

ADIKAVI NANNAYA UNIVERSITY
B.Sc. Forensic Science
w.e.from 2016-17 Admitted Batch

Table-3: B.Sc. Forensic Science SEMESTER – III

Paper No.	Course	Total Marks	Mid Sem Exam*	Sem End Exam	Teaching Hours	Credits
1	First Language English	100	25	75	4	3
2	Foundation course - 5 Information and communication technology-2	50	0	50	2	2
3	Foundation course – 6 Communication and soft skills-2	50	0	50	2	2
4	Cyber Security	100	25	75	4	3
5	Cyber Security Lab	50	0	50	2	2
6	Forensic documents Examination	100	25	75	4	3
7	Forensic Science Lab- 3	50	0	50	2	2
8	Fingerprints & Impressions	100	25	75	4	3
9	Inorganic Chemistry & Organic Chemistry- 3	100	25	75	4	3
10	Chemistry Lab- 3	50	0	50	2	2
Total		750			30	25

Paper-1: First Language English

Paper-2: Foundation course – 5 Information and communication technology-2

Paper-3: Foundation course – 6 Communication and soft skills-2

Paper-4: Cyber Security

Unit- 1 : Need of Cyber Security- Introduction to Cyber -The Cybersecurity World, Cybersecurity Domains Overview of the Cybersecurity Domains, Examples of Cybersecurity Domains, The Growth of the Cyber Domains, Cybersecurity Criminals versus Cybersecurity Specialists, Cybersecurity Criminals, Who Are the Cyber Criminals? Cyber Criminal Motives, Cybersecurity Specialists, Why Become a Cybersecurity Specialist? Thwarting Cyber Criminals Digital Forensic and Cyber Crime- Understanding Cyber Crime: Indian IT Act 2008 and amendments categories of cyber crimes ie., unauthorized access and hacking

Unit- 2: E-mail related crimes, Internet relay, chat relating crimes, sale of illegal articles, online gambling, phishing, Intellectual property crimes, web defacement, cyber stalking etc., Computer hardware/Software: Hardware- Storage related simple problems, OCR, OMR, BAR Code etc., Memory Hierarchies : Basics of Semiconductor Memories, Circuits, Address Decoding, Access Time, Examples of Integrated Circuit ROMs, PROMs, EPROMs, EEPROM, Components of CPU, Register, Accumulator, Software System- application Software and their Examples in real life. Operating System and their usage. Multitasking – Multiprogramming- Multiprocessing Operating System

Unit- 3: Foot printing & Social engineering, Information gathering methodologies, Competitive Intelligence, DNS Enumerations, Social Engineering attacks, Analysis of Deep web/ dark web and silk road analysis, Working with Windows and DOS Systems, Understanding File Systems, Exploring Microsoft File Structures, Examining NTFS Disks, Understanding Whole Disk Encryption, Understanding the Windows Registry, Understanding Microsoft Startup Tasks, Understanding MS-DOS Startup Tasks, Understanding Virtual Machines. Examining UNIX and Linux Disk Structures and Boot Processes, Understanding Other Disk Structures, Free space Management Bit-Vector Linked List Grouping Counting Efficiency Performance Recovery Physical Damage, Physical Damage Recovery Logical Damage, Logical Damage Recovery.

Unit- 4: Ethical Hacking terminology: Five stages of hacking, Vulnerability Research, Legal implication of hacking, Impact of hacking, System Hacking, Password cracking techniques, Key loggers, Escalating privileges, Hiding Files, Steganography, The Cybersecurity Cube, Three Dimensions of the Cybersecurity Cube, The Principles of Security, Cybersecurity Safeguards, CIA Triad, Confidentiality, The Principle of Confidentiality, Protecting Data Privacy, Controlling Access-Laws and Liability Integrity: Principle of Data Integrity, Need for Data Integrity Integrity Checks, Availability, The Principle of Availability, Ensuring Availability

Unit- 5: States of Data: Data at Rest, Types of Data Storage, Challenges of Protecting, Stored Data, Data In-Transit, Methods of Transmitting Data, Challenges of Protecting, Stored Data,

Data In-Transit, Methods of Transmitting Data, Challenges of Protecting Data In-Transit, Data in Process, Forms of Data Processing and Computation, Challenges of Protecting Data In-Process, Cybersecurity Countermeasures

Paper-5: Cyber Security Lab

LAB Concepts:

1. Phishing
2. Fake Email
3. VM Ware Installations
4. System Hacking
5. Key - Loggers & Key Scramblers

Paper-6: Forensic documents Examination

Unit-1: Introduction to questioned document- Terminology of documents- History of forensic document examination. Classification of documents-procurement of standard admitted/specimen writings-handling and marking of documents-preliminary examination of documents – Types of crimes related to documents – criminal investigation.

Unit-2: Handwriting analysis –Definition of Graphology- Basics of Handwriting Identification - Individuality of handwriting - General characteristics of handwriting- Analysis of hand writing- Tools for Forensic document examination- Simulation and Comparison for Handwriting- Collection of proper standards.

Unit-3: Disguised writing and anonymous letters-Identification of writer-Examination of signatures. Characteristics of forged and genuine signatures. Examination of alterations, erasures, over writings, additions and obliterations. Decipherment of secret writings indented and charred documents. Examination of seal impressions and mechanical impressions.

Unit-4: Forgeries and their detection. Types of forgeries. Examination of built up documents. Determination of sequence of strokes, physical matching of documents. Examination of black and white, colour Xerox copies, carbon copies and fax messages- Identification of type writer writings-identification of type writer, identification of printed matter, various types of printing of security documents, printing of currency notes. Examination of counterfeit currency notes, passports, visa, stamp papers, postal stamps etc.

Unit-5: Determination of age of documents by examination of signatures, paper, ink writing/signatures etc. Examination of computer printouts- dot matrix, ink jet and laser printers, electronic type writers, credit cards, E-documents, digital signatures, opinion writing, reasons for opinion and court testimony. Instrumentation and Principles of video spectral comparator, Stereoscopic microscopes, TLC, HPLC, Spectrofluorimetry and X-Ray fluorimetry.

Paper-7: Forensic Science Lab- 3

Forensic documents Examination Lab

1. Detection of types of Forgeries.
2. Examination of rubber stamps and seals.
3. Examination of Typescripts & Printed Material
4. Examination of Alterations, Additions, Erasures, Obliterations and overwritings
5. Deciphering of indented writing, secret writing and charred documents
6. Examination of inks by TLC & Spectrophotometry
7. Examination of inks & Paper by VSC
8. Examination of security features of documents like Currency notes, Passports, Stamp papers, Driving License by VSC.
9. Development of Finger prints by Powders and Iodine fuming.
10. Lifting & Collection of developed Finger prints
11. Collection of Plain & Rolled Finger prints
12. Development of Footprint casting.

Paper-8: Forensic Imprints, Impressions & Biometrics

Unit-1: Fingerprints- introduction – History and development of fingerprints- Fundamentals of fingerprints- Fingerprint Patterns- Systematic method of classification – Fingerprinting cadavers- Fingerprint development Physical , Chemical methods & Scene of crime - Preservation and lifting techniques - Inner, Outer termini and tracing of fingerprints- Dactylography - Palm prints – AFIS - Digital imaging of FP.

Unit-2: Foot wear impressions – Introduction – Forms of footwear/ bare foot impressions – Location and recovery of footwear/bare foot impressions – Examination of foot wear/bare foot impressions - Enhancement methods – gait pattern analysis- Gait pattern scan and its principles- Determination of personality by gait analysis.

Unit-3: Tire impressions-Introduction – Original equipment tires, Replacement tires and tire construction – Tread nomenclature& side wall information – Tread wear indicators- Retreated tires – Tire reference database – Tire impression examination – Photography of tire impressions – Evidences Collection process.

