TEACHING SCHEME

CODE	COURSE NAME	TEACHING HRS/WEEK	CREDITS				CREDIT/ SEM
	SEMESTER I		T	P	Pr	PER	
CUFS1080	Introduction to Forensics, Psychology, Law and Statistics	5	3	0	1	4	24
CUFS1081	Instrumental Techniques	5	3	1	0	4	
CUFS1082	Crime Scene Management and Forensic Evidence	5	3	1	0	4	
CUFS1083	Fingerprints and Questioned Documents	5	3	1	0	4	
CUFS1084	Forensic Biology and Anthropology	5	3	1	0	4	
--	Skill for Success I	4	0	2	2	4	
	SEMESTER II						
CUFS1085	Quality Management, Narcotic Drugs, Explosives and Forensic Chemistry	5	3	1	0	4	22
CUFS1086	Forensic Serology and DNA Profiling	5	3	1	0	4	
CUFS1087	Forensic Medicine and Toxicology	5	3	1	0	4	
CUFS1088	Forensic Ballistics	5	3	1	0	4	
	Elective I	5	3	0	1	4	
CUFS1089/ CUFS1090	Summer Internship / Minor Project	4	0	0	2	2	
	SEMESTER III						
	Specialization Paper I	5	3	1	0	4	24
	Specialization Paper II	5	4	0	0	4	
	Specialization Paper III	5	3	1	0	4	
	Elective II	5	3	1	0	4	
CUFS1110	Research Methodology	5	3	0	1	4	
	Skill for Success II	4	0	2	2	4	
	SEMESTER IV						
CUFS1113	Capstone Project and Thesis	32	0	0	16	16	20
CUFS1111/ CUFS1112	MOOC Courses/ Internship	8	0	0	4	4	
							90

T: Theory; P: Practice; Pj: Project [1 Credit= 1 hr Theory; 1 credit= 2 Hours Practice/ Project]

BASKET

BASKET 1: DISCIPLINE-SPECIFIC CORE COURSES

SI. No.	COURSE CODE	NAME OF THE CORE COURSES	CREDITS	TEACHING HRS / WEEK
1	CUFS1080	Introduction to Forensics, Psychology, Law and Statistics	3+0+1	5
2	CUFS1081	Instrumental Techniques	3+1+0	5
3	CUFS1082	Crime Scene Management and Forensic Evidences	3+1+0	5
4	CUFS1083	Fingerprints and Questioned Documents	3+1+0	5
5	CUFS1084	Forensic Biology and Anthropology	3+1+0	5
6	CUFS1085	Quality Management, Narcotic Drugs, Explosives and Forensic Chemistry	3+1+0	5
7	CUFS1086	Forensic Serology and DNA Profiling	3+1+0	5
8	CUFS1087	Forensic Medicine and Toxicology	3+1+0	5
9	CUFS1088	Forensic Ballistics	3+1+0	5
Specialization : Forensic Chemistry and Toxicology				
10	CUFS1091	Forensic pharmacology and Pharmaceutical drug analysis	3+1+0	5
11	CUFS1092	Advanced Forensic Toxicology	3+1+0	5
12	CUFS1093	Modern and Applied Analytical Forensic Chemistry	3+1+0	5
Specialization : Forensic Biology and Biotechnology				
13	CUFS1094	Forensic Genomics and Biocomputing	3+1+0	5
14	CUFS1095	Molecular Biology and r-DNA Technology	3+1+0	5
15	CUFS1096	Immunological techniques and Forensic Proteomics	3+1+0	5
Specialization : Forensic Physics and Ballistics				
16	CUFS1097	Advance in Physical Techniques	3+1+0	5
17	CUFS1098	Advances in Forensic Ballistics & Armour Materials	3+1+0	5
18	CUFS1099	Audio Recognition and Video Analysis	3+1+0	5
Specialization : Fingerprints and Questioned Documents				
19	CUFS1100	Modern Trends in Fingerprint Sciences	3+1+0	5
20	CUFS1101	Questioned Documents and Forensic Accounting	3+1+0	5

21	CUFS1102	Forensic Photography & Biometrics	3+1+0	5
Specialization : Cyber Forensic				
23	CUFS1103	Cyber Law, Risk and Compliance	3+1+0	5
24	CUFS1104	Incident Response and Digital Forensics	3+1+0	5
Specialization : Crime Scene Management				
26	CUFS1106	Basics of Crime, Evidence and Law	3+1+0	5
27	CUFS1107	Concepts of Crime Scene Management	3+1+0	5
28	CUFS1108	Advance techniques in Crime Scene Management	3+1+0	5

BASKET 2: DISCIPLINE-SPECIFIC ELECTIVE COURSES

SI. No.	COURSE CODE	NAME OF THE ELECTIVE COURSES	CREDITS	TEACHING HRS / WEEK
1	CUFS1114	Forensic Engineering	3+0+1	5
2	CUFS1115	Scientific Protocols of Fire Investigation	3+0+1	5
3	CUFS1116	CCTV Forensics	3+0+1	5
4	CUFS1117	Anti-Dope Forensics	3+0+1	5
5	CUFS1118	Nano-Biotechnology	3+0+1	5
6	CUFS1119	Cryptography & Steganography	3+0+1	5
7	CUFS1120	Disaster Victim Management	3+0+1	5
8	CUFS1121	Machine Learning for Data Science	3+0+1	5
9	CUFS1122	Forensic Journalism	3+0+1	5

BASKET 3: MINOR PROJECT AND INTERNSHIP

SI. No	COURSE CODE	NAME OF THE COURSES	CREDITS	TEACHING HOURS / WEEK
1	CUFA1089	Summer Internship	0+0+2	4
2	CUTM1090	Minor Project	0+0+2	4
3	CUFS1111	Internship	0+0+4	8
4	CUFS1112	MOOC Course	4+0+0	8

BASKET 4: RESEARCH

SI. No	COURSE CODE	NAME OF THE COURSES	CREDITS	TEACHING HOURS / WEEK
1	CUFS1110	Research Methodology	3+0+1	5
2	CUFS1113	Capstone Project and Thesis	0+0+16	32

BASKET 5: SKILL FOR SUCCESS (PREFERRED FROM CUTM BASKET OF 120+ COURSES)

BASKET 1:

DISCIPLINE-SPECIFIC CORE COURSES

CUTM1080: INTRODUCTION TO FORENSIC SCIENCE, PSYCHOLOGY, LAW AND STATISTICS

Credits: 04 (3+0+1)

Course Description: This interdisciplinary course provides postgraduate students with a foundational understanding of forensic science, psychology, law, and statistics. It covers crime scene investigation, evidence analysis, the psychological aspects of criminal behavior, and the legal standards for forensic practices. Students will also learn statistical tools for evidence interpretation, equipping them to apply multidisciplinary approaches in forensic investigations and contribute effectively to the justice system.

