ANDHRA PRADESH STATE COUNCIL OF HIGHER EDUCATION

MINOR

Subject: Forensic Science

w.e.f. AY 2023-24

COURSE STRUCTURE

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
I	II	1	Forensic Science and Criminology	3	3
			Forensic Science and Criminology Practical Course	2	1
II	III	2	Crime Scene Management	3	3
			Crime Scene Management Practical Course	2	1
	IV	3	Forensic Biology and DNA Fingerprinting	3	3
			Forensic Biology and DNA Fingerprinting Practical Course	2	1
		4	Forensic Chemistry	3	3
			Forensic Chemistry Practical Course	2	1
III	V	5	Forensic Physics	3	3
			Forensic Physics Practical Course	2	1
		6	Instrumentation	3	3
			Instrumentation Practical Course	2	1

SEMESTER-II

COURSE 1: FORENSIC SCIENCE AND CRIMINOLOGY

Theory Credits: 3 3 hrs/week

Learning objectives: The student will be able to understand the basics and history of forensic science and criminology.

Learning outcomes: After studying this course the students will know-

- The significance of Forensic Sciences to the Criminal Justice System.
- The working conditions of Forensic Science Laboratory.
- The importance of criminology and penology for crime detection.
- The working of Indian courts and role of criminal justice system in crime detection.

Unit 1: Basics and Historical Development of Forensic Science

Introduction, Definition, need, signification and scope of Forensic Science. Principles of Forensic Science. Domains in Forensic Science: Forensic Biology, Forensic Medicine, Forensic Toxicology, Forensic Osteology and Odontology, Forensic Physics, Forensic Photography, Ballistics, Fingerprint, Questioned Documents, Forensic Psychology, Forensic Anthropology, Wild life Forensic, DNA profiling, Computer Forensic etc.
Specific contribution of scientists in the field of Forensic Science. Development of Forensic Science in India. National and international scenario of teaching and research institution in Forensic Science. Functions of: Forensic Scientist, Police officers, Prosecution, Judicial Officers and Medico legal expert etc. Problem of proof in Forensic Science, corpus dilecti, modus operandi.

Unit 2: Forensic Science Laboratory and National and International perspective of Forensic Science

Structure and function of State and regional Forensic Science Laboratory, Central Forensic Science Laboratory and facility provided, Mobile Forensic Science Laboratory. Directorate of Forensic Science Service. Police and Forensic scientist relationship, role of FSL in criminal investigation, relationship between forensic expert and judiciary officer, Importance of FSL, National and International scenario of FSL, facilities provided in forensic science laboratory. Ethical issues in FSL.
National perspective of forensic science: Central and Divisional Fingerprint Bureaus, National Crime Records Bureau, Police & Detective Training Schools, Bureau of Police Research & Development, Police Academies, Police dogs.
International perspectives of forensic science: INTERPOL, FBI, CIA, CSI, Ameripol, Europol, Frontex etc.

Unit 3: Policing System and Criminal Justice System in India

Policing style and principles, police power of investigation, filling of criminal charges, community policing a heterogenous society. Introduction to penology, Broad concepts of criminal justice system, Correctional measures and rehabilitation of offenders, Human rights and criminal Justice system in India.
Criminal Justice System in India- Introduction, Administration of Civil and Criminal Laws. Introduction to constitution of India- Fundamental Rights, Indian Penal Code (IPC), Criminal

Procedure Code (Cr. PC), Indian Evidence Act (IEA), IT Act-2000, Wild Life Protection Act-1972, POCSO Act, etc. Indian Courts- Introduction, Hierarchy of courts- Powers of courts, types of courts, Lok Ayukta & Lok Adalat, etc. Role and responsibilities of Public Prosecution – Defence Council -Admissibility of Expert Testimony.

Unit 4: Crime & Criminology

Crime: Definition of crime, history and development, Victimology, criminological perspective, characteristics of crime, classification of crimes, present scenario of crime in India. Criminal and Criminology: Definition of criminology & criminal, classification of criminals, growth of criminology in India, conservative criminology, liberal criminology, radial criminology.
Criminal behaviour: Introduction of criminal behaviour, Theories of criminal behaviour, Ethical issues in forensic science: Definition of ethics, professional standards for practice of Criminalistics, sanction against expert for unethical conduct.