Unit-4: Poroscopy – Skin outer surface impressions – Types of skin impressions – Lip prints – Introduction, History and forensic significance -Ear prints - Introduction, History and forensic significance – Ear morphology – Identification and comparison. Bite marks – Introduction and forensic significance – Judicial acceptance – evidence collection on victim and suspects – identification and comparison.

Unit-5: Biometrics – Introduction- History – Definition – Types of Biometrics – Features and functions of biometrics – Eye scan/ Retinal Scan and its principles – Iris detection – Face scan and its principles – Vascular scan- Hand Geometry scan- Voice scan- other emerging biometrics.

Paper 9 - INORGANIC & ORGANIC CHEMISTRY- III

INORGANIC CHEMISTRY

UNIT – I

1. Chemistry of d-block elements: Characteristics of d-block elements with special reference to electronic configuration, variable valence, magnetic properties, catalytic properties and ability to form complexes. Stability of various oxidation states.
2. Theories of bonding in metals: Metallic properties and its limitations, Valence bond theory, Free electron theory, Explanation of thermal and electrical conductivity of metals, limitations, Band theory, formation of bands, explanation of conductors, semiconductors and insulators.

UNIT – II

1. Metal carbonyls : EAN rule, classification of metal carbonyls, structures and shapes of metal carbonyls of V, Cr, Mn, Fe, Co and Ni.
2. Chemistry of f-block elements: Chemistry of lanthanides - electronic structure, oxidation states, lanthanide contraction, consequences of lanthanide contraction, magnetic properties. Chemistry of actinides - electronic configuration, oxidation states, actinide contraction, comparison of lanthanides and actinides, separation of lanthanides by ion exchange method and solvent extraction method.

ORGANIC CHEMISTRY

UNIT – III

1. Halogen compounds: Nomenclature and classification of alkyl (into primary, secondary, tertiary), aryl, aryl alkyl, allyl, vinyl, benzyl halides. Nucleophilic aliphatic substitution reaction- classification into S_N1 and S_N2 – reaction mechanism with examples – Ethyl chloride, t-butyl chloride and optically active alkyl halide 2-bromobutane.
2. Hydroxy compounds: Nomenclature and classification of hydroxy compounds. Alcohols: Preparation with hydroboration reaction, Grignard synthesis of alcohols. Phenols: Preparation i) from diazonium salt, ii) from aryl sulphonates, iii) from cumene. Physical properties- Hydrogen bonding (intermolecular and intramolecular). Effect of hydrogen bonding on boiling point and solubility in water. Identification of alcohols by oxidation with $KMnO_4$, Ceric ammonium nitrate, Luca's reagent and phenols by reaction with $FeCl_3$. Chemical properties: a) Dehydration of alcohols. b) Oxidation of alcohols by CrO_3 , $KMnO_4$. c) Special reaction of phenols: Bromination, Kolbe-Schmidt reaction, Reimer-Tiemann reaction, Fries rearrangement, azocoupling, Pinacol-Pinacolone rearrangement.

UNIT-IV

Carbonyl compounds

Nomenclature of aliphatic and aromatic carbonyl compounds, structure of the carbonyl group. Synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones using 1,3-dithianes, synthesis of ketones from nitriles and from carboxylic acids. Physical properties: Reactivity of carbonyl group in aldehydes and ketones. Nucleophilic addition

reaction with a) NaHSO₃, b) HCN, c) RMgX, d) NH₂OH, e) PhNHNH₂, f) 2,4 DNPH, g) Alcohols-formation of hemiacetal and acetal. Base catalysed reactions: a) Aldol, b) Cannizzaro's reaction, c) Perkin reaction, d) Benzoin condensation, e) Haloform reaction, f) Knoevenagel reaction. Oxidation of aldehydes Baeyer-Villiger oxidation of ketones. Reduction: Clemmensen reduction, Wolf-Kishner reduction, MPV reduction, reduction with LiAlH₄ and NaBH₄. Analysis of aldehydes and ketones with a) 2,4-DNPH test, b) Tollen's test, c) Fehling test, d) Schiff's test e) Haloform test (with equation)

UNIT-V

1. Carboxylic acids and derivatives: Nomenclature, classification and structure of carboxylic acids. Methods of preparation by a) Hydrolysis of nitriles, amides b) Hydrolysis of esters by acids and bases with mechanism c) Carbonation of Grignard reagents. Special methods of preparation of aromatic acids by a) Oxidation of side chain. b) Hydrolysis by benzotrichlorides. c) Kolbe reaction. Physical properties: Hydrogen bonding, dimeric association, acidity strength of acids with examples of trimethyl acetic acid and trichloroacetic acid. Relative differences in the acidities of aromatic and aliphatic acids. Chemical properties: Reactions involving H, OH and COOH groups- salt formation, anhydride formation, acid chloride formation, amide formation and esterification (mechanism). Degradation of carboxylic acids by Huns-Diecker reaction, decarboxylation by Schimdt reaction, ArndtEistert synthesis, halogenation by Hell- Volhard- Zelinsky reaction.

2. Active methylene compounds: Acetoacetic ester: keto-enol tautomerism, preparation by Claisen condensation, Acid hydrolysis and ketonic hydrolysis. Preparation of a) monocarboxylic acids. b) Dicarboxylic acids. c) Reaction with urea Malonic ester: preparation from acetic acid. Synthetic applications: Preparation of a) monocarboxylic acids (propionic acid and n-butyric acid). b) Dicarboxylic acids (succinic acid and adipic acid) c) α,β -unsaturated carboxylic acids (crotonic acid). d) Reaction with urea.

LABORATORY COURSE –III

Practical Paper -10: Titrimetric Analysis and Organic Functional Group Reaction

Titrimetric analysis

1. Determination of Fe (II) using KMnO₄ with oxalic acid as primary standard.
2. Determination of Cu(II) using Na₂S₂O₃ with K₂Cr₂O₇ as primary standard.

Organic Functional Group Reactions

3. Reactions of the following functional groups present in organic compounds: (at least four) Alcohols, Phenols, Aldehydes, Ketones, Carboxylic acids and Amides

Table-4: B.Sc. Forensic Science SEMESTER – IV

Paper No.	Course	Total Marks	Mid Sem Exam*	Sem End Exam	Teaching Hours	Credits
1	Foundation course - 7 CSS-2	50	0	50	2	2
2	Foundation course – 8 Analytical Skills	50	0	50	2	2
3	Foundation course – 9 Entrepreneurship	50	0	50	2	2
4	Foundation course –10 Leadership Education	50	0	50	2	2
5	Cyber Forensics	100	25	75	4	3
6	Cyber Forensics Lab	50	0	50	2	2
7	Forensic Biology	100	25	75	4	3
8	Forensic Science Lab- 4	50	0	50	2	2
9	Forensic Ballistics	100	25	75	4	3
10	Spectroscopy & Physical Chemistry- 4	100	25	75	4	3
11	Chemistry Lab- 4	50	0	50	2	2
Total		750			30	25

Paper-1: Foundation course – 7 CSS-2

Paper-2: Foundation course – 8 Analytical Skills

Paper-3: Foundation course – 9 Entrepreneurship

Paper-4: Foundation course –10 Leadership Education

Paper-5: Cyber Forensics

UNIT- 1 : Cybersecurity Threats, Vulnerabilities, and Attacks * Types of Malware * Viruses, Worms, and Trojan Horses * Ransomware * Email and Browser Attacks * Types of Cyber Attacks * Sniffing * Spoofing

UNIT- 2 : The Art of Protecting Secrets * Cryptography * Types of Encryption * Types of Access Controls * Access Control Strategies * Identification * Authentication Methods * Types of Security Controls * Data Masking

UNIT- 3 : Cyber Incident Response * Threat classification * Factors contributing to incident severity and prioritization * Scope of impact * Types of data

UNIT- 4 : Forensics kit * Digital forensics workstation * Forensic investigation suite * Stakeholders * Purpose of communication processes * Role-based responsibilities * Common network-related symptoms * Containment techniques * Incident summary report

UNIT- 5 : Security Architecture * Regulatory compliance - Frameworks * Policies * Controls * Procedures * Verifications and quality control * Security issues associated with context-based authentication * Security issues associated with identities * Security issues associated with identity repositories * Security issues associated with federation and single sign-on * Exploits * Types of Data Storage * Challenges of Protecting Stored Data * Challenges of Protecting Data Cybersecurity Countermeasures

Paper-6: Cyber Forensics Lab

Paper-7: Forensic Biology

Unit-1: Introduction to Forensic Biology- Developmental History of Modern Forensic Biology- Definition and introduction of F.Botany- Toxic Principles of Plants and their forensic significance- Poisonous mushrooms – Study and Identification of pollen grains- identification of seeds, leaves, flowers, starch grains, powders, stains of spices.