Course Objectives

1. To help students learn basic principles of Forensic science
2. To help students learn basic laws pertaining to the Criminal Justice System.
3. To study the basic concept of report writing and study the concepts of Psychology.

Course Outcomes: On successful completion of this course, the students should be able to,

1. Understand the Foundations of Forensic Science
2. Develop Proficiency in crime scene photography and laboratory photography
3. Analyze Legal and Procedural Aspects in Forensic Science
4. Apply Investigative Techniques like Polygraph, narco analysis, Brain Mapping and behavioral Analysis
5. Acquire research skills, including an understanding of forensic statistics.

UNIT – I

Forensic science Definition and Scope of Forensic Science, History and development of Forensic science, Need and Principle**,** Police and, Forensic science laboratories /

institutions in India, Organizational Structure of a Forensic Science Laboratory/Institution, Services provided by other institutions, Functions and responsibility of Forensic scientist Ethics in forensic science

Forensic Photography: Definition of photography, Cameras and its working, types of camera lenses, crime scene and laboratory photography, UV and IR photography, Photomicrography and macro photography. Digital photography, digital imaging, photogrammetry, basic concepts of videography/high speed videography.

UNIT – II

Law: *Sections of Bharatiya Sakshya Adhiniyam*: 26, 39(1) & 39 (2), 40, 41(1)& 41(2), 52, 53, 55, 72, 140, 141, 142, 162, Sections of Bharatiya Nagarik Suraksha Sanhita:51, 52, 53,105,176 (3), 185, 326, 328, 329, 349

Sections of Bhartiya Nyaya Sanhita: Offences against person: 63, 80, 100, 101, 103(1), 103 (2), 108, 114, 116, 118(2), 126(1), 127(1), 131, 137(1) (a) (b),138

Offences against property: section 62, 303, 308, 309, 316, 318, 329, 336, 340, 356, 351. Indian constitution article 20, 21

Unit - III

Criminal Justice System: Structure of Police, Police and Forensic Scientist relationship with reference to Crime Investigation, Modus Operandi and its role in Crime Record, maintenance of crime records, Prosecution and Judicial Organizations. Courts in India, Jurisdiction of courts in criminal cases and FIR.

Report writing and evidence evaluation: Components of reports and report format in respect of crime scene and laboratory findings.

Court testimony: Admissibility of expert testimony, pre court preparation and court appearance, examination in chief, cross-examination and re- examination.

UNIT - IV

Crime: Definition, types of crimes, causes of crime, Theories and prevention of crime, characteristics of criminals.

Psychology and investigative techniques: Polygraph (Lie-detection), Narco analysis, Brain mapping, Forensic psychiatry – human behavior and relationship between human behavior and legal proceeding in both civil and criminal cases

UNIT – V

Laboratory management System: Laboratory information management system, Chain of custody of samples covered by LAN system, Security system, validation and safety equipment.

Forensic statistics: Types of data, Basic concept of frequency distribution, measure of central values – Mean, median and mode, measure of dispersion, range, mean deviation and standard deviation, probability, theory and classical definition of probability, Bayes theorem of probability, conditional probability and coincidence probability, Chi-square test

Reference Books:

1. Saferstein: Criminalistics : An Introduction To Forensic Science, Prentice Hall Inc. USA
2. James, S.H. And Nordby, J. J.; Forensic Science; An Introduction To Scientific And Investigative Techniques, CRC Press USA
3. O' Hara & Osterberg: An Introduction to Criminalistics.
4. Lee, Henry; Advances in Forensic Science.
5. Sharma JD: Vidhivigyan Avem Vish Vigya.
6. Sharma JD: Apradh Ka Vaigyanik Anveshan.
7. Sharma BR: Forensic Science in Criminal Investigation And Trials.
8. Mordby, J Deed Reckoning – The Art Of Forensic Science Detection, CRC Press LLC, Boca Raton FL, CRC Press
9. Ram Ahuja: Criminology, Rewal Publ. Jabalpur
10. Bhartiya Nyaya Sanhita
11. Bharatiya Sakshya Adhiniyam.

CUTM1081 : INSTRUMENTAL TECHNIQUES

Credits: 04 (3+1+0)

Course Description: This course offers an in-depth exploration of the fundamental and advanced techniques used in modern instrumental analysis. Students will gain theoretical and practical knowledge of various analytical instruments and their applications in fields such as chemistry, biology, environmental science, and material science. Topics covered include spectroscopic methods (UV-Vis, IR, NMR, and mass spectrometry), chromatographic techniques (GC, HPLC), electrochemical methods, and microscopic techniques.

Course Objectives

1. To help students learn theory and basics of instrumentation.
2. To help students learn Spectroscopic and chromatographic techniques.
3. To study the concepts of microscopy and centrifugation Techniques.

Course Outcomes: On successful completion of this course, the students should be able to,

1. Describe the theory of electronic and molecular spectra
2. Dain knowledge about basic principles and instrumentation of UV, IR
3. Apply principles of chromatography to examination of evidence.
4. Gain knowledge about the concepts of microscopy and centrifugation Techniques.
5. Apply Instrumental techniques such as GC, HPLC, MS, Sem etc to the examination of samples of forensic significance.

UNIT - I

Basics of Instrumentation: Electromagnetic radiations and their properties General properties of electromagnetic radiations: Wave and Quantum mechanics Interaction of EMR with matter Photoelectric effect, De Broglie-Bohr Theory and derivation of

equation, Heisenberg uncertainty principle, Plank's Quantum theory Davisson and Germer Experiment, Electronic spectra and molecular structure.

UNIT - II

Spectroscopic Techniques: Absorption, Emission and Transmission Spectroscopy, Ultraviolet and visible spectroscopy: Instrumentation and Applications. Infrared Spectroscopy: Molecular vibration, Theory of IR absorption, IR Basics of Mass Spectroscopy

UNIT - III

Chromatography and Hyphenated Techniques: Introduction to Chromatography: Theory of separation techniques, Types of chromatography and their Forensic Applications, Thin layer chromatography, High Performance Liquid Chromatography, Gas Chromatography, GC- MS, GC-HS, LC-MS, LC-MS/MS

UNIT - IV

General Principles of Biological/Biochemical Analysis: pH and Buffers, Physiological solution**,** Centrifugation Techniques: Basic principle of centrifugation and sedimentation, various types of centrifuges, Density Gradient Centrifugation, Preparative Centrifugation, analysis of sub-cellular fractions, Ultra centrifuge-Refrigerated Centrifuges.

Unit-V

Basics of Microscopy and Electron Micropcope: Basic principles of microscopy, Simple and Compound microscope, Study of different types of microscopes: Comparison microscope, Phase contrast microscope, Stereoscopic microscope, Polarizing microscope, Fluorescence microscopy, IR microscopy, Scanning electron microscope (SEM).