Unit 5: Criminal Psychology

Introduction, Definition & Scope. Mc. Naughten Rule, Insanity in IPC, Sensation and Perception. Gestalt principle of perceptual process. Personality – definition, traits and approaches. Freuds psycho-analytical theory. Personality disorders, delusional disorder, anti-social personality. Psychological Motives and its impact on behaviour. Mental disorder and Mental deficiency as factor in the causation of Crime. Psychological methods of control and rehabilitation of offenders – Psychotherapy and counselling – Victims, Witnesses and Suspects. Polygraphy, Narco Analysis & BEOS in the Criminal Justice System.

Suggested Readings:

1. Henry Lee's Crime Scene Handbook: Henry C Lee
2. Crime Scene Processing and Laboratory Work Book: Patric Jones
3. Forensic Science: An Introduction to Scientific and Investigative Techniques 3rd ed.: Stuart H. James
4. Criminalistics: An Introduction to Forensic Science, 9th edition.: Richard Saferstein
5. Criminal Profiling: An Introduction to a Behavioral Evidence Analysis, 3rd edition.: Brent E. Turvey
6. Forensic Science in Criminal Investigation and Trial, 4th edition.: B.R. Sharma
7. Handbook of Forensic Psychology: Dr. Veer raghavan crime scene, sketching of crime scene, searching, collection, preservation, packing of physical evidence, documentation of crime scene, forwarding or dispatch of exhibit in to the laboratory, chain of custody, collection of standard/reference samples.
8. Crime Scene Management with Special Emphasis on National Level Crime Cases: Dr. Rukmani Krishnamurthy under publishing
9. Richard Saferstein: Forensic science from the crime scene to the crime lab.
10. S.H. James and J.J. Nordby, *Forensic Science: An Introduction to Scientific and Investigative Techniques*, 2nd Edition, CRC Press, Boca Raton (2005).
11. Criminology – Ram Ahuja

Suggested Co-Curricular Activities:

- Visit to FSL and Allied institutions.

- Quiz and seminars on Forensic Science.
- Jurisdiction & Powers of various courts in India.
- Debate on Criminology & its importance
- Case studies and assignments on criminal psychology.

SEMESTER-II

COURSE 1: FORENSIC SCIENCE AND CRIMINOLOGY

Practical Credits: 1 2 hrs/week

List of Experiments:

1. To study the Do's and Don'ts in the Forensic Science Laboratory.
2. To prepare a poster on various domains of forensic science.
3. To prepare a poster on the contribution of various scientists in forensic science.
4. To prepare a poster on the forensic teaching and research institutes in India.
5. To prepare a case study of famous criminal and civil cases in India.
6. To prepare a poster on the hierarchy and functions of working professionals in Central Forensic Science Laboratory.
7. To study the different forensic science kits available in the Forensic Science Laboratory.
8. To understand the roles of forensic experts of various divisions of the Forensic Science Laboratory. (Role Play)
9. To study the types, causes and rate of crimes in India.
10. To prepare a poster on functions and hierarchy of the Policing System and Criminal Justice System in India.

SEMESTER-III

COURSE 2: CRIME SCENE MANAGEMENT

Theory Credits: 3 3 hrs/week

Learning objectives: The student will be able to understand the basics and importance of crime scene management.

Learning outcomes: After studying this course the students will know-.

- The importance of protection of crime scene.
- The significance of photography and videography at scene of crime.
- The importance of physical evidences.
- The Integrity of chain of custody.
- The role of crime scene reconstruction in crime investigation.

Unit 1: Crime Scene Management

Types of crime scenes- Macroscopic, Microscopic, Indoor and Outdoor. Set up involved in CSM- Components of Crime Scene Management- Information management, manpower management, technology management & logistics management, Role of crime scene managers and FRO, Duties of various officers at crime scene, educational background & hierarchy of forensic expert. Crime scene security, contamination control, documentation protocols and maintaining health & safety procedures.