Unit-2: Forensic Microbiology- Microbial poisoning-Quality of various food products & examination procedure- growth of microorganisms- Bioterrorism- Diatoms test for drowning- Diatoms types & morphology- collection of diatom samples & examination. Hair analysis- Structure of hair – growth and chemistry of hair - Differences between human & animal hair- characteristics and traits of hair.

Unit-3: Fibre examination- Introduction – Classification of fibres- Identification and comparison of fibres by physical, chemical, microscopic, spectroscopic – Forensic Significance. Wood analysis- sample preparation- wood anatomy- interpretation of wood evidence – Paper pulp identification.

Unit-4: Forensic Entomology- introduction to insects, arthropods- insects of forensic importance – indicators of time of death- stages of insect development & comparative decomposition of human body- colonization- Evidence collection of insects.

Unit-5: Wildlife Forensics- Introduction- importance of wildlife- Wildlife protection act- endangered species- CITES- Census of wild life population- Smuggling and poaching – crime scene search- criminal investigation- identification of animals by teeth, claws, ivory, antlers, furs, skins, bitemarks, pugmarks- identification of blood, excreta, and other visceral samples.

Paper-8: Forensic Biology & Ballistics Lab

1. Identification of Diatoms
2. Identification of Pollen grains
3. Manufacturing process of Paper observation in paper mill.
4. Morphological characteristics of plant material (datura, Cannabis, Nerium etc)
5. Morphological Examination of Human Hair & Animal hair
6. Morphological Examination of natural & synthetic Fibres
7. Examination of Bullets & Cartridge cases.

Paper-9: Forensic Ballistics

Unit-1: Definition of firearms. History of firearms-parts of firearm, classification-smooth bore and rifled firearm. Single shot firearms, repeaters-self loaders, automatics and assault rifles. Rifling and its significance-types of rifling and methods to produce rifling-trigger and firing mechanism-cartridge firing mechanism

Classification of firearms based on handling, bore, loading and action. Characteristics of firing. Technique of dismantling/assembling of firearms. Identification of origin-improvised/country made/imitative firearms and their constructional features.. Ammunition-introduction, classification of ammunition. constructional features of different types of cartridges. Types of primers, priming compositions. Propellants and their compositions. Various types of bullets and their compositional aspects. Identification of origin-improvised ammunition and safety aspects of handling firearms and ammunitions.

Unit-2: Gunshot residues-introduction, nature-black powder and smokeless powder residues. Location , detection, collection-dry methods, wet methods and collection of organic residues. Evaluation-visual examination, infrared photography, soft x-ray radiography, dermal nitrate test, Walker's test , Harrison and Gilroy's test, price's spot test, neutron activation analysis, flameless atomic absorption spectrometry, SEM and X-Ray fluorescence. Management and reconstruction of crime scene.

Unit-3: Internal and external ballistics-introduction, direction of fire, time of fire, range of fire-muzzle patterns, scorching, blackening, tattooing, powder residues, metal particles, wad distribution, pellet patterns, direction of wound. Projectile velocity determination-theory of recoil, trajectory determination..

Unit-4: Terminal Ballistics-effect of projectile on hitting the target, function of bullet shape-striking velocity, striking angle tumbling bullets, caviations, ricochet and its effects.Wound ballistics-nature of wounds of entry and exit, threshold velocity for penetration of skin, flesh, bones. Explosive wounds-evaluation of injuries caused due to shot gun, rifle, handguns and country made firearms. Methods for measurement of wound ballistic parameters. Postmortem and ante mortem firearm injuries.

Unit-5: Principles for identification of fire arms .different types of marks produced during firing process on cartridge-firing pin marks, breech, face marks , chamber marks, extractor and ejector marks and on bullet-number/direction of land and grooves, striation marks on land and grooves. Identification of various parts of firearms-techniques for obtaining test material from various types of weapons and their linkage with fired ammunition.-Indian Arms act-report writing and court of testimony.

Paper 10 (SPECTROSCOPY & PHYSICAL CHEMISTRY) - 4

SPECTROSCOPY

UNIT-I: General features of absorption - Beer-Lambert's law and its limitations, transmittance, Absorbance, and molar absorptivity. Single and double beam spectrophotometers. Application of Beer-Lambert law for quantitative analysis of 1. Chromium in $K_2Cr_2O_7$ 2. Manganese in Manganous sulphate

Electronic spectroscopy: Interaction of electromagnetic radiation with molecules and types of molecular spectra. Energy levels of molecular orbitals (σ , π , n). Selection rules for electronic spectra. Types of electronic transitions in molecules effect of conjugation. Concept of chromophore and auxochrome.

UNIT-II

Infra red spectroscopy: Different Regions in Infrared radiations. Modes of vibrations in diatomic and polyatomic molecules. Characteristic absorption bands of various functional groups. Interpretation of spectra-Alkanes, Aromatic, Alcohols carbonyls, and amines with one example to each.

Proton magnetic resonance spectroscopy (1H -NMR): Principles of nuclear magnetic resonance, equivalent and non-equivalent protons, position of signals. Chemical shift, NMR splitting of signals - spin-spin coupling, coupling constants. Applications of NMR with suitable examples - ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromo ethane, ethyl acetate, toluene and acetophenone.

PHYSICAL CHEMISTRY

UNIT-III

Dilute solutions: Colligative properties. Raoult's law, relative lowering of vapour pressure, its relation to molecular weight of non-volatile solute. Elevation of boiling point and depression of freezing point. Derivation of relation between molecular weight and elevation in boiling point and depression in freezing point. Experimental methods of determination. Osmosis, osmotic pressure, experimental determination. Theory of dilute solutions. Determination of molecular weight of non-volatile solute from osmotic pressure. Abnormal Colligative properties- Van't Hoff factor.

UNIT-IV

Electrochemistry-I: Specific conductance, equivalent conductance. Variation of equivalent conductance with dilution. Migration of ions, Kohlrausch's law. Arrhenius theory of electrolyte dissociation and its limitations. Ostwald's dilution law. DebyeHuckel-Onsagar's equation for strong electrolytes (elementary treatment only). Definition of transport number, determination by Hittorfs method. Application of conductivity measurements- conductometric titrations.

UNIT-V

1. Electrochemistry-II: Single electrode potential, sign convention, Reversible and

irreversible cells Nernst Equation- Reference electrode, Standard Hydrogen electrode, calomel electrode, Indicator electrode, metal – metal ion electrode, Inert electrode, Determination of EMF of cell, Applications of EMF measurements - Potentiometric titrations.