List of Practicals

1. Measurement and adjustment of pH.
2. Preparation of buffers and standard solutions.
3. Separation of mixture using centrifugation.
4. Calibration of Micropipettes.
5. Morphological examination of samples and microstructures using microscope
6. To prepare TLC plate and identify natural dyes
7. To identify the compound UV-VIS spectrophotometer
8. Understand the concepts and working GC, GC-MS and HPLC
9. Microscopic examination of forensic evidences
10. Understand basic concepts of column chromatography and to separate mixture of samples

Reference Books:

1. D.A.Skoog, F.J.Holler and T.A.Neman, Harcourt Principles of Instrumental Analysis college publishers, Singapore
2. G.D.Christian and J.E.O'Reilly, Instrumental Analysis, Allyn and Bacon, Inc., Boston.
3. F.W.Fifield and D.Kealey, Principles and practice of Analytical Chemistry, International Textbook Company, London.
4. R.P.Bauman, Absorption Spectroscopy, John Wiely, New York.
5. M.Donhrow, Instrumental Methods in Analytical Chemistry; Their Principles and practice Vol.2, optical method, Pitaman, New York.
6. G.G.Guilbanlt, Practical Fluorenscence: Theory, Methods and Practice, Marcel Dekker, New York.
7. S.Udenfriend, Fluorescence Assay in Biology and Medicine, Academic Press, New York.
8. W.J.Price, Spectrochemical Analysis by Atomic Absorption, Hyden, London.
9. R.S.Alger, Electron Paramagnetic Resonance: Techniques and Applications,

Interscience, New York.

10. Analytical Chemistry by Open Learning, John Wiley & Sons, New York.
11. J.C.Giddings, Dynamics of Chromatography, Marcel Dekker, New York.
12. R.C.Grob, Modern Techniques of Gas Chromatography, Marcel Dekker, New York.
13. J.A.Dean, Chemical Separation Methods, Ban Nostrand Reinhold Co., New York.
14. R.E.Smith, Ion Chromatography Applications, C.R.C. Press, Inc., Boca Raton.
15. R.E.Smith, Supercritical Fluid Technology, C.R.C. Press, Inc., Boca Raton.
16. G.Zweig and J.R.Whitaker, Paper Chromatography and Electrophoresis, Academic Press, New York.
17. Safferstein: Forensic Science Handbook Vol. I, II, III.
18. Lee Henry: An Introduction to Forensic Science
19. Egon Stahl: Thin Layer Chromatography

CUTM1082 : CRIME SCENE MANAGEMENT AND FORENSIC EVIDENCES

Credits: 04 (3+1+0)

Course Description: This course provides a comprehensive introduction of crime scene investigation and the analysis of physical evidence. The course encompasses the overview of fundamentals of crime scene management, including securing the scene, documenting evidence, and processing the physical evidence. The course delves into various types of physical evidence, such as glass, paint, soil, fingerprints, and tool marks, and examines the techniques used to analyze and interpret these items. Additionally, information related to advanced technologies in crime scene investigation, including digital imaging, 3D scanning, and tele forensic techniques is encompassed in the course.

Course Objectives

1. To learn the significance of Crime scene and physical evidences
2. To learn the legal importance of Chain of custody
3. To learn the basic principles of crime scene management

Course Outcomes: On successful completion of this course, the students should be able to,

1. Understand the protocols and procedures involved in managing various types of crime scenes, including documentation, evidence collection, and preservation.
2. Analyze different types of evidence and apply appropriate collection methods while maintaining their integrity .
3. Gain skills for characterizing different type of tool marks analysis
4. Understand the significance of different trace material such as fibers gems
5. Acquire skills , understanding of analysis of different types of physical evidence found under different conditions.

UNIT – I

Crime scene management: Introduction to the crime scene, Types of crime scene, Evaluation and processing of crime scene, Securing the scene of crime, Documenting the crime scene (Note making, Sketching, Photography ,videography of crime scene), role of the first arriving officer at the crime scene.

Searching techniques of Crime scene, Processing of physical evidence-discovering, recognizing and examination of physical evidence. Collection, Safety measures for evidence collection. Preservation, Packaging, sealing, labeling and forwarding of physical evidence, Maintaining the chain of custody, Probative value of physical evidence, Reconstruction of scene of crime. Introduction to physical evidence, Types of physical Classification and Role of physical evidence in Criminal Investigations & Trails.

Advances in crime scene management:

- Tele forensic Technology for crime scene investigation
- Information, Manpower, and logistics management of crime scene
- Mobile kits and equipment's, their utility on crime scene
- Digital Imaging of Crime Scene, 3-D scanning technique
- Case studies & report writing of crime scene visits
- National and International scenario of crime scene management

UNIT - II

Glass: Introduction to glass, Types of glass and their compositions, Forensic examination of glass fractures under different conditions, determination of direction of impact: hackle marks, backward fragmentation, Physical measurements of glass, color and fluorescence, physical matching, density comparison, physical measurements, refractive index by refractometer, elemental analysis, and interpretation of glass evidence, Case Studies.

Paints: Introduction, Composition, Manufacture of Paint, types of paint, Forensic Examination of Paints and Coatings: Collection and Preservation of paint samples,

macroscopic and microscopic techniques for the characterization of Paint Fragments, Physical , Chemical & Instrumental analysis of paint, , interpretation of Paint Evidence, Case Studies

Soil: Soil and its composition, Classification of soil, Collection and preservation of soil as a evidence, analysis of soil samples: Physical, chemical and instrumental, interpretation of soil evidence, Case Studies

UNIT - III

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

Ear Prints: Introduction to the history of ear prints, Morphology of the ear, Procedure of taking standards from the suspects, Identification and comparison of ear prints

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

Bite marks: Objectives and forensic importance of bitemark examination, the typical bitemarks morphology, types of bite marks, Evidence collection from victims and suspects, Photography, lifting, preservation of bite marks, casting of bitemarks, Identification and comparison of bite marks, Case Studies.

UNIT - IV

Tyre Impressions: Introduction to tire impressions, Collection and Preservation of the tire impression evidence, Forensic Significance of skid marks, Forensic Examination for identification and comparison, Case Studies.

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

Restoration of erased/obliterated marks: Principle of restoration of erased marks, Techniques involved for alteration of individual markings, Restoration of erased and

obliterated marks on various surfaces, Photography and Forensic assessment of methods for restoration of obliterated marks, case studies

UNIT - V

Fiber analysis: Forensic significance, Classification, Textile Fibers, Yarns, Fabric construction, Fabric characteristics, Microscopy characteristic, Birefringence, Fluorescence Microscopy, Colors in textile, Color Assessment, Chemical properties, Physical, chemical and instrumental methods of examination of string/ropes, wires/cables, seals, counterfeit coins, physical matches of broken objects.