Unit 2: Crime Scene Evidence

Introduction to evidence, Importance of evidence, Classification of crime scene evidence, Locard's principle of exchange, Handling of evidences, Precautions, Evidence collection methodologies and materials, Collection, preservation, labelling, sealing and forwarding of evidences, Chain of custody.

Unit 3: Crime Scene Investigation

Steps of CSI- Self-protection, Medical Assessment, Secure the crime scene, Search for evidence, Crime Scene Documentation (Note taking, Photography, Sketching and Videography), Role of first responding officer, Coordination between police personnel and forensic scientists at crime scenes. The evaluation of 5Ws -who? what? when? where? why? and 1H -how?

Unit 4: Crime Scene Reconstruction

Defining crime scene reconstruction, nature & importance of crime scene reconstruction, basic principles of physical evidence and crime scene reconstruction, stages of crime scene reconstruction, types of crime scene reconstruction- (Specific Type of Incident/Crime Reconstruction, Specific Events Reconstruction, Degree of Involvement Reconstruction and Specific Type of Physical Evidence Reconstruction), Crime Scene Staging, Sequence of events recording, Documentation required for Crime scene reconstruction, Computerized Reconstruction (Faro).

Unit 5: Report Writing

Introduction, Expert report, General guidelines, Importance of report, Nature of report, Types of report, Report format, Length of report, Common reporting mistakes, Tips to Keep in Mind When Writing an Expert Report, Do's and Don'ts while preparing forensic report, Legal challenges, Legal considerations of report: Sec 45 of IEA, Sec 293 of Cr.P.C.

Suggested Reading:

1. Henry Lee's Crime Scene Handbook: Henry C Lee
2. Forensic Biology: Shrikant H. Lade
3. Crime Scene Processing and Laboratory Work Book: Patric Jones
4. Forensic Science: An Introduction to Scientific and Investigative Techniques 3rd ed.: Stuart H. James
5. Criminalistics: An Introduction to Forensic Science, 9th edition.: Richard Saferstein
6. Computer Crime and Computer Forensic: Dr. R.K. Tiwari
7. Criminal Profiling: An Introduction to a Behavioral Evidence Analysis, 3rd edition.: Brent E. Turvey
8. Forensic Science in Criminal Investigation and Trial, 4th edition.: B.R. Sharma
9. Handbook of Forensic Psychology: Dr. Veer raghavan crime scene, sketching of crime scene, searching, collection, preservation, packing of physical evidence, documentation of crime scene, forwarding or dispatch of exhibit in to the laboratory, chain of custody, collection of standard/reference samples.
10. Crime Scene Management with Special Emphasis on National Level Crime Cases: Dr. Rukmani Krishnamurthy under publishing
11. Text Book of Medical Jurisprudence, Forensic Medicine and Toxicology: Parikh C.K.
12. The Identification of Firearms and Forensic ballistics: Barrard and Gerald
13. M. Byrd, *Crime Scene Evidence: A Guide to the Recovery and Collection of Physical Evidence*, CRC Press, Boca Raton (2001).
14. Richard Saferstein: Forensic science from the crime scene to the crime lab.
15. S.H. James and J.J. Nordby, *Forensic Science: An Introduction to Scientific and Investigative Techniques*, 2nd Edition, CRC Press, Boca Raton (2005).
16. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's, *Techniques of Crime Scene Investigation*, CRC Press, Boca Raton (2013).

Suggested Co-Curricular Activities:

- Flow chart Preparation-Crime scene investigation
- Poster making –Photographic skills
- Seminar on crime scene management
- Collection of samples-for museum
- Simulation of various crime scenes
- Workshop on crime scene sketching techniques

SEMESTER-III

COURSE 2: CRIME SCENE MANAGEMENT

Practical Credits: 1 2 hrs/week

List of Experiments:

1. To study the seven principles of forensic science with examples.
2. To study the different evidence collection methods with examples.
3. To study the different evidence collection materials with examples.
4. To search, collect and preserve the physical evidence recovered from the crime scene.
5. To record the crime scene by photography and videography methods of crime scene documentation.
6. To record the crime scene by Note making and Sketching methods of crime scene documentation.
7. To study the reconstruction of blood spatter patterns.
8. To study the reconstruction of glass fracture evidence.
9. To simulate the scene of crime and perform its investigation.
10. To prepare a forensic report on crime scene investigation.