2.Phase rule: Concept of phase, components, degrees of freedom. Thermodynamic Derivation of Gibbs phase rule. Phase equilibrium of one component system - water system. Phase equilibrium of two- component system, solid-liquid equilibrium. Simple eutectic diagram of Pb-Ag system, simple eutectic diagram, desilverisation of lead., NaCl-Water system, Freezing mixtures.

Paper- 11 Physical Chemistry and IR Spectral Analysis- 4

Physical Chemistry

- 1.Critical Solution Temperature- Phenol-Water system
2. Effect of NaCl on critical solution temperature (Phenol-Water system)
- 3.Determination of concentration of HCl conductometrically using standard NaOH solution.
- 4.Determination of concentration of acetic acid conductometrically using standard NaOH Solution.

IR Spectral Analysis

5. IR Spectral Analysis of the following functional groups with examples
 - a) Hydroxyl groups
 - b) Carbonyl groups
 - c) Amino groups
 - d) Aromatic groups

Table-5: B.Sc. Forensic Science SEMESTER – V

Paper No.	Course	Total Marks	Mid Sem Exam*	Sem End Exam	Teaching Hours	Credits
1	Digital Forensics	100	25	75	4	3
2	Digital Forensics Lab	50	0	50	2	2
3	Forensic Medicine & Anthropology	100	25	75	4	3
4	Forensic Science Lab- 5	50	0	50	2	2
5	Forensic Toxicology	100	25	75	4	3
6	Forensic Science Lab- 6	50	0	50	2	2
7	DNA Fingerprinting	100	25	75	4	3
8	Forensic Science Lab- 7	50	0	50	2	2
9	Inorganic, Organic & Physical Chemistry- 5	100	25	75	4	3
10	Chemistry Lab- 5	50	0	50	2	2
11	Inorganic, Organic & Physical Chemistry- 6	100	25	75	4	3
12	Chemistry Lab- 6	50	0	50	2	2
Total		900			36	30

Paper-1: Digital Forensics

UNIT-1: Computer Forensics and Investigations: Understanding Computer Forensics ,Preparing for Computer Investigations , Taking A Systematic Approach ,Procedure for Corporate High-Tech Investigations ,Understanding Data Recovery Workstations and Software Office and Laboratory: Understanding Forensics Lab Certification Requirements Determining the Physical Requirements for a Computer, Forensics Lab Selecting a Basic Forensic Workstation

UNIT-2: Data Acquisition: , Understanding Storage Formats for Digital Evidence, Determining the Best Acquisition Method, Contingency Planning for Image Acquisitions, Using Acquisition Tools, Validating Data Acquisition, Performing RAID Data Acquisition, Using Remote Network Acquisition Tools, Using Other Forensics Acquisition Tools

UNIT-3: Processing Crime and Incident Scenes:, Identifying Digital Evidence, Collecting the Evidence in Private-Sector Incident Scenes, Processing law Enforcement Crime Scenes, preparing for a Search, Securing a Computer Incident or Crime Scene, Sizing Digital evidence at the Scene, Storing Digital evidence, Obtaining a Digital Hash, Current Computer Forensics Tools, Evaluating Computer Forensics Tool Needs, Computer Forensics Software Tools, Computer Forensics Hardware Tools

UNIT-4: Validating and Testing Forensics Software Computer Forensics Analysis and Validation, Determining What Data to Collect and Analyse, Validating Forensic Data, Addressing Data-Hiding Techniques, Performing Remote Acquisition, Recovering Graphics and Network Forensics, Recognizing a Graphics File, Understanding Data Compression, Locating and Recovering Graphics Files, Understanding Copyright Issues with Graphics, Network Forensic

UNIT-5:

Developing Standard Procedure for Network Forensics, Using Network Tools, Examining Honey Project, E-mail Investigations Cell Phone and Mobile Device Forensics, Exploring the Role of E-mail in Investigations, Exploring the Role of Client and Server in E-mail, Investigating E-mail Crimes and Violations, Understanding E-mail Servers, Using Specialized E-mail Forensics Tools, Understanding Mobile Device Forensics, Understanding Acquisition Procedure for Cell Phones and Mobile Devices

Paper-2: Digital Forensics Lab

Paper-3: Forensic Medicine & Anthropology

Unit-1: Introduction to Forensic Medicine – History of F.M – Definitions of Forensic Medicine, Pathology, Medical Jurisprudence. Medical evidences- documentations, investigation of scene of death - Medical Law and Ethics. Introduction, History & Development of Forensic Anthropology & Archaeology, Definitions of F.Anthropology, F.Archaeology, F.Odontology & F.Taphonomy. Role of Anthropologist at the Scene of Crime -Scene of Occurrence, Differences between Anthropologist & Archaeologist. Techniques & Equipment opted for search and recovery

Unit-2: Introduction to Human anatomy and Physiology- Axial Skeleton- Skull, Sutures of skull, Cranial bones, Facial bones, Sternum, thoracic bones, vertebral column, Appendicular Skeleton- Bones of Upper limbs, Lower limbs, Pelvic Girdle etc Organization of human body- Circulatory System- Digestive system- Respiratory system- nervous system- Excretory System- Endocrine System- Urinogenital system- Reproductive System-

Unit-3: Medico-legal Autopsy- Death and its Causes- External examination of deceased body – Internal Examination- Determination of time since death and cause of death- Injuries - classification- Medico-legal aspects of injuries- Postmortem changes- collection of post-mortem samples and preservation. Determination of sex- from skull, mandible, pelvis, Femur, scapula etc., Determination of Age- Suture closures, growth of teeth & appearance of ossification centres- Determination of Stature- Height determination- Facial Reconstruction, Facial Superimposition, Exhumation process and its importance.

Unit-4: Sexual offences- rape- unnatural sexual offences- sexual perversions- Abortion- Infanticide- foeticides- impotence and sterility- virginity, Pregnancy and Delivery linked crimes- medico-legal crimes- thermal deaths- electrocution- starvation- anaesthetic & operative deaths- Mechanical Asphyxia- accidental- Drowning deaths- Poisoning deaths - Lightning.

Unit-5: Forensic Odontology- Basic principles, Applications in criminal investigations- Bite mark Analysis, Age estimation etc., Development of teeth- Dentition, Architecture of teeth, growth of teeth- Milk, Permanent. Dentition Library, Forensic Odontology limitations.

Paper-4: Forensic Science Lab- 6
Forensic Medicine Lab

1. Autopsy
 - i) External Examination of Deceased body
 - ii) Internal Examination of Deceased body
 - iii) Post-mortem Changes
2. Collection and Preservation of Visceral Samples.
3. Identification and differentiation of Human Bones (Male & Female)
 - i) Skull
 - ii) Pelvis
 - iii) Upper limbs
 - iv) Lower limbs

Paper-5: Forensic Toxicology

Unit-1: Introduction, History & Development of Forensic Toxicology, Definition of F.Toxicology, Toxicokinetics, Toxicodynamics, Pharmacology, Pharmacokinetics, Pharmaco-dynamics. Basics Principles of Toxicology. Role of F.Toxicologist in criminal investigation, Coordination of Forensic Pathologist and Forensic Toxicologist. Court testimony of toxicological cases.

Unit-2: Classification of Toxic agents- Inorganic, Organic, Biological, Homicidal, Suicidal, Accidental, types of effects, Collection of visceral samples, other body fluids, their Preservation and General Identification techniques employed- Chemical tests, Electrophoresis, chromatography-TLC, HPLC, Spectrography, Mass spectrometry, XRD, NAA, SEM, RIA.