Gemology: Examination of Gems, Diamonds and Precious and Semi-Precious Stones to Identify their Authenticity and Quality, Physical Methods, Optical Methods, Fluorescence Techniques, Spectroscopic Techniques, X-Ray Diffraction Studies.

List of Practicals

1. Density gradient analysis of soil and glass samples.
2. Restoration of erased identification marks.
3. Physical matching of Cloth piece and/or rope piece and /or garments or broken pieces of different objects.
4. Physical and microscopic studies of affected electric wires, panel boards due to electrical overload and short-circuit.
5. Physical examination of paint samples by microscopic method
6. Comparison of tool marks.
7. Sketching and photography of crime scenes.
8. Collection and packing of physical clues at the scene of crime.
9. Reconstruction and evaluation of scene of crime
10. Physical and microscopic studies of gems and fibers.

Reference Books:

1. C.E. O 'Hara al1d .J.W. Osterburg; An Introduction to Criminalistics: Indiana

University Press, Blomington.

2. Dahiya M S, Crime scene management: a scientific approach; Shanti SarvarPrakashan
3. R. Saferstein; Forensic Science Handbook, Vols. I, II; (Ed); Prentice Hall, Eaglewood Cliffs,NJ;
4. F.W. Sears, M.W Zemansky, and H. D. Young; University Physics, Sixth Ed.,Narosa;
5. Dennis Shaw; Physics in the Prevention and Detection of Crime, Contem Phys. Vol7;
6. Philip Rose; Forensic Speaker Identification; Taylor and Francis Forensic Science Series, London
7. Bengold & Nelson Moryson- Speech and Audio signal processing; John Wiley & Sons, USA, Nickolls, L.C; Scientific Investigation of Crime, Butler West, London
8. Raymond C Murray & John C.F Tedrew; Forensic Geology; Prentice Hall, NewJersey
9. Working Procedure Manual: Physics BPR&DPublication
10. B. Caddy; Forensic Examination of glass and paints analysis and interpretation ISBN 0784 05749
11. Philip Rose; Forensic Speaker Identification; Taylor & Francis Forensic Science series,London
12. Bengold& Nelson Morgan; Speech and Audio Signal Processing; John Wiley and Sons,USA
13. Jenkins and White; Fundamentals of Optics; McGraw Hill; Fourth Ed, (I) James, S.H. And Nordby, J. J.; Forensic Science; An Introduction to Scientific And Investigative Techniques, CRC PressUSA
14. Ray D. Kent and Charles Read; Acoustic analysis of speech
15. Phil Rose & James R Robertson; Forensic speaker identification

CUTM1083 : FINGERPRINTS AND QUESTIONED DOCUMENTS

Credits: 04 (3+1+0)

Course description: This course provides an in-depth exploration of the forensic examination of questioned documents. Students will learn about the various techniques and methodologies used to analyze and authenticate handwritten, typed, or printed documents that are under investigation. Key topics include handwriting analysis, signature verification, ink and paper analysis, detection of alterations, forgeries, security features of currency notes , passport, VISA and counterfeiting. The course also covers the legal implications and procedures related to the presentation of document evidence in court. Practical lab sessions will allow students to apply theoretical knowledge to real-world scenarios, enhancing their skills in document examination.

Course Objectives

1. To help students learn about basic concepts of fingerprint science
2. To help students learn about basics of forensic document examination
3. To learn the basics of different fingerprint development techniques

Course Outcomes: On successful completion of this course, the students should be able to,

1. Establish proficiency in Fingerprint Science
2. Incorporate legal aspects in document examination & apply instrumental techniques in examination of various documents
3. Implement Fingerprint Classification Systems
4. Develop hands-on competence in examination of alterations, erasers, overwriting, obliteration and printed documents
5. Effectively communicate findings through documentation and reports of document examination.

UNIT – I

Introduction to Fingerprint science: Definition, History, development, Scope of Fingerprint science, Composition of sweat, Introduction to chanced prints: their search, development and collection procedure, Maintaining the fingerprint slips: rolled and plain prints. Identification of fingerprints: pattern analysis, ridge characteristics, comparison of fingerprints. Ridge tracing, Ridge counting, Photography of fingerprint exhibits

UNIT - II

Introduction to document examination: Definition, scope, nature and problems, care, handling and packaging of document evidence. Collection of writing standards: specimen and admitted. Forgeries and its types, Principles of handwriting examination, authorship identification, detection of alterations/tampering in documents, Photography of document exhibits.

UNIT - III

Fingerprint classification techniques: Single digit, 10-digit classification, Henry classification system, numerical value, symbol, primary classification, secondary classification, sub-secondary classification, final classification and key classification.

UNIT – IV

Document Examination: Physical matching of Documents, Examination of alterations, erasers, overwriting, addition and obliterations. Examination of secret writings and charred documents, Examination of typewriting, photocopies and computer printouts. Examination of counterfeit currency notes, passport, credit card, visa, seal and other mechanical impressions. Instrumental techniques used for document examinations.

UNIT –V

NCIC classification, AFIS classification. Introduction to FACTS and AFIS.

List of Practicals

1. Identification of Handwriting-general characteristics, fundamental divergences and individual characteristics.
2. Examination and Identification of Signature Forgeries
3. To study the natural variations in handwriting written in different circumstances.
4. Examination of additions, alterations, and obliterations in the documents.
5. Examination of mechanical and chemical use of erasers on the documents
6. Examination of indented handwriting.
7. Examination of sequence of intersecting strokes
8. To take plain and rolled fingerprints and to identify the patterns.
9. To perform ridge tracing and ridge counting.
10. To identify ridge characteristics.
11. To compare the fingerprints.
12. Develop latent fingerprints with powders, fuming and chemical methods.

Reference Books:

1. David R. Ashbaugh; Quantitative and Qualitative Friction Ridge Analysis, CRC Press
2. E. Roland Menzel; Fingerprint Detection, with Lasers, Second edition; Marcel, Dekker,Inc. USA.
3. James F. Cowger; Friction Ridge skin CRC PressLondon.
4. Mehta, M.K: Identification of Thumb Impression & Cross Examination of FingerPrints, N.M. Tripathi (P) Ltd,Bombay
5. Moenssens: FingerPrints Techniques, Chitton Book Co. Philadelphia, NewYork.
6. Chatterjee S.K., Speculation in Finger print identification, Jantralekha, Printing Works, Kolkata.
7. Cowger, James F: Friction ridge skin: Comparison and Identification of Fingerprints; CRCPress, Boca Raton, NewYork.