SEMESTER-IV

COURSE 3: FORENSIC BIOLOGY AND DNA FINGERPRINTING

Theory Credits: 3 3 hrs/week

Learning objectives: The student will be able to understand the basics and importance of Forensic Biology and DNA Fingerprinting.

Learning Outcomes: After studying this course the students will know-

- The various techniques used for examination of biological evidences.
- Applications of entomology in death investigation
- Importance of Wildlife Forensics in Wildlife Protection and Conservation
- Forensic examination of bodily fluids of human body
- DNA fingerprinting technology in crime investigation.
- Laws related to DNA technology in India and other countries.

Unit I: Cell Biology and Human Physiology

The Cell Theory, Structure of Prokaryotic & Eukaryotic cells (Plant & Animal), Structural organization and functions of plasma membrane and cell wall. Cell-organelles and cytoskeletal elements (Microtubules, microfilaments and intermediate filaments); Biomolecules – Proteins (Amino acids, Enzymes), Nucleic acids, Carbohydrates, Lipids; Minerals & Vitamins.

Immunity: Definition, Types: Innate - physical & chemical barriers, Acquired, Active, Passive. Immunogens & Antigens - Definition, types of antigens, factors influencing antigenicity; Antibody - Definition, structures, types, properties and functions of immunoglobulin. Antigen - Antibody Reactions –Agglutination & Precipitation.

Human Physiology: Introduction to Nervous system, Respiratory system, Circulatory system, Endocrine system, Excretory system & Digestive system

Unit II: Biological Evidences

Biological Evidence – Nature, Importance and Identification of Blood, Semen, Vaginal fluids, Saliva, Urine, Feces, Sweat, Skin, Nails, Tissues, Tooth, Bones, Uterine fluids, Vomit, Vitreous humor, CSF, Colostrum.

Diatoms – Structure, Identification Tests & Importance. Hair – Structure & growth - Differences between human & animal hair. Fibre - Classification of fibres- Identification and comparison of fibres by Physical & Chemical methods - Forensic Significance.

Blood and its function, Composition of blood, Formation of Blood cells, Types of Blood cells and blood groups, (ABO systems & Rh factor).

Unit III: Forensic Entomology

Forensic Entomology - Introduction, History, Advances in Forensic Entomology, Forensic Importance of Insects, Arthropod Biology and Entomology, Crime Scene Investigation, Collection of evidence at the Crime Scene, Estimating the time since death, The use of insects in death investigations, Expert Witness, Report Writing.

Unit IV: Genetics

Basics of Genetics - Mendelian principles, Sex determination and Sex-linked Inheritance Prokaryotic & Eukaryotic Genetic material: Discovery, Experiments, Composition and Structure of DNA & RNA, Organization of DNA in Chromosomes, DNA replication, Genetic code, Proteins synthesis, Introduction to recombinant DNA technology - its Forensic applications.
DNA isolation, Extraction methods – Phenol Chloroform, Chelation, Differential & Silica based. DNA Quantification – Slot blot Assay, FID Assay & PCR Amplification.

Unit V: DNA Fingerprinting

DNA Separation techniques – Supporting matrices, Gel & Capillary Electrophoresis. Advances in DNA testing: VNTR, STR, STR multiplex, STR Polymorphism, SNPs, mtDNA, Y - chromosome analysis; DNA profiling and applications. Rapid DNA Testing. DNA Database & Databank – CODIS. Human Genome Project. Admissibility of DNA evidence in court of law. The DNA Legislation-India, USA, UK. The DNA Profiling Regulation bill. Application of DNA Fingerprinting in Wildlife Forensics.