Unit-3: Individual Poisons- Nature, use, Administration, Symptoms, Detection of Chemical Poisons- Cyanides, Copper sulphate, Barbiturates, Organo-phosphorus, Arsenic, methyl alcohol etc., Plant Poisons -Opium, Datura, Oleander, Madar, Animal Poisons- Spider, Snakes, Frog, Insects venoms - other miscellaneous poisons etc., Radioactive poisoning

Unit-4: Routes of Administration- Inhalation, Ingestion, Skin contact, Injection etc. Toxicokinetics - Mechanism of Absorption- cell membranes, Transportation, Gastrointestinal tracts, Lungs, Distribution- Volume of Distribution, Storage in tissues, Fat depots, Redistribution, Excretion of toxicants- Urinary excretion, Fecal Excretion, and other routes of elimination. Toxicodynamics- Dose response, Tolerance, interaction of chemicals.

Unit-5: Management of acute poisoning- Introduction- Maintenance of Vital Functions- Safety Measures to Eliminate Poisons- Emergency Hospital Toxicology- Antidotes- Classification of Antidotes- Action Mechanism- pharmacokinetics – Lethal Dose – Identifying Route of Administration- Estimation of Time – Recovery from Poison Lethargy – Pharmacodynamics- Interaction of Chemicals- Side Effects of Antidotes.

Paper-6: Forensic Science Lab- 7 Forensic Toxicology Lab

1. Preliminary tests of heavy metals, Pesticides and Alcohol
2. Detection of Ethanol by Kozelka & Hine Method
3. Detection of Ethanol by GC
4. Identification of pesticides by TLC
5. Determination of a Drug / pesticides by GC
6. Determination of a Drug / pesticides by HPLC

Paper-7: DNA Fingerprinting

Unit-1: Introduction to Molecular biology – DNA – Structure of DNA – Nucleotides- General structure of nucleotides – Pyrimidines & Purines – RNA&DNA- Short hand representation of DNA back bones- Antiparallelity of Polynucleotide chain – Denaturation and Renaturation of DNA- Organization of DNA into Chromosome – Human Chromosomes – loci, Alleles, Genotypes and DNA markers – DNA markers nomenclatures – Types of DNA polymorphisms – Legal Standards for admissibility of DNA profiling.

Unit-2: Sources of DNA Evidences – Collection of Forensic DNA evidence- Anticontamination measures for samples – Preservation of Samples -Extraction & Isolation of DNA samples – Different Extraction Methods - Quantisation of DNA – Spectrophotometry- DNA Electrophoresis – Slot blot Assay – PCR Technique - PCR inhibition – Basic Principle.

Unit-3: Modern DNA profiling – Genome Project – VNTR – STR – RFLP analysis –Multi banded patterns- Single banded patterns- Sequence polymorphism – Length Polymorphism- Minisatellites- STR multiplex – STR Polymorphism - SNP's – Phenotype informative SNPs- Detection of SNPs – mtDNA -Application of mtDNA in forensic- Y -chromosome analysis – Significance of DNA Profiling – Paternity Determination – Mass Disaster & Victim identification – Application to sexual offences.

Unit-4: Interpretation of DNA Typing Results – Statistical Probability- Parentage Testing and Kinship Analysis – Bayes theorem – Hardy Weinberg law – Frequency estimation calculations – Likelihood ratios – Bayesian Networks – Accounting for Sub-Population – Mixture interpretation –Low template DNA testing - Determination of uncertainty.

Unit-5: DNA Database & Databank – Laboratory automation – Internet accessible DNA Databases – Human Genome Project – Genomics – Bioinformatics - Proteomics – Protein Polymorphism – Central dogma of life- Transcription and translation process- Aminoacids & polypeptide chain formation – Gene Regulation.

Paper-8: Forensic Science Lab- 8 Forensic DNA Fingerprinting Lab

1. Preservation of DNA Samples
2. Isolation of DNA from Blood
3. Amplification of DNA using PCR
4. Gel Electrophoresis of DNA & Proteins
5. Assay of Amylase
6. Assay of urease
7. Quantitative estimation of DNA by DPA Method
8. Quantitative estimation of RNA by Orcinol Method
9. Quantitative estimation of DNA by Lowry Method

Paper - 9 (INORGANIC, ORGANIC & PHYSICAL CHEMISTRY)

INORGANIC CHEMISTRY

UNIT – I

Coordination Chemistry: IUPAC nomenclature - bonding theories - Review of Werner's theory and Sidgwick's concept of coordination - Valence bond theory - geometries of coordination numbers 4-tetrahedral and square planar and 6-octahedral and its limitations, crystal field theory - splitting of d-orbitals in octahedral, tetrahedral and square-planar complexes - low spin and high spin complexes - factors affecting crystal-field splitting energy, merits and demerits of crystal-field theory. Isomerism in coordination compounds - structural isomerism and stereo isomerism, stereochemistry of complexes with 4 and 6 coordination numbers.

UNIT-II

1. Spectral and magnetic properties of metal complexes: Types of magnetic behavior, spin-only formula, calculation of magnetic moments, experimental determination of magnetic susceptibility-Gouy method.

2. Stability of metal complexes: Thermodynamic stability and kinetic stability, factors affecting the stability of metal complexes, chelate effect, determination of composition of complex by Job's method and mole ratio method.

ORGANIC CHEMISTRY

UNIT- III

Nitro hydrocarbons: Nomenclature and classification-nitro hydrocarbons, structure - Tautomerism of nitroalkanes leading to aci and keto form, Preparation of Nitroalkanes, reactivity - halogenation, reaction with HONO (Nitrous acid), Nef reaction and Mannich reaction leading to Micheal addition and reduction.

UNIT – IV

Nitrogen compounds: Amines (Aliphatic and Aromatic): Nomenclature, Classification into 1°, 2°, 3° Amines and Quarternary ammonium compounds. Preparative methods – 1. Ammonolysis of alkyl halides 2. Gabriel synthesis 3. Hoffman's bromamide reaction (mechanism). Reduction of Amides and Schmidt reaction. Physical properties and basic character - Comparative basic strength of Ammonia, methyl amine, dimethyl amine, trimethyl amine and aniline - comparative basic strength of aniline, N-methylaniline and N,N-dimethyl aniline (in aqueous and non-aqueous medium), steric effects and substituent effects. Chemical properties: a) Alkylation b) Acylation c) Carbylamine reaction d) Hinsberg separation e) Reaction with Nitrous acid of 1°, 2°, 3° (Aliphatic and aromatic amines). Electrophillic substitution of Aromatic amines – Bromination and Nitration. Oxidation of aryl and Tertiary amines, Diazotization.

PHYSICAL CHEMISTRY

UNIT- V:

Thermodynamics- The first law of thermodynamics-statement, definition of internal energy and enthalpy. Heat capacities and their relationship. Joule-Thomson effect- coefficient. Calculation of w , for the expansion of perfect gas under isothermal and adiabatic conditions for reversible processes. State function. Temperature dependence of enthalpy of formation Kirchoff's equation. Second law of thermodynamics. Different Statements of the law. Carnot cycle and its efficiency. Carnot theorem. Concept of entropy, entropy as a state function, entropy changes in reversible and irreversible processes. Entropy changes in spontaneous and equilibrium processes.

Paper – 10 Organic Chemistry

Laboratory Course – V

Organic Qualitative Analysis:

Analysis of an organic compound through systematic qualitative procedure for functional group identification including the determination of melting point and boiling point with suitable derivatives.

Alcohols, Phenols, Aldehydes, Ketones, Carboxylic acids, Aromatic Primary Amines, Amides and Simple sugars.

Paper 11 (INORGANIC, ORGANIC & PHYSICAL CHEMISTRY) - VI

INORGANIC CHEMISTRY

UNIT-I

1. Reactivity of metal complexes: Labile and inert complexes, ligand substitution reactions - SN 1 and SN 2, substitution reactions of square planar complexes - Trans effect and applications of trans effect.