8. Cook Nancy: Classifying fingerprints -Innovative learning publication MentoPark
9. Cossidy, M. J. Footwear Identification, Royal Canadian Mounted Police, Ontario,Canada.
10. J A Seigel, P.J Saukoo and G C Knupfer; Encyclopedia of Forensic Sciences Vol. I, II andIII, Acad.Press
11. Hillison, S; Dental Anthropology, Cambridge Univ. Press,UK.
12. Albert S. Osborn; Questioned Documents, Second Ed.; Universal Law Publishing, Delhi
13. Koppenhaver, K. (2010). Forensic Document Examination: Principles and Practice (1st Ed.).
14. Hilton, O. (1993). Scientific examination of questioned documents (1st ed.). Boca Raton:CRC Press.
15. Harrison, W. (1958). Suspect documents.
16. Kelly, J., & Lindblom, B. (2006). Scientific examination of questioned documents. Boca Raton, FL: CRC/Taylor & Francis.
17. Ellen, D. (2006). Scientific examination of documents. Boca Raton, FL: Taylor & Francis.
18. Huber, R., & Headrick, A. (1999). Handwriting identification (1st ed.). Boca Raton: CRC Press.

CUTM1084 : FORENSIC BIOLOGY AND ANTHROPOLOGY

Credits: 04 (3+1+0)

Course Description: This course provides a comprehensive introduction to forensic biology, focusing on the examination and analysis of biological evidence. Details enumerating different domains of forensic biology, including hair analysis, diatom examination, forensic palynology, and forensic entomology has been outlined. The course delves into the principles of genetics and their application in forensic investigations, covering topics such as Mendelian inheritance, pedigree analysis, and DNA analysis. Additionally, wildlife forensics, forensic anthropology, and forensic odontology, including the techniques used to identify individuals from skeletal remains and dental records are also shed light on in the respective course.

Course Objectives:

1. To learn the protocol for collection of biological evidences.
2. To learn the classical principles of genetics.
3. To learn the core concepts of anthropology and anthropometry.

Course Outcomes: On successful completion of this course, the students should be able to,

1. Understand the significance of different biological evidences and the method for their collection and preservation
2. Solve genetic problems using principles of Mendelian inheritance and demonstrate karyotyping techniques.
3. Analyze cases involving wildlife forensics and determine the methods used to identify species and assess the impact of poaching.
4. Interpret the significance of entomological evidences in estimating time since death.
5. Assess the role of forensic anthropological and odontological techniques used in individual identification.

UNIT – I

Fundamentals of Forensic Biology and Biological Evidences: Scope of forensic biology**,** Different domains of forensic biology, Types of biological evidence**,** Importance of biological evidence in forensic investigation**,** Procedure for Collection, Preservation, Packing, Sealing and Forwarding of biological samples.

UNIT - II

Hair examination: Morphological, anatomical and Microscopic examination of hair. Characteristics of hair to determine the species origin, race and sex.

Diatoms Examination : Introduction to Diatoms, Types and Structure of Diatoms, Importance and examination of Diatoms in Forensic Science.

Forensic Palynology : Introduction to Forensic Palynology, Examination of Pollen grains and Spores.

Forensic Entomology : Basic elements of Entomology, Importance of insects in forensic investigations, life cycles of insects to determine time since death, Applications of Forensic Entomology.

UNIT - III

Introduction to Classical genetics: Organization of genome, Structure and Functions of Nucleic acids; Griffith's experiments, Introduction to Mendelian inheritance and its extensions, Pedigree analysis, Sex-linked inheritance, Linkage and crossing-over, Cytoplasmic inheritance and maternal effects, Cytogenetics; karyotyping, chromosomal abnormalities.

UNIT - IV

Wildlife Forensics : Definition and advances in wildlife forensics; Threats to the natural resources and wild species inhabiting globally; Importance of Wildlife Conservation; Classification of Species as per IUCN Red Data Book; CITES; Wildlife (Protection) Act, 1972 of India; Different Methods of Poaching; Conventional methods

of species identification; Morphological identification and examination of wildlife products; Application of DNA technologies used in Wildlife Forensics.

UNIT - V

Forensic Anthropology : Introduction to forensic anthropology, Forensic Anthropometry, Osteometry, Identification of individuals (living), Identity of missing person by superimposition techniques, Facial reconstruction method, Advanced Imaging Techniques and Musculo-Skeletal Reconstruction, Portrait parley.

Forensic Odontology- Human Dentition; Structure and types of Teeth; Definition and dental formula; Identification of individuals from teeth; Ages of eruption and other individual characteristics; Determination of age, sex and race from teeth - Role of teeth in mass disaster– Forensic significance in individual identification.

Disaster Victim Identification : Examination and identification of dead bodies in mass disasters; mutilated bodies; fragmentary skeletal remains and bones; Determination of age, sex, race and species origin from bones and assessment of stature; Identification of burnt bones, skeletal remains in accidents, crimes and mass disaster.

List of Practicals

1. Protocol of handling different biological sample and maintaining their chain of custody
2. Studying the life cycle of Diptera on human carcasses.
3. Examination of Diatoms and Pollen grains
4. Examination of hair characteristics for identification of species.
5. Examination of skeletal remains- Long bones- Femur, Humerus,
6. Identification of individuals by long bones and stature estimation
7. Determination of sex and age from Skull with mandible
8. Determination of sex from pelvis and sacrum.
9. Identification of individuals by dental examination
10. Anthropometry.- Identification of individuals (in living)

Reference Books:

1. Criminalistics: An Introduction to Forensic Science (2014) Saferstein, Pearson Prentice Hall Inc. USA, ISBN-13: 978-0133458824
2. James, S.H. And Nordby, J. J.; Forensic Science; An Introduction to Scientific and Investigative Techniques, CRC Press USA
3. Laboratory Procedure Manual - Forensic Biology (2005), Directorate of Forensic Science, MHA, New Delhi
4. Forensic DNA Typing, Second Edition: Biology, Technology, and Genetics of STR Markers 2nd Edition (2005) - John M. Butler, Academic Press, ISBN:0121479528
5. Forensic Science: An Introduction to Scientific and Investigative Techniques – Stuart H. James, Jon J. Nord by, CRC Press, ISBN:084932

CUTM1085: QUALITY MANAGEMENT, NARCOTIC DRUGS, EXPLOSIVES & FORENSIC CHEMISTRY

Credits: 04 (3+1+0)

Course Description: This course provides a comprehensive overview of quality management principles in forensic laboratories alongside in-depth knowledge of narcotic drugs, explosives, and forensic chemistry. It covers analytical techniques for detecting and identifying controlled substances and explosives, while also emphasizing the importance of quality control, accreditation standards, and laboratory best practices. Students will gain practical insights into the chemical analysis of forensic evidence and develop expertise in managing complex forensic investigations

Course Objectives:

1. To help students learn the basics of forensic chemistry and quality management
2. To study and understand Narcotics and psychotropic substances.
3. To learn about explosives, arson and petroleum products.