Suggested Readings:

1. Forensic Biology – Richard Li
2. Forensic DNA collection at Death Scenes - Rhonda Williams & RogerKahn
3. Forensic DNA Analysis: Current Practices and Emerging Technologies – Jaiprakash G. Shewale.
4. Forensic DNA Evidence Interpretation - Jhon S. Buckley on, Jo-Anne Bright, Duncan Taylor.
5. Forensic Biology - Dr. (Mrs) Rukmani Krishnamurthy, Sharikant H.Lade, Dr. Trupti Khedkar
6. Encyclopedia of Forensic Science Vol I, II & III, - Siegel.J.A , Sukoo.R.J and Knufer
7. Forensic Science in Criminal Investigation in trials – B.R.Sharma
8. Interdisciplinary Approach to Forensic science – Dr. Praveen Kumar Janjua, Dr. G.Sunil Babu , Dr.Navjot Kaur Kanmai
9. Forensic Science in Criminal Investigation – Dr. (Mrs) Rukmani Krishnamurthy
10. Criminalistics – An Introduction to Forensic science 5th edition –Saferstein
11. Statistical Methods in Human Population Genetics, ISI,1988 – Malhotra.K.C
12. An Introduction to Software tools for Biological Applications -Jambeck, P &Gibas.C
13. Bioinformatics Basics: Applications in Biological Sciences and Medicine - Rashidi, HH &Bueler.

Suggested Co-Curricular Activities:

- Seminars on wild life forensics
- Preparation of Model DNA
- Assignments on cell structure & cell organelles

SEMESTER-IV

COURSE 3: FORENSIC BIOLOGY AND DNA FINGERPRINTING

Practical Credits: 3 3 hrs/week

List of Experiments:

1. Serological Test – ABO Blood grouping
2. Identification tests for bodily fluids.
3. Antigen - Antibody reactions – Agglutination and Precipitation
4. Identification of Diatoms
5. Identification of Pollen grains
6. Morphological Examination of Human Hair, Animal hair & Fiber
7. Isolation & Extraction of DNA from Blood
8. Gel electrophoresis of DNA
9. Gel electrophoresis of Protein.
10. Identification of Diatoms

SEMESTER-IV

COURSE 4: FORENSIC CHEMISTRY

Theory Credits: 3 3 hrs/week

Learning objectives: The student will be able to understand the basics and importance of Forensic Chemistry.

Learning Outcomes: After studying this course the students will know-

- The roles of chemistry and Ballistics in Forensic Science.
- The classification and characteristics of NDPS.
- The analysis of drugs and its importance in detecting the culprit.
- The introduction to explosives and petroleum products.

Unit I: Basics of Forensic Chemistry

Forensic Chemistry: Introduction & Significance, Qualitative analysis of precious metals –Gold, Silver & Platinum, Agrochemicals, Industrial chemicals. Chemical Etching techniques. Bribe Trapping by Phenolphthalein.
Chemistry of fire – Fire triangle. Definition of Arson & Incendiary Fire. Motive of Arson – Indicators of arsons in SoC. Collection for Evidence. Chemical analysis of Arson residues & Charred debris. Relevant IPC sections – 285,435, 436 & IEA 113B.

Unit II: Beverages

Beverages: Classification & Composition of Alcoholic & Non-Alcoholic beverages. Collection of samples for identification of alcohols – Blood, Urine, Vitreous fluid, Brain, Liver etc. Tests and Evaluation - Blood alcohol content (BAC), Urine Alcohol Content (UAC), Breath Analysis. Clinical Features, Diagnosis and Treatment for Chronic and Acute effects of Alcohol. Relevance of Central Excise Act -1944 on Beverages. Motor Vehicles Act - 1988 (Penalties for Drunk n Drive).

UNIT III: Explosives

Explosives - Definition of Explosives, Definition as per Indian Explosive Acts. History of Explosives, Chemistry of explosives, Deflagration and Detonation phenomenon (Redox Chemistry, Kinetics -Molecular Theory of gases & Gas Laws), Characteristics of high and low explosives, Dust explosion, Gas/vapour explosion, Effect of blast wave on structures & human and Pyrotechnics.
Analysis of Explosive: Pre-blast and Post blast residue collection, Systematic examination of explosives
and explosion residues in the laboratory using chemical and instrumental techniques and interpretation of results.

