details of various small arms used in crime – shotguns, rifles, revolvers, pistols, carbines, improvised firearms.
Bore and caliber, choke, automatic mechanisms employed in smallarms, rifling – class characteristics of rifled bore, purpose of rifling, types of rifling, methods to produce rifling, various locks used in smallarms. Head-space.
Various types of primers/ priming mixtures, propellants, shotgun ball ammunition, various kinds of bullets, head-stamp markings.
Manufacture of smallarms and their ammunition. Proof firing, various physical, ballistic & functional tests of ammunitions.

b) Physical evidence and other clues available in crimes involving firearms. Handling of evidence, various precautions.

c) Internal Ballistics: Ignition and burning of propellants, degressive and progressive powders, rate of burning propellants, factors affecting internal ballistics of projectiles, internal ballistics of 12-bore guns, recoil.

d) 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 – fin stabilization and gyroscopic stability, stability
factor, nutation and precessional 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, Doppler-radar method. Automated system of trajectory computation. Falling bullets – limiting velocity, drop, use of lead as bullet material.


f) 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.

g) 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, IR photography.

h) Chemical tests for examination and identification of shotgun holes in various targets. Gunshot residue. Identification of shooter.
i) Reconstruction of sequence of events in crimes involving firearms, high velocity impact splatter blood. Firing through glass, determination of direction of firing & sequence of shots. Scientific methods of shooting reconstruction, suicide, murder, accident, self-defense and encounter cases. All considerations during direct investigation of shooting incidents without the benefit of original crime scene investigation – the scene of occurrence, medico-legal report, basic ballistic facts, laboratory examination report, firearm and ammunition, clothes of victims, etc. Documentation and evaluation of bullet holes, ricochet marks, pellet pattern in various targets, etc. Bullet holes in tyres.

j) Instrumentation techniques - AAS, NAA, SEM/EDXA, ICP-MS, ASV and their application in ballistic examination.

k) Arms Act and Arms Rule, 2016.

**ELECTIVE V: FORENSIC PHYSICS**

1) **GENERAL GUIDELINES FOR PHYSICAL EVIDENCE COLLECTION**

Evidence collection from crime scene, victim & deceased in cases of - Homicide Investigation; Investigation of - Death due to fall from height, sexual offences and sex related homicide, Hanging (suicidal, accidental and homicidal), Write Blockers, Imaging of Storage media and Capturing of volatile evidence in Computer fraud & Cybercrime, Audio & Video, CCTV footage, Paint, Glass, Soil, Fibre, Metals, Wildlife Crime.

Sources of Exhibits, Goals of Evidence Packaging- Protection of Evidence from possible hazards; Elements of Packaging Evidence – Packing Material, Sealing of Evidence; Precautions, General Directions, Directions for Specific type of Exhibits – Weapons and tools, Hair and Fibres, Dust or Soil, Arson Cases and Cases of Burning, Tool Marks, Glass, Paint,. Packaging and transportation of Digital & Electronic Evidence
2) ANALYTICAL INSTRUMENTS & TECHNIQUES OF FORENSIC PHYSICS


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.


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

Radio chemical techniques: Basic principles and theory introduction about nuclear reactions and radiations, Neutron sources, Neutron Activation Analysis. Basics of Electrostatic

Ultra violet and visible spectroscopy: Qualitative discussion of molecular binding, molecular orbital, types of molecular energies, qualitative discussions of rotational, vibrational and electronic spectra, spectra of polyatomic molecules.
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 and Dispersive & FT analysis and Applications in Forensic Chemistry and Toxicology. Advantage of Raman over IR and vice versa, Role of microscope.


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 and applications.

Nuclear Magnetic Resonance Spectroscopy: Basic principles, theory and Instrumentation and applications.

3) PATTERN EVIDENCE

Tool marks- Types, Class and Individual Characteristics, Comparisons, Impression Marks, Compression Marks, Striated Marks, Combination of
Impression and Striated Marks, Repetitive Marks, Materials for making Test Tool Marks, Methods of preparation of Test Tool Marks, Comparison of test and evidence tool marks, Rubber Stamp Impressions, Metallic Seal Impressions, Embossed Impressions and Indentation marks, Mechanical Impressions.

Cast, Engraved and Punched Marks – Methods of their restoration.

Glass: types of glass and their composition, manufacturing of various types of glass and their properties. Soil- Formation, Types, Composition and physical properties. Paints- Composition, Types, Manufacturing and physical properties of paints.

Fibre- Types, Constituents &their forensic importance.

Impression Evidence: Types of Impression Evidence, Significance of Impression Evidence. Tyre Marks Comparison. Skid marks, Serial numbers restoration.

Audio: Basics of sound, human ear and voice, Sound recording and reproduction, Forensic significance of voice.