Course Outcomes: On successful completion of this course, the students should be able to,

1. Learn about the basics of forensic chemistry and quality management.
2. Acquire skills to perform presumptive and screening tests for narcotic drugs and psychotropic substances.
3. Understand the use of chemicals in bribe trap cases, alcoholic beverages, petroleum products and the forensic analysis techniques employed in identifying substances.
4. Understand the classification and chemistry of explosives, fire thermodynamics and analysis of explosives and fire residues using colour tests and instrumental techniques

5. Identify common food adulterants and understand their forensic analysis. To perform physical and chemical analysis of lipids, oils, fats, butter and butter fats.

UNIT – I

Forensic chemistry: Introduction to forensic chemistry, Types of cases/exhibits received for analysis, Overview of forensic chemical analysis

Quality management: Introduction to Quality, Quality Assurance, Quality control, TQM, Definition of Accreditation, History and development of ISO, Importance of accreditation in Forensic science laboratories, Process of accreditation, Quality system, International Laboratory Accreditation Co-operation (ILAC), Asia Pacific Laboratory Accreditation Co- operation (APLAC). American Society of Crime Laboratory Directors (ASCLD), Traceability and Validation of new methods, measurement of uncertainty, Equipment maintenance and calibration , Proficiency testing, internal audit/External audit, MRM, Training and conferences

UNIT – II

Narcotic Drugs & Psychotropic Substances: Introduction to NDPS drugs, Controlled Substances, Classification of controlled substances, Precursor chemicals, Narcotic raids and clandestine drug laboratories investigation, Mandatory provisions of NDPS Act, 1985. Drug addiction (Physical & Psychological), Drug dependence and Drug Tolerance. Designer Drugs, Doping Drugs, Analysis of Drug of abuse by colour test and other instrumental techniques, Case studies.

UNIT-III

Explosives Chemistry: Introduction, Classification and chemistry of explosives; Post blast investigation. Systematic examination of explosive and explosion residues (organic and inorganic) by colour test and other instrumental techniques. Case studies.

Introduction to Fires & Arson Investigation: Introduction to Thermodynamics and

Chemistry of Fire , Investigation of Fire and Arson, Forensic Analysis of Fire Debris by Instrumental methods, Case studies.

UNIT – IV

Forensic Analysis of Petroleum Products: Introduction to Petroleum Products and Analysis of Petrol, Kerosene and Diesel as per BIS Specifications. Case Studies

Alcoholic Beverages: Forensic Analysis of alcoholic beverages, country made liquor, illicit liquor and medicinal preparations containing alcohol as constituents. Case studies.

UNIT-V

Bribe Trap Case and Food Adulteration: Examination of Chemicals (Phenolphthalein) used in Bribe trap cases. Case studies. Introduction to food adulteration and general color tests to detect common food adulterants.

LIST OF PRACTICALS:

1. Identification of NDPS drugs by color test and TLC.
2. Identification of psychotropic substances by color tests and TLC
3. Analysis of NDPS drugs by instrumental methods.
4. Detection of low explosives by chemical/color test and TLC
5. Detection of high explosives by chemical/color test and TLC
6. Analysis of fire/arson by GC-MS
7. Examinations of petroleum products as per BIS specifications.
8. Identification of alcohol/alcoholic beverages by chemical/color test.
9. Analysis of phenolphthalein in bribe trap cases
10. Identification of adulterants in some common food samples by chemical methods/color test (Turmeric, chilli, ghee, honey, pulses, sugar, salt etc.)

Reference Books:

1. J A Siegel, P.J Saukko (2000) Encyclopaedia of Forensic Sciences Vol. I, II and III, Acad. Press.
2. J A Seigel, Forensic Chemistry Fundamentals and Applications
3. Forensic Chemistry Handbook, Lawrence Koblinsky
4. NABL -, Guide for Internal audit and Management Review for Laboratories.
5. NABL-210, Assessor Guide Issue No.3, 1.5.2002.
6. DFSS: Manuals of Forensic Sciences.
7. Forensic Investigation of Explosions, Alexander Beveridge
8. D A Skoog, D.M. West, F.J. Holler; Analytical Chemistry – An Introduction, 7th Ed. Saunders College Pub, Philadelphia, USA.
9. The chemistry of Explosives, J. Akhavan
10. Practical Bomb Scene Investigation, James T. Thurman
11. Dettean J D; Kirk's Fire Investigation, 5th Ed. Prentice Hall, Eaglewood Cliffs, N. J.
12. Working Procedure Manual – Chemistry, Explosives and Narcotics, BPR&D Pub.
13. Feigl; Spot Test in Inorganic Analysis, Elsevier Pub. New Delhi.
14. Feigl; Spot Test in Organic Analysis, Elsevier Pub. New Delhi.
15. NDPS Act, 1985

CUTM1086 : FORENSIC SEROLOGY AND DNA PROFILING

Credits: 04 (3+1+0)

Course Description: This course explores the principles and techniques of forensic serology and DNA analysis used in criminal investigations. Students will learn about blood typing, body fluid identification, and the role of DNA in forensic science. Key topics include the collection and preservation of biological evidence, DNA extraction and profiling methods, and the interpretation of genetic data. Through hands-on laboratory experiences and case studies, participants will develop critical skills in forensic analysis and enhance their understanding of the legal implications surrounding DNA evidence. Ideal for students pursuing careers in forensic science, law enforcement, or criminal justice.

Course Objectives:

1. To learn about examination of blood and other biological fluids.
2. To learn about biochemical concepts and cellular processes.
3. To study the basic concept of DNA profiling and their analysis.

Course Outcomes: On successful completion of this course, the students should be able to,

1. Acquire skills to identify, characterize and analyse the various body fluids using different serological techniques.
2. Understand the biochemistry of carbohydrates, lipids, proteins and their forensic significance.
3. Apply knowledge of biochemistry and cell biology to forensic scenarios, including the role of cellular components in forensic investigations.
4. Analyze the effectiveness and accuracy of various DNA extraction and quantification methods in forensic scenarios.
5. Evaluate the role of DNA markers and mitochondrial DNA in forensic analysis.

UNIT-I

Basic Serology: Blood and its composition, Hemoglobin and its variants, Blood Typing/Grouping - 'ABO' system and its significance in forensic investigation., Other blood group antigens - 'Rh sub types', MN, I, P, Kell, Duffy, Kidd, Lewis, Lutheran and Bombay blood group, Identification of other biological fluids like Saliva, Urine, Semen and Vaginal secretion, and their forensic significance.

UNIT-II

Cytology: Introduction of plant and animal cells. Different eukaryotic cellular organelles, Plasma membrane, Transport across membrane Endoplasmic Reticulum, Golgi complex, Mitochondria, Chloroplast and Lysosomes. Organization of Nucleus and nuclear transport., Cell division-Mitosis and Meiosis; Barr bodies and their importance in forensic investigation

UNIT-III

Biochemistry and Cell Biology: Chemistry of Carbohydrates -Definition, classification and their importance in forensic investigation. Chemistry of Lipids -Definition, classification and their importance in forensic investigation. Types and properties of amino acids, structure of proteins and their importance in forensic investigation.