2. Bioinorganic chemistry: Essential elements, biological significance of Na, K, Mg, Ca, Fe, Co, Ni, Cu, Zn and Cl. Metalloporphyrins – Structure and functions of hemoglobin, Myoglobin and Chlorophyll.

ORGANIC CHEMISTRY

UNIT- II

Heterocyclic Compounds: Introduction and definition: Simple five membered ring compounds with one hetero atom Ex. Furan. Thiophene and pyrrole - Aromatic character – Preparation from 1,4,- dicarbonyl compounds, Paul-Knorr synthesis. Properties : Acidic character of pyrrole - electrophilic substitution at 2 or 5 position, Halogenation, Nitration and Sulphonation under mild conditions - Diels Alder reaction in furan. Pyridine – Structure - Basicity - Aromaticity - Comparison with pyrrole - one method of preparation and properties - Reactivity towards Nucleophilic substitution reaction.

UNIT-III

Carbohydrates: Monosaccharides: (+) Glucose (aldo hexose) - Evidence for cyclic structure of glucose (some negative aldehydes tests and mutarotation) - Proof for the ring size (methylation, hydrolysis and oxidation reactions) - Pyranose structure (Haworth formula and chair conformational formula). (-) Fructose (keto hexose) - Evidence of 2 - keto hexose structure (formation of pentaacetate, formation of cyanohydrin its hydrolysis and reduction by HI). Cyclic structure for fructose (Furanose structure and Haworth formula) - osazone formation from glucose and fructose – Definition of anomers with examples. Interconversion of Monosaccharides: Aldopentose to Aldo hexose (Arabinose to D- Glucose, D-Mannose) (Kiliani - Fischer method). Epimers, Epimerisation - Lobry de bruyn van Ekenstein rearrangement. Aldo hexose to Aldopentose (D-Glucose to D- Arabinose) by Ruff degradation. Aldo hexose to Keto hexose [(+) Glucose to (-) Fructose] and Keto hexose to Aldo hexose (Fructose to Glucose)

UNIT- IV

Amino acids and proteins: Introduction: Definition of Amino acids, classification of Amino acids into alpha, beta, and gamma amino acids. Natural and essential amino acids - definition and examples, classification of alpha amino acids into acidic, basic and neutral amino acids with examples. Methods of synthesis: General methods of synthesis of alpha amino acids

(specific examples - Glycine, Alanine, valine and leucine) by following methods: a) from halogenated carboxylic acid b) Malonic ester synthesis c) strecker's synthesis. Physical properties: Zwitter ion structure - salt like character - solubility, melting points, amphoteric character, definition of isoelectric point. Chemical properties: General reactions due to amino and carboxyl groups - lactams from gamma and delta amino acids by heating peptide bond (amide linkage). Structure and nomenclature of peptides and proteins.

PHYSICAL CHEMISTRY

UNIT-V

1. Chemical kinetics: Rate of reaction - Definition of order and molecularity. Derivation of rate constants for first, second, third and zero order reactions and examples. Derivation for time half change. Methods to determine the order of reactions. Effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy.
2. Photochemistry: Difference between thermal and photochemical processes. Laws of photochemistry Grothus-Draper's law and Stark-Einstein's law of photochemical equivalence. Quantum yield-Photochemical reaction mechanism- hydrogen- chlorine, hydrogen- bromine reaction. Qualitative description of fluorescence, phosphorescence, Photosensitized reactions- energy transfer processes (simple example)

Practical Paper –12 Physical Chemistry

Laboratory Course – VI

1. Determination of rate constant for acid catalyzed ester hydrolysis.
2. Determination of molecular status and partition coefficient of benzoic acid in Benzene and water.
3. Determination of Surface tension of liquid
4. Determination of Viscosity of liquid. 5. Adsorption of acetic acid on animal charcoal, verification of Freundlich isotherm.

Table-6: B.Sc. Forensic Science SEMESTER – VI

Paper No.	Course		Total Marks	Mid Sem Exam*	Sem End Exam	Teaching Hours	Credits
1	Mobile Forensics		100	25	75	4	3
2	Mobile Forensics Lab		50	0	50	2	2
3	Narcotics Drugs & Psychotropic Substances		100	25	75	4	3
4	Forensic Science Lab- 8		50	0	50	2	2
5	Forensic Chemistry		100	25	75	4	3
6	Forensic Science Lab- 9		50	0	50	2	2
7	Forensic Physics		100	25	75	4	3
8	Forensic Science Lab- 10		50	0	50	2	2
9	Chemistry	7A- Analytical methods of chemistry	100	25	75	4	3
10	Chemistry Lab- 7A		50	0	50	2	2
11	Chemistry	8A-1: Polymer chemistry 8A-2: Instrumental methods of chemistry 8A-3: Analysis of Drugs, Foods, Dairy Products & Biochemical Analysis	100	25	75	4	3
12	Chemistry Lab 8A-1, 8A-2 & 8A-3		50	0	50	2	2

Total	900			36	30
-------	-----	--	--	----	----

Paper-1: Mobile Forensics

UNIT-1: Introduction to Mobile Forensics – I - Mobile Phone Basics, Inside Mobile devices , Cell Phone Crime, SIM Card , SIM Security ,Mobile forensics ,Mobile forensic & its challenges, Mobile phone evidence extraction process ,The evidence intake phase , The identification phase, The preparation phase, The isolation phase, The processing phase, The verification phase, The document and reporting phase, The presentation phase
Practical mobile forensic approaches, Mobile operating systems overview , Mobile forensic tool levelling system, Data acquisition methods

UNIT-2: Introduction to Mobile Forensics – II - Potential evidence stored on mobile phones - Rules of evidence , Admissible, Authentic , Complete , Reliable, Believable. Good forensic practices-Securing the evidence, preserving the evidence, Documenting the evidence, Documenting all changes. Windows Phone Forensics- Windows Phone OS ,Windows Phone file system, Data acquisition. BlackBerry Forensics- BlackBerry OS, Data acquisition, BlackBerry analysis

UNIT-3: Android Forensics - I - The Android models- The Linux kernel layer, Libraries , Dalvik virtual machine, The application framework layer , The applications layer. Android security - Secure kernel, The permission models, Application sandbox, Secure interprocess communication, Application signing. Android file hierarchy - Android file system , Viewing file systems on an Android device, Extended File System – EXT

UNIT-4: Android Forensics – II- 4.1. Android Forensic Setup and Pre-Data Extraction Techniques , A forensic environment setup, Screen lock bypassing techniques, Gaining root access. Android Data Extraction Techniques- Imaging an Android Phone, Data extraction techniques. Android Data Recovery Techniques ,Data recovery. Android App Analysis and Overview of Forensic Tools- Android app analysis, Reverse engineering Android apps, Forensic tools overview , Cellebrite – UFED, MOBILedit, Autopsy

Paper-2: Mobile Forensics Lab

Paper-3: Narcotic Drugs & Psychotropic Substances

Unit-1: Narcotics- Introduction, Legal Definitions, Classification- Sedatives, , Stimulants, Hallucinogens, Solvents, Synthetic Narcotics, Designer Drugs and Miscellaneous - Addiction- Nature, Causes of Drug Addiction - Addict - Identification of the addict, Withdrawal Syndrome.

Unit-2: Drugs and crimes- non violent crimes, violent crimes, drug problems in India- cannabis and poppy cultivation – illegal possession – Smuggling – Transportation – Drug Profiling – Clandestine laboratories – Drug abuse in sports – Forensic analysis & Synthesis of various Narcotic Drugs and Psychotropic Substances (NDPS) – Sample collection.

Unit-3: Sedatives-opium and opium derivatives- Morphine- Administration, Physiological Effects, Metabolism, Addiction, Identification - Heroin- Abuse, Physiological Effects and Identification -Barbiturates- Nature, Administration, Addiction, Metabolism and Identification -Other non opiate sedatives.