Unit IV: Improvised Explosive Devices and Bomb Scene Investigation

Improvised Explosive Devices - Definition of IED, Components of IED, Explosives Initiation (Explosive Trains); Types (Molotov cocktail, Letter bomb, Pipe bomb, VBIED and CBRN), Detection of Hidden Explosives.
Bomb Scene Investigation - Specific approach to scene of bombing, Investigation of

bombing scene, Reconstruction of sequence of events, Evaluation and assessment of scene of explosion.

UNIT V: Petroleum and Petroleum Products

Distillation and fractionation of petroleum. Commercial uses of different petroleum fractions. Analysis of petroleum products. Analysis of traces of petroleum products in forensic exhibits. Comparison of petroleum products. Adulteration of petroleum products.

Suggested Readings:

1. Analytical chemistry: An Introduction – Skoog, D.A.West.D.M,Holler
2. Fuels and Combustion – Sarkar – Orient longmann1990
3. Modern Techniques of Bomb Detection and Disposal & Security– Narayanan,T.V.
4. The Analysis of Explosives, - Yinon, J. and Zitrin –Oxford
5. Kirks Fire Investigation – Dettean, J.D – Prentice Hall2002
6. Bureau of Indian standards: Specifications and Methods of Analysis for Alcoholic Beverages
7. Bureau of Indian standards: Specifications and Methods of Analysis for Petroleum Products
8. Explosive act with Amendments
9. Explosive Substances act with Amendments
10. Working Procedure Manual: Chemistry, Explosives & Narcotics, BPRd2000
11. Forensic Science in Criminal Investigation in trials – B.R.Sharma
12. Forensic Biology - Dr. (Mrs) Rukmani Krishnamurthy, SharikantH.Lade, Dr. Trupti Khedkar
13. Interdisciplinary Approach to Forensic science – Dr. Praveen Kumar Janjua, Dr. G.SunilBabu , Dr.Navjot KaurKanmai
14. Encyclopedia of Forensic Science Vol I, II & III, - Siegel.J.A , Sukoo.R.J andKnufer
15. Forensic Science in Criminal Investigation – Dr. (Mrs) Rukmani Krishnamurthy
16. Criminalistics – An Introduction to Forensic science 5th edition –Saferstein
17. Analytical chemistry: An Introduction – Skoog, D.A.West.D.M,Holle

Suggested Co-Curricular Activities:

- Seminars on explosives
- Assignments on screening of drugs
- Quiz on various ‘NDPS Act’.
- Examination of various petroleum products.
- Visit to Forensic Chemistry Lab.

SEMESTER-IV

COURSE 4: FORENSIC CHEMISTRY

Practical Credits: 1 2 hrs/week

List of Experiments:

1. Analysis of alcohol as per BIS specifications
2. Detection of Methanol, Chloral Hydrate, Diazepam & Alprazolam in Alcoholic Liquors
3. Density/ Specific gravity Determination of petroleum products by Hydrometer
4. Filter Course test for detecting adulteration of petrol
5. Phenolphthalein test for Bribe Trap cases
6. Preliminary examination of Explosives (tests for nitrite, nitrate, thiocynate, chlorate, Thiosulphate, Perchlorate, Sulphite, Phosphate etc.)
7. To prepare a case report on a case involving arson.
8. To prepare a case report on bomb scene management.
9. To carry out analysis of low explosive materials.
10. Analysis of Alcoholic and Non-alcoholic Beverages.

SEMESTER-V

COURSE 5: FORENSIC PHYSICS

Theory Credits: 3 3 hrs/week

Learning Objectives: The student will be able to understand the basics and importance of Forensic Physics

Learning Objectives: After studying this paper the students learn about

- Types of glass and their composition.
- Photographic examination of tool marks.
- Able to determine direction of force on a piece of glass
- Able to describe the common methods for the analysis of soil
- Different types of tools involved in criminal activity
- What other types of polymer-based evidences are analyzed?
- How paint evidence is encountered, collected and preserved

Unit I: Soil, Cement and Concrete

Types and composition of soil, sample preparation, molecular particle size distribution, turbidity test, pH measurements, microscopic examination, density gradient analysis, ignition-loss test, elemental analysis, interpretation of soil evidence. Cement bromoform test, fineness test, ignition-loss test. Identification of adulterated cement. Mortar and concrete analysis.