UNIT-IV

DNA extraction, quantification and separation: Techniques and equipment for DNA extraction and purification, Different methods of DNA quantitation, DNA separation and detection techniques, Polymerase Chain Reaction (PCR),

UNIT-V

Introduction to Forensic DNA analysis: History of DNA fingerprinting, DNA polymorphism, Genes and DNA markers in forensic DNA analysis, Introduction to mitochondrial DNA and its forensic importance, Important case studies of DNA

fingerprinting.

List of Practicals

1. Physical, biochemical and spectrophotometric examination of blood stains.
2. Blood group typing of biological fluid stains.
3. Biochemical and microscopic examination of Saliva, Semen stain and Urine
4. Determination of protein concentrations in various biological samples
5. Microscopic examination of mitotic and meiotic cell division
6. Staining and visualization of Barr Bodies.
7. Extraction and quantification of DNA from biological samples.
8. Extraction of DNA using FTA card.

Reference Books:

1. The examination and Typing of Blood Stains in the crime laboratory-BJ Culliford, U.S.Dept. of Justice, Washington D. C.
2. Blood Group Serology - Boorman KE, Dodd BE and LOncoln PJ, Chuchill LivingstoneInc. New York.
3. Laboratory Procedure Manual - Forensic Serology (2005), Directorate of Forensic Science, MHA, New Delhi
4. Lehninger Principles of Biochemistry 6th Edition (2012) – Nelson and Cox, W.H. Freeman, ISBN: 978-142923414
5. Molecular Biology of the Cell, 6th Edition (2014) – Bruce Alberts, et al., Garland Science, ISBN: 978-0815341055
6. Laboratory Procedure Manual - DNA Profiling (2005), Directorate of Forensic Science,MHA, New Delhi.
7. Molecular Biology of the Cell, 6th Edition (2014) - Bruce Alberts, et al., Garland Science, ISBN: 978-0815341055
8. Forensic DNA Typing, Second Edition: Biology, Technology, and Genetics of STR Markers 2nd Edition (2005) - John M. Butler, Academic Press, ISBN:0121479528

9. Forensic Science: An Introduction to Scientific and Investigative Techniques - StuartH. James, Jon J. Nord by, CRC Press, ISBN:0849327474
10. Genes XI (2012) - Benjamin Lewin, Jones & Bartlett Learning, ISBN: 978-1449659851Kuby Immunology6th Edition-Kindt, Goldsby and Osborne, W.H. Freeman and Co. ISBN: 978-0716767640
11. Lehninger Principles of Biochemistry 6th Edition (2012) - Nelson and Cox, W.H. Freeman, ISBN: 978-1429234146
12. Microbiology 5th Edition - Pelczar et. al., McGraw-Hill Inc., ISBN: 978-0074623206
13. Prescott's Microbiology 9th Edition (2013) - Joanne Willey, Linda Sherwood, Christopher J. Woolverton, McGraw-Hill Education, ISBN: 978-0073402406
14. An Introduction to Forensic Genetics 2nd Edition (2010) - William Goodwin, Adrian Linacre and Sibte Hadi, Wiley-Blackwell, ISBN: 978-0470710197

CUTM1087 : FORENSIC MEDICINE AND TOXICOLOGY

Credits: 04 (3+1+0)

Course description: This course offers a comprehensive overview of forensic medicine and toxicology, focusing on the application of medical knowledge to legal issues and the analysis of toxic substances in the human body. Students will explore the role of forensic medicine in determining causes of death, injury analysis, and the examination of living individuals in cases of assault, abuse, and other medico-legal cases. The toxicology component covers the identification, effects, and detection of various poisons, drugs, and chemicals, and their relevance in criminal investigations.

Course Objectives:

1. To learn about basic concepts of Death and postmortem changes.
2. To develop the skill of identification of various deaths due to asphyxia, burns, sexual violence etc.
3. To help students learn basic principles of toxicology and concepts of toxicological examination.

Course Outcomes: On successful completion of this course, the students should be able to,

1. Comprehend the signs of death, postmortem changes, and the mode and manner of death, including the challenges and legal implications associated with custodial deaths.
2. Classify different asphyxial deaths, such as hanging, strangulation, suffocation, drowning, and traumatic asphyxia.
3. Understand and evaluate the medicolegal aspect of injuries and trauma and Understandthe complexities of crimes against women, especially sexual offenses.
4. Understand the laws related to poisons, the role of toxicologists, and the types and modes of poisoning and Apply knowledge of forensic toxicology Analyze

crime scenes involving poisons.

5. Extract and examine poisons using various methods and techniques.

UNIT – I

Forensic medicine/Medico legal investigation Objectives of medico legal investigation, Inquest and types of Inquest, Thanatology, Death and its causes, types of death, Signs of death, Postmortem changes, Mode and Manner of death, Custodial Death, Determination of cause of death, Autopsy, Post-mortem examination of dead body, Estimation of time since death, Postmortem biochemistry of the body fluids, Modern techniques used for the estimation of time since death, exhumation.

UNIT – II

Asphyxial deaths: Classification of asphyxia deaths, Hanging, Strangulation, evidence collection and analysis, establishing manner of deaths Suffocation, Drowning and traumatic asphyxia, medico legal importance of diatoms, medico legal importance, manner of deaths.

General and medico legal aspects of injuries/traumatology: Injuries, types of injuries,Mechanical Injuries: Abrasions, Bruises, Lacerations, Incised wounds, Stab wounds, Firearm injuries, Electrical and Thermal Injuries, Regional Injuries and traffic injuries; self inflicted injuries and examination.

Crimes against women- Introduction to sexual offences. Natural and unnatural sexual offences, perversions Domestic violence and abuses at work place against women child abuses and abuses of old people, Abortion & Infant Deaths.

UNIT – III

Forensic Toxicology: Basics of Forensic Toxicology, History Scope and Significance, Crime scene involving poisons, medico legal aspects of poisoning, Laws related to poisons, nodal agencies and stakeholders, Poisons and classification of poisons, mode of action, types of poisoning, factors affecting poisoning, nature of forensic toxicological examinations, Roles and Responsibilities of forensic toxicologists, drug paraphernalia, poisoning management, Format of autopsy report and laboratory

report, expert witness testimony.

Collection and Preservation Biological and non-biological samples, National and International guidelines of toxicological sample collection and preservation.

UNIT – IV

Extraction and Examination of Poisons : Extraction of poisons from biological and non- biological samples, Methods of Extraction, Liquid-Liquid extraction, extraction methods for acidic, basic and neutral poisons, extraction of volatile and non-volatile poisons, extraction of plant poisons, common methods of poison detection (Volatile, non-volatile, metallic, plant poisons, insect and snake bites), chemical tests or preliminary examination.