Unit-4: Stimulants: Cocaine-Origin, Use, Abuse, Intake, Psychological Effects Of Cocaine, Physiological Effects, Addiction, Metabolism And Identification – Amphetamine, Benzodiazepines: Administration, Effects, Addiction, Metabolism, Identification - Hallucinogens: Cannabis, Quinazolones- Administration, Effects, Addiction, Metabolism and Identification- LSD (Lysergic Acid Diethylamide), Psylocybin, Mescaline and MDMA: Administration, Effects, Addiction, Metabolism And Identification.

Unit-5: NDPS Act 1985 - Drug law enforcements in India- Narcotic control bureau, Central Bureau of Narcotics, Narcotics Control and Intelligence Bureau– Prevention Drug trafficking -Penalties for NDPS related offenses – NDPS Amendments 2014 – United Nations Drugs Conventions.

Paper-4: Forensic Science Lab- 9 Narcotics Lab

1. Detection of NDPS Eg: Opiates, Barbiturates, Benzodiazepines, Amphetamines, and Cannabis by spot tests/ colour tests
2. Detection of NDPS by TLC, GC, HPLC , MS.

Paper-5: Forensic Chemistry

Unit-1: Introduction to Forensic Chemistry – Types of cases – Preliminary Screening – Presumptive Tests (colour/spot tests) Examination procedure by Standard methods – Different types Test kits & contents – Introduction to Analytical Chemistry -Quantitative and Qualitative Forensic analysis of inorganic and organic material – Volumetric, Titrimetric, Gravimetric methods of analysis -Analysis of fertilizers , Insecticides & Metallurgical analysis – Industrial chemicals – Organic Solvents- Significance of Forensic Chemistry

Unit-2: Introduction to Explosives – Classification – chemical structures of explosive components – Synthesis of Explosive material - Individual Explosives – Explosive Devices – Improvised Explosive devices – Country made explosive and material used - Investigation of explosives - Identification of hidden explosives – Approach to SOC – Post blast Residues Collection – Systematic Analysis of Explosive – Profiling & evaluation of explosives – Disposal of IEDs – Explosives act & Explosive substances act

Unit-3: Chemistry of fire – Arson Cases – Nature of Fire – Collection of Evidences – Evaluation of Evidences – Causes of Fire – Chemical analysis of Arson residues – Instrumental methods of analysis- Microtrace analysis of Cosmetics, Dyes, Paints, Pigments, Oils, Fats , Industrial Dust , Polymers chemicals etc. Collection of trace evidences.

Unit-4: Analysis of beverages: Composition and analysis of alcoholic and non alcoholic beverages – country made liquor – illicit liquor – classification of alcoholic beverages – Toxicokinetics of alcohol – Effects of alcohol – Collection of samples for identification of alcohols – Chemical & physical tests and evaluation – common adulterants and toxic substances in alcoholic beverages – Breath analysers – Blood alcohol content (BAC).

Unit-5: Examination of Petroleum products – Distillation and fractionation – Standard methods of analysis of petroleum products – Adulteration of petroleum – Various fractions and their commercial use – Petroleum act – BIS – Drugs and Cosmetics act – Central excise act.

Paper-6: Forensic Science Lab- 9
Forensic Chemistry Lab

1. Analysis of Alcoholic Liquor as per BIS Specifications
2. Detection of Methanol, Chloral hydrated, Diazepam, Alprazolam in Alcoholic Liquors
3. Extraction and detection of organic and inorganic explosive / explosion residues by spot/ colour tests / TLC
4. Density/ Specific gravity Determination of Petroleum by Hydrometer
5. Filter paper test for detecting adulteration of petrol
6. Detection of adulteration of petrol by GC
7. Chemical Properties of Oils& Fats
8. Analysis of Precious Metals
9. Phenolphthalein test for Bribe Trap cases
10. Preliminary examination of Explosives (tests for nitrite, nitrate, thiocyanate, chlorate, Thiosulphate, Perchlorate, Sulphite, Phosphate etc)
11. Test for Cations & anions

Paper-7: Forensic Physics

Unit-1: Forensic Engineering – Building materials – cement and its composition – determination of its adulteration – Bitumen and tar examination – reinforced cement concrete. chemical etching – magnetic and electrolytic etc. – Recording of restored marks – restoration of marks on wood, polymers and leather.

Unit-2: Forensic Phonetics: Introduction, Authentication of Tape Recordings – Physical Examination & Laboratory examination, Difficult tapes and Transcripts – Enhancing speech – Speech Decoding and transcripts – Decoding Mechanics, Speaker Identification – Ear Witness identification – Aural perceptual approaches – Machine/computer approaches , Vocal behaviours – Stress – Alcohol Speech Relationships.

Unit-3: Voice Analysis – Introduction – Human Voice – Nature of voice and production of speech – Perception of voice and speech- Collection of evidence – Quality of Evidence – Types of voice Evidences – Speaker variability & Simulation – Transmission channel Distortion – Recording system distortion – Court testimony admissibility – Forensic audio clarification

Unit-4: Forensic Acoustics –Introduction – Types – Procedure and methods – Feature extraction – Feature comparison – Classification, Speaker recognition by listening – Recognition by non-experts and experts, speaker identification by visual comparison of spectrograms – Technology – Kersta method, Tosi Study , Automatic Speaker Recognition – Feature Extraction – Feature Comparison and normalization techniques - interpretation of results , Speaker Profiling, Intelligibility enhancement of audio recording, Transcription & analysis of disputed utterances – Authenticity and integrity examination of audio recording.

Unit-5: Forensic Video Analysis – Introduction – Video Recording – CCTV – Spy camera technology - Comparative analysis – Image analysis – Data Recovery – Image Analysis – Image Enhancement – Format of Video Files - Transcoding of videos and images – Forensic Video Recovery Field kit – Collection, clarification, analysis & report – Admissibility in court.

**Paper-8: Forensic Science Lab-
Forensic physics Lab**

1. Examination of Glass Fractures
2. Determination of Refractive indices of glass & liquids
3. Physical Examination of Soil, pH determination, Presence of Biological material
4. Determination of Particle size Distribution of soils
5. Density gradient method of soil
6. Chemical analysis of cement
7. Determination of Calcium in cement by EDTA method
8. Examination of Paint samples by microscopy
9. TLC & Spectrophotometric comparison of Paint evidence
10. Comparison of Tool marks
11. Chemical Etching

Paper-9: Chemistry Elective – VII A

Analytical Methods In Chemistry

UNIT-I

Quantitative analysis: a) Importance in various fields of science, steps involved in chemical analysis. Principles of volumetric analysis :. Theories of acid-base, redox, complexometric, iodometric and precipitation titrations - choice of indicators for these titrations. b) Principles of gravimetric analysis: precipitation, coagulation, peptization, coprecipitation, post precipitation, digestion, filtration and washing of precipitate, drying and ignition.

UNIT-II

Treatment of analytical data: Types of errors, significant figures and its importance, accuracy - methods of expressing accuracy, error analysis and minimization of errors, precision - methods of expressing precision, standard deviation and confidence limit

UNIT-III

Separation techniques in chemical analysis: Introduction, principle, techniques, factors affecting solvent extraction, Batch extraction, continuous extraction and counter current extraction. Synergism., Application - Determination of Iron (III) Ion exchange : Introduction, action of ion exchange resins, separation of inorganic mixtures, applications, Solvent extraction: Principle and process.

UNIT-IV

Chromatography: Classification of chromatography methods, principles of differential migration adsorption phenomenon, Nature of adsorbents, solvent systems, R_f values, factors effecting R_f values. Paper Chromatography: Principles, R_f values, experimental procedures, choice of paper and solvent systems, developments of chromatogram - ascending, descending and radial. Two dimensional chromatography - applications.