Unit II: Paint

Types of paint and their composition, macroscopic and microscopic analysis of paint pigments, pigment distribution, micro-chemical analysis- solubility test, pyrolysis gas chromatography, IR spectroscopy and X-ray diffraction, elemental analysis, interpretation of paint evidence.

Unit III: Fiber

Types of fiber, forensic aspects of fiber examination- fluorescence, optical properties, refractive index, birefringence, dye analysis. IR-micro spectroscopy, Py-MS. Difference between natural and man-made fibers.

Unit IV: **Glass**

Types of glass and their composition-soda-lime, boro-silicate, safety glass, laminated, light sensitive, tampered/ toughened, wire glass, coloured glass. Forensic examinations of glass fractures- rib marks, hackle marks, cone fracture, wavy, backward fragmentation, concentric and radial fractures. Refractive index, density gradient, becke-line, specific gravity examination.

Unit V: Toolmarks

Types of toolmarks- compression marks, striated marks, combination of compression and striated marks, repeated marks, class characteristics and individual characteristics, tracing and lifting of marks. Restoration of erased/ obliterated marks- Method of making-cast,

punch, engrave, method of restoration- etching (etchings for different metals), magnetic, electrolytic etc.

Suggested Readings:

1. Physical Evidence in Criminal Investigation and Trials Dr B P Maithil
2. Forensic Evidence Real Cash Study Dr H K Pratihari
3. Introduction to Forensic Science in Crime Investigation Dr Rukmani Krishnamurty
4. Caddy, B; Forensic Examination of Glass and Paint Analysis and Interpretation, CRCPress, New York, 2001.
5. Shaw, D; Physics in the Prevention and Detection of Crime, Contem Phys. Vol.17,1976.
6. Saferstein, R; Forensic Science Handbook. Vol. I,II, (Ed.), Prentice Hall, New Jersey, 1988.
7. Working Procedure Manual; Physics BPR&D Publication, 2000.
8. Sharma, B.R; Forensic Science in Criminal Investigation and Trials (3rd Ed.), UniversalLaw Publishing Co., New Delhi, 2001.
9. Working Procedure Manual- Physics, BPR&D Publication. 2000
10. Hess, K.P; Textile Fibers and their Use, 6th Edn, Oxford and IBH Publishing Co., 1974.
11. Trace Evidence By Max M. Houck.
12. Laboratory Procedural manual, Physics Section, DFSL, Mumbai.
13. Forensic science in criminal investigation and trail by B R Sharma
14. Forensic Science in Criminal Investigation & Court Evidence V N Sehgal

SEMESTER-V

COURSE 5: FORENSIC PHYSICS

Practical | Credits: 1 | 2 hrs/week

List of Experiments:

1. Microscopic examination of soil.
2. Particle size distribution of soil sample.
3. Density gradient method for soil.
4. Density gradient method for glass.
5. Microscopic examination of Paint.
6. Examination of glass fracture.
7. Determination of sequence of strokes on glass.
8. Examination and matching of paint chips.
9. Examination and Comparison of tool marks.
10. Restoration of erased/obliterated punch marks.

Suggested co-curricular activities:

- Visit to Glass Industry
- Visit to Fiber Industry
- Visit to Paint Industry
- Visit to Vehicle Manufacturing Industry

SEMESTER-V

COURSE 6: INSTRUMENTATION

Theory Credits: 3 3 hrs/week

Learning Objectives: The student will be able to understand the basics and importance of instrumentation.

Learning Outcomes:

- The students will be able to understand about the principle and working of optical and electronic microscopes used for characterization of micro evidences.
- Students will be able to gain knowledge about the concept of different chromatographic techniques which are used to separate chemical compounds.
- Students will be aware about the basics of spectroscopy, sources of radiation, their utility and limitations.
- Student will able to recognize the best suited techniques to be employed for examination of evidence.