Basic principles and techniques of black & white and colour photography; Camera and lenses, exposing, development & printing, different kinds of developers & fixers, modern developments in photography; Digital photography, Working of SLR & DSLR Cameras and basics of Digital Imaging Photography, photo-morphing, Crime Scene photography, Laboratory photography; Brief about speaker identification & tape authentication techniques and their applications in forensic science, Data Mining Techniques.

Videography: types of video cameras, recording of playback technique of analog video, recording and playback technique of analog video, basics of video codecs and file formats.

Restoration: Restoration of erased numbers, methods of marking-cast, punch and engraved, methods used for removal of serial numbers, theory behind number restoration, restoration of marks on cast iron, Aluminum,
brass, wood, leather etc., chemical methods of restoration (etching), reagents used for various metals, electrolytic methods of restoration-reagents used, ultrasonic cavitation for restoration, magnetic particle method for restoration, other methods of restoration, laser etched serial numbers and bar codes and their restoration, recording of restored marks.

4) 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, Favorable Events, Exhaustive Events etc., Baye’s theorem, Addition and Multiplication theorem, Conditional Probability, Binomial Probability distribution, Normal Distribution, Hyper-geometric distribution, Applications – Matching of hair evidence, Uniqueness of Fingerprints,


5) FORENSIC VOICE AUTHENTICATION

Physics of sound: waves and sound, analysis and synthesis of complex waves, Human and non-human utterances, anatomy of vocal tract, vocal formants, analysis of vocal sound, frequencies and overtones
Electronics of Audio Recording, Transmission and Playback devices, noise and distortion, voice storage and preservation

Forensic Linguistics: Phonetics, Morphology, Syntax, Semantics, Stylistics, Pragmatics, Script, orthography and graphology, Difference between language and speech, Psycholinguistics, Neurolinguistics, Sociolinguistics, Scientific approaches; Reliability and admissibility of evidence in the court, linguistic profile, language register

Discourse Analysis: Connivance, acceptance, listening feedback and rejection in the context of Mens-Rea, Narrative, Dialectology, Linguistic variety as a geographical marker, Idiolects and speaker characterization, Phonology, Morphology and Word formation processes as individual linguistic abilities

Various approaches in Forensic Speaker Identification, Instrumental Analysis of speech sample, Interpretation of result, Statistical interpretation of probability scale, Objective/Subjective methods, discriminating tests, closed test, open test, likelihood ratio calculation, Concept of test and error in Speaker Identification, case studies.

Techniques and Best Practices for examination of Audio recording authentication and case studies.

Automatic speaker identification and verification system based on fuzzy logics, neural network, MPCC etc., Voice Biometrics

VoIP and other modes of speech communication and their forensic analysis

6) **FORENSIC VIDEO ANALYSIS**

Introduction to video technology: electronic photography, scanning, synchronizing the analog signal, Digital signal processing, color video, Digital television standard, HD Video, digital scopes, compression, image acquisition and recording formats, optical media, time code, audio for video, displays, Types of video Camera

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, challenges and precaution at the scene of crime, evidence handling procedure, legal issues, recommended equipments needed.
Watermarking, Interlacing, De-interlacing, Double Compression, Duplication, Re-projection

Forensic analysis: Best practices of collection, recovery, enhancement, analysis and interpretation of video evidence

Facial image recognition, vehicle registration plate image enhancement, foreign object detection, Authentication of Video evidence, video source identification techniques, Case studies

7) CRIMINALISTICS AND FORENSIC ENGINEERING
Soil: Physical examinations of soil evidence, Soil mechanics, Structure & Composition, Baking, Compaction and Agro-soil additives, Instrumental analysis of soil, Interpretation of soil evidence, Standard Operating Procedures for examination, Discussion on important case studies of soil evidence

Glass: Forensic examination of glass fractures, Physical and Microscopic examination of glass evidence, Standard Operating Procedures for examination, Discussion on important case studies of glass evidence

Paint: Types of paint and their composition, physical examination of paint, instrumental analysis of pigment, interpretation of paint evidence, Standard Operating Procedures for examination, Discussion on important case studies of paint evidence

Fibre: Classification and properties of textile, paper and fibres, Physical and Instrumental analysis of fibres evidence and dyes, Examination of damage to textiles, yarn, weaving & fabrics, Collection of fibre evidence, Interpretation of fibre evidence, Discussion on important case studies of fibre evidence

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

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

Arson: Faults and failure of evidence of Arson & Fire due to electrical & mechanical faults/failure, Power Physics: Voltage, current generation and transmission, Current and Power Transformers, 3-phase electricity and Earth faults

8) COLLISION INVESTIGATION AND RECONSTRUCTION

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, tyres – 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, dynamics rake 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: overview of reconstruction software and techniques, computer aided design techniques, vehicle specification databases, momentum and energy analysis program, collision simulators, photogrammetry software
ELECTIVE VI: CYBER FORENSICS

1) COMPUTER FORENSICS


e) 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, Spoofed Mails. Virtual Machine and Cloud Technology Forensics.