UNIT

-V

Thin layer Chromatography (TLC): Advantages - Principles, factors effecting R_f values - Experimental procedures - Adsorbents and solvents - Preparation of plates - Development of the chromatogram - Detection of the spots – Applications - Column Chromatography: Principles - experimental procedures - Stationary and mobile Phases - Separation technique – Applications. HPLC : Basic principles and applications.

Paper-10: Chemistry Laboratory Course – VII-A-1

1. Identification of amino acids by paper chromatography.
2. Determination of Zn using EDTA
3. Determination of Mg using EDTA

Paper-11: Chemistry Cluster Elective – VIII-A-1

Polymer Chemistry

UNIT-I:

Introduction of polymers: Basic definitions, degree of polymerization, classification of polymers - Natural and Synthetic polymers, Organic and Inorganic polymers, Thermoplastic and Thermosetting polymers, Plastics, Elastomers, Fibres and Resins, Linear, Branched and Cross Linked polymers, Addition polymers and Condensation Polymers, mechanism of polymerization. Free radical, ionic and Zeigler – Natta polymerization

UNIT-II:

Techniques of Polymerization: Bulk polymerization, solution polymerization, suspension and emulsion polymerization. Molecular weights of polymers: Number average and weight average molecular weights Determination of molecular weight of polymers by Viscometry and Osmometry methods.

UNIT-III:

Kinetics of Free radical polymerization, Glass Transition temperature (T_g) and Determination of T_g: Free volume theory, WLF equation, factors affecting glass transition temperature (T_g).

UNIT-IV:

Polymer additives: Introduction to plastic additives – fillers, Plasticizers and Softeners, Lubricants and Flow Promoters, Anti aging additives, Flame Retardants, Colourants, Blowing agents, Cross linking agents, Photo stabilizers, Nucleating agents.

UNIT-V:

Polymers and their applications: Preparation and industrial applications of Polyethylene, Polyvinyl chloride, Teflon, Terelene, Polyacrylonitrile, Nylon6,6 and silicones

Chemistry Cluster Elective – VIII-A-2

Instrumental Methods Of Analysis

UNIT

–

I

Introduction to spectroscopic methods of analysis: Recap of the spectroscopic methods covered in detail in the core chemistry syllabus: Treatment of analytical data, including error

analysis. Classification of analytical methods and the types of instrumental methods. Consideration of electromagnetic radiation

UNIT – II

Molecular spectroscopy: Infrared spectroscopy: Interactions with molecules: absorption and scattering, Means of excitation (light sources), separation of spectrum (wavelength dispersion, time resolution), detection of the signal (heat, differential detection), interpretation of spectrum (qualitative, mixtures, resolution), advantages of Fourier Transform (FTIR), Samples and results expected, Applications: Issues of quality assurance and quality control.

UNIT – III:

UV-Visible/ Near IR – emission, absorption, fluorescence and photoacoustic, Excitation sources (lasers, time resolution), wavelength dispersion (gratings, prisms, interference filters, laser, placement of sample relative to dispersion, resolution), Detection of signal (photocells, photomultipliers, diode arrays, sensitivity and S/N), Single and Double Beam instruments, Interpretation (quantification, mixtures, absorption vs. fluorescence and the use of time, photoacoustic, fluorescent tags).

UNIT – IV

Separation techniques - Chromatography: Gas chromatography, liquid chromatography, supercritical fluids, Importance of column technology (packing, capillaries), Separation based on increasing number of factors (volatility, solubility, interactions with stationary phase, size, electrical field), Detection: simple vs. specific (gas and liquid), Detection as a means of further analysis (use of tags and coupling to IR and MS).

Mass spectroscopy: Making the gaseous molecule into an ion (electron impact, chemical ionization), Making liquids and solids into ions (electrospray, electrical discharge, laser desorption, fast atom bombardment), Separation of ions on basis of mass to charge ratio, Magnetic, Time of flight, Electric quadrupole. Resolution, time and multiple separations, Detection and interpretation (how this is linked to excitation).

UNIT – V

Elemental analysis:

Mass spectrometry (electrical discharges). Atomic spectroscopy: Atomic absorption, Atomic emission, and Atomic fluorescence. Excitation and getting sample into gas phase (flames, electrical discharges, plasmas), Wavelength separation and resolution (dependence on technique), Detection of radiation (simultaneous/scanning, signal noise), Interpretation (errors due to molecular and ionic species, matrix effects, other interferences).

NMR spectroscopy: Principle, Instrumentation, Factors affecting chemical shift, Spin coupling, Applications.

Chemistry Cluster Elective – VIII-A-3

Analysis Of Drugs, Foods, Dairy Products & Bio-Chemical Analysis

UNIT- I

Analysis of the following drugs and pharmaceuticals preparations: (Knowledge of molecular formula, structure and analysis)

Analysis of analgesics and antipyretics like aspirin and paracetamol.

Analysis of anti malaria drugs like chloroquine.

Analysis of drugs in the treatment of infections and infestations: Amoxicillin, chloramphenicol, penicillin, tetracycline. Anti tuberculous drug- isoniazid.

UNIT – II

Analysis of the following drugs and pharmaceuticals preparations: (Knowledge of molecular formula, structure and analysis) Analysis of antihistamine drugs and sedatives like Allegra, Zyrtec (cetirizine), Alprazolam, Trazodone, Lorazepam, Ambien (zolpidem), Diazepam.

UNIT – III

Analysis of anti epileptic and anti convulsant drugs like phenobarbital and phenacetamide.

Analysis of cardiovascular drugs like atenolol, norvasc (amlodipine).

Analysis of Lipitor (atorvastatin) - a drug for the prevention of production of cholesterol.

Analysis of diuretics like furosemide (Lasix).

Analysis of Prevacid (lansoprazole) - a drug used for the prevention of production of acids in stomach.

UNIT – IV

Analysis of Milk and milk products: Acidity, total solids, fat, total nitrogen, proteins, lactose, phosphate activity, casein, chloride.

Analysis of food materials - Preservatives: Sodium carbonate, sodium benzoate, sorbic acid.

Coloring matters - Brilliant blue FCF, fast green FCF, sunset yellow FCF. Flavoring agents - Vanilla, diacetyl, isoamyl acetate, limonene. Adulterants in rice and wheat, wheat flour, coconut oil, coffee powder, tea powder, milk.

UNIT – V

Clinical analysis of blood: Composition of blood, clinical analysis, trace elements in the body. Estimation of blood cholesterol, glucose, enzymes, RBC & WBC, Blood gas analyser.

Paper-12: Chemistry Laboratory Course – VIII-A-1/ VIII-B-1/ VIII-C-1

1. Preparation of Aspirin
2. Preparation of Paracetamol
3. Preparation of Acetanilide
4. Preparation of Barbituric Acid
5. Preparation of Phenylazo β -naphthol

Chemistry Laboratory Course – VIII-A-2/ VIII-B-2/ VIII-C-2

1. Electrochemistry: Determination of redox potential of $\text{Fe}^{2+}/\text{Fe}^{3+}$ by potentiometric titration of ferrous ammonium sulphate vs. potassium dichromate.
2. pH metry:
 - i) Preparation of phosphate buffer solutions.
 - ii) pH metric titration of weak acid, acetic acid with strong base, NaOH and calculation of dissociation constant.
3. Colorimetry:
 - i) Verification of Beer-Lambert law for KMnO_4 and determination of concentration of the given solution.
 - ii) Verification of Beer-Lambert law for $\text{K}_2\text{Cr}_2\text{O}_7$ and determination of concentration of the given solution.

Chemistry Laboratory Course - VIII-A-2/ VIII-B-2/ VIII-C-2

PROJECT WORK