Unit I: Microscopy

Microscopy**:** Principles and techniques: Light Microscope, Phase contrast, Fluorescence, stereomicroscope, polarizing, comparison and Electron Microscope (Scanning, Transmission), Forensic applications.

Unit II: Chromatography

Chromatography: Basic principles. Thin Layer Chromatography - Theory and Instrumentation, HPLC - Principle and Instrumentation application, HPTLC, densitometer, applications.
Gas chromatography: Principle and Instrumentation, types of GC (GLC, and GSC) and column types, Detectors for GC -TCD, FID, ECD, NPD etc., Pyrolysis GC, GC-MS; applications.

Unit III: Spectroscopy I

Spectroscopy: Spectrum of EMR, Interaction of EMR with matter, Source of radiations wavelength selector, Optical detector UV-Visible, IR and Raman spectroscopy Principle of single and double beam spectrophotometer, Instrumentation of IR, UV, spectroscopy qualitative and quantitative analysis of spectroscopy and their Forensic applications.

Unit IV: Spectroscopy II

Mass Spectroscopy: Principle, instrumentation, ion sources, types mass analyser-quadrupole time of flight, double focusing, tandem mass spectroscopy, detectors for mass spectroscopy their applications. NMR Spectroscopy, Neutron Activation Analysis: Principle, techniques and Forensic application. X-rays spectroscopy: Principles of X ray diffraction and X ray florescence technique, their forensic applications.

Unit V: Centrifugation and Electrophoresis

Basic fundamentals of molecular separation methodologies and parts of centrifuge – Bench top centrifugation, micro centrifugation, Low speed centrifugation, Ultra centrifugation, Gas centrifugation.
Fundamentals of electrophoresis – Agarose gel electrophoresis, Poly acrylamide Gel electrophoresis.

Suggested Readings:

1. Instrumental Methods Forensic Science Analysis 2022 Dr A K Jaiswal
2. Forensic Science UGC Net / JRF MCQ's Dr Anusinghla
3. Past 10 Years Question Bank with Answers UGC Net / JRF Khushal Singh
4. Question Answers Criminology & Forensic Science UGC Net/ JRF V N Sehgal
5. Forensic Science UGC Net / JRF MCQ s Anil Kumar Sigh
6. Barbara Wheeler and Lori J. Wilson. Practical Forensic Microscopy: A Laboratory Manual,Wiley
7. Lee and Caensstem. Advances in Forensic Science, Vol. 2. Instrumental Analysis.
8. B. K. Sharma. Instrumental Methods of Chemical Analysis, Goel Publishing House, 26thEdition (2007).
9. D. A. Skoog, D. M. West, F. James Holler and S. R. Crouch, Fundamentals of Analytical Chemistry, 8th Edition, Thomson, 2004.
10. G.Chatwal and S. Anand, Instrumental Methods of Chemical Analysis, 7 Edition Himalaya Publishing House.
11. Hobart H. Willard, Instrumental Methods of Analysis (Chemistry) Wadsworth Publishing Company.

SEMESTER-V

COURSE 6: INSTRUMENTATION

Practical | Credits: 1 | 2 hrs/week

List of Experiments:

1. To determine the concentration of a coloured compound by calorimetry analysis.
2. To carry out thin layer chromatography of ink samples.
3. To carry out separation of organic compounds by paper chromatography.
4. To identify drug samples using UV-Visible spectroscopy.
5. To perform Agarose Gel Electrophoresis by using any forensic sample
6. To Separate the Molecules by using Ultra centrifugation
7. To identify the unknown petroleum product by GC-MS.
8. To separate the unknown compound by HP-TLC.
9. To determine the chlorophyll by using UV-Visible spectroscopy.
10. To determine the caffeine and benzoic acid in soft drinks by using FT-IR.

Suggested Co-Curricular Activities:

1. Visit to IICT, NIN, CDFD, CCMB
2. Visit to Forensic Science Lab.