2) NETWORK FORENSICS


3)  **MOBILE AND WIRELESS DEVICE FORENSICS**

a) Introduction to Mobile Technologies - Asynchronous Transfer Mode (ATM), Wireless Application Protocol (WAP). Cellular technologies - Advanced Mobile Phone System (AMPS), Imode, 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).


4)  **SOCIAL MEDIA FORENSICS AND CRYPTOGRAPHY**
a) 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,

b) 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 technique for intelligence gathering– indirect method, direct method with login, direct method without login.


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SUGGESTED READINGS

SECTION : A

APTITUDE IN FORENSIC SCIENCE

10. Constitution of India.
12. Criminal Procedure code.
20. Indian Penal Code.
37. Wentworth and Wilder (1948), Personal Identification, R. G. Badger, Boston.

SECTION : B

ELECTIVE I : FORENSIC BIOLOGICAL SCIENCES

**Biology, Serology and DNA**


**Forensic Physical Anthropology including Forensic Medicine:**

35. William D. Haglernd, Marculla H. Sorg (1997), Forensic Taphonomy, CRC Press, LLC.

**Specialization in Forensic Biology And Serology**

42. Jane E. Huffman, John R. Wallace (2012), Wildlife Forensics: Methods and Applications, John Wiley & Sons Ltd.
44. Jens Amendt, (2010), Current Concepts in Forensic Entomology, John Wiley & Sons Ltd.
45. Julie Roberts, Nicholas Marquez-Grant, (2012), Forensic Ecology: From Crime Scene to Court, John Wiley & Sons Ltd.
47. Robertson, J. (1999), Forensic and microscopic examination of human hair, Taylor & Francis

**Advanced Forensic Serology Including DNA Forensics**

50. Chowdhari, S., (1971), Forensic Biology, BPR & D, Govt, of India.
62. William Goodwin, Adrian Linacre, Sibte Hadi, (2007), An Introduction to Forensic Genetics, John Wiley & Sons Ltd.
ELECTIVE II : FORENSIC CHEMICAL SCIENCES

Chemistry and Toxicology

1. Arena Poisoning: Chemistry, Symptoms and Treatment.
3. Casarett & Doll Toxicology : The Basic Science of poisons

**Narcotics:**

25. Indian Pharmacopoeia 2014 with DVD - Seventh edition
26. Narcotic Drugs and Psychotropic Substances Act, 1985

**Explosives:**

28. Explosive Substances Act, 1908

**Specialization In Forensic Chemistry And Toxicology**

35. Houck Max M; (2015) Forensic Chemistry; 1st Edition; Elsevier science publication; Amsterdam
42. Moonesens A.A; Mosses and Inbaw (1973), Scientific Evidence in Criminal Cases
43. Newton David E (2008), Forensic Chemistry (Series – The new Chemistry); 1st Edition; Facts on file publication; USA
47. Suzanne Bell; Forensic chemistry; 2nd Edition; Pearson Higher Education
48. Walb & Brounds, Drunks, Drugs & Driving.
49. White , Dynamics of Accident Investigation in criminal cases.

Advanced Forensic Toxicology

53. Burcham Philip C (2013); An introduction to toxicology; 1st edition; Springer Publication; New York;
57. Curry A.S. (1972), Advances in Forensic and Clinical Toxicology, CRC Press.
64. Hodgson Ernst (2011); A textbook of modern toxicology; 3rd Edition, John Wiley & Sons, Inc. Publication; Canada
69. Moffat Anthony C, Osselton M David, Widdop Brian (2011); Clarke’s analysis of drug and poisons in pharmaceuticals, body fluids and post-mortem material; 4th Edition; Pharmaceutical press; Chicago
71. Neal Michael J (2012); Medical Pharmacology at a glance; 7th Edition; Wiley – Blackwell publication; London
74. Sunshine (1975), Methods for Analytical Toxicology, CRC Press, USA.
78. Vij Krishnan (2011); Textbook of forensic medicine and toxicology: Principles and practices; 5th Edition; Elsevier publication; India.

ELECTIVE IV: FORENSIC DOCUMENT EXAMINATION

12. Andrea Mc Nichol, Jeffrey A Nelson; Handwriting Analysis Putting it to work for you, Jaico Books, Delhi (1994)
15. Morris (2000); Forensic Handwriting Identification (fundamental concepts & Principals)

**ELECTIVE V: FORENSIC BALLISTICS**


**ELECTIVE V: FORENSIC PHYSICS**

61. Laboratory procedure manual, Forensic Physics, Directorate of Forensic Science, MHA, Govt. of India, 2005.

ELECTIVE VI: CYBER FORENSICS