UNIT –V

Instrumental Analysis of poisons:

Instrumental Analysis of different poisons like plant, volatile, non- volatile and metallic poisons using chromatographic and spectroscopic methods.

List of Practicals

1. Postmortem examination in various Asphyxial deaths.
2. Postmortem examination of various homicidal/ accidental injuries
3. Extraction of heavy metals using wet digestion and dry digestion
4. Extraction of acidic, basic and neutral poisons by liquid-liquid extraction
5. Extraction of pesticides by QuEChERS method
6. Advanced extraction procedures using SPE and SPME.
7. Extraction of volatile and non-volatile poisons
8. Analysis of heavy metals using colour tests(reinsch test).
9. TLC of acidic and basic drug
10. Identification of plant poisons by color test, TLC and spectroscopic method

Reference books:

1. Modi JS: Medical Jurisprudence and Toxicology
2. Taylor: Medical Jurisprudence
3. Anil Aggrawal: Text book of Medical Jurisprudence and Toxicology
4. R.K. Sharma: Consice text book of forensic medicine & Toxicology
5. Keith Simpson & Bernard Knight: Forensic Medicine
6. C.M.V. Cox Medical Jurisprudence and Toxicology
7. K.S. N. Reddy: Text book of Forensic Medicine & Toxicology
8. Apurba Nandi: Textbook of Forensic Medicine
9. V.V. Pillay: Textbook of Forensic medicine and toxicology
10. Modi JS: Medical Jurisprudence and Toxicology
11. Taylor: Medical Jurisprudence
12. Parikh CK: Medical Jurisprudence and Toxicology
13. Keith Simpsen& Bernard Knight: Forensic Medicine
14. Poison, CJ, DJ Gee, B. Knight: Forensic MedicineReddy: Forensic Medicine
15. Laboratory Procedure Manual- Forensic Toxicology, DFS, MHA, New Delhi
16. Essentials of Toxicology- Ellenhorn

CUTM1089 : FORENSIC BALLISTICS

Credits: 04 (3+1+0)

Course Description: This course provides a comprehensive understanding of forensic ballistics, focusing on the science of firearms, ammunition, and the mechanics of projectile motion in forensic investigations. Students will explore the principles of internal, external, and terminal ballistics, as well as firearm identification, ammunition types, and the role of ballistics in crime scene analysis. The course will also cover gunshot residue analysis, bullet trajectory reconstruction, and wound ballistics, along with their legal implications in criminal cases.

Course Objectives:

1. To have a core knowledge for Forensic Ballistics and its types.
2. Understand about the assembly of ammunition and their importance in wound ballistics.
3. To learn the methods for analysis of Gunshot Residues and Firearms Identification, along with instrumental techniques

Course Outcomes: On successful completion of this course, the students should be able to,

1. Identify different types of firearms, ammunition, including classifications based on constructional features
2. Understand the concepts of internal, external, terminal and wound ballistics for their application in case analysis.
3. Explain the functional assembly and cartridge-firing mechanism of different types of firearms.
4. Examine the principles of firearm identification and the class and individual characteristics produced during the firing process.
5. Evaluate the various techniques involved in analyzing gunshot residue (GSR), determining the range of fire, including the use of stereo and comparison

microscopy, BDAS, and IBIS.

UNIT-I

Introduction to Forensic Ballistics, Basics concept of forensic ballistic, its definition, History and development of Forensic Ballistics, Introduction to Internal, External and Terminal ballistics, Role of Forensic Ballistics Expert.

Introduction to firearms: Parts of firearms and its function, Firearm safety, Assembly and disassembly of firearm, Firearms characteristics & classification of firearms on different basis, History and background of firearms, Functional assembly & Operating principle of firearms, Bore and caliber, choke, rifling – class characteristics of rifled bore, purpose of rifling, types of rifling, methods to produce rifling, Characteristics & Working mechanism of Standard: Rifled firearms, Small arms, Shot guns & Non-standard: Improvised, Country made, Imitative firearms, identification of origin.

UNIT-II

Introduction to Ammunition: Definition of Ammunitions, Ammunition & its constructional parts, Introduction to Shotgun ammunition and Rifle Ammunition, Classifications of Ammunition on basis of constructional features, Functional assembly of different types of ammunition & their types, Safety aspects for handling firearms and ammunition, cartridge-firing mechanism. Bullet and its types, Case studies related to firearm cases.

Indian Firearm Act: Introduction to Act, Basic concepts of chapters describe in Act, Prohibited & Non-Prohibited Firearms calibers.

UNIT-III **(15 HRS)**

Types of ballistics & their aspects,

Internal ballistics: General elementary & other principle problems: Heat problems, Pressure, Recoil, Vibration & Jump, Barrel Fouling.

External ballistics: Trajectory formation & its computation, Vacuum Trajectories & its

measurement, Influence of earth trajectory, Effect of air resistance on trajectories, Parameters involved in exterior ballistics.

Terminal/Wound ballistics: Effect of projectile on target based on: nature of target, bullet shape, striking velocity, striking angle and nature of target, intermediate targets, range, etc., Basic concepts of wound ballistics & phenomenon involved: threshold velocity for penetration of skin / flesh / bones, Nature of wound of entry & exit wound, Characterization & evaluation of injuries depending upon Range, Velocity, Projectile Types, Firearm types, etc.

UNIT-IV

Identification of firearms, ammunition and their components: Principles, Processing of Firearm Exhibits involved, Class characteristics & Individual characteristics (Identifiable marks) produced during firing process on cartridge cases & projectiles and their linkage with firearms.

UNIT-V

Analysis of GSR and Range Determination–Composition of GSR, Location & Collection, Mechanism of formation, Chemical & Instrumental techniques involved in analysis, Shooter Identification Technique. Techniques involved in ballistic studies, Stereo and comparison microscopy, BDAS, IBIS

List of Practicals

1. Characteristics of Firearms-Caliber, Choke, Trigger pull, and Proof marks.
2. Examination and comparison of fired bullet with reference to caliber, rifling characteristics, and identification of firearm
3. Examination and comparison of fired cartridge case with reference to caliber, firing pin, breech face, chamber indentations, extraction, and ejector marks by comparison microscope
4. Determination of shot numbers from size and weight of shots
5. Identification of propellants

6. Chemical tests for powder residue and barrel wash
7. Instrumental examination of Gunshot Residues.
8. Study on Deformed bullets
9. Determination of velocity using BDAS
10. Determination of angle and direction of fire on different surfaces

Reference Books:

1. J. Howard Mathews; Charles C. Thomas, Firearms Identification, Vols 1,2,& 3; Springfield, Illinois;
2. Hatcher, Jury And Weller, Firearms Investigation, Identification And Evidence; Stackpole Books, Harrisburg, PA
3. Vincent Di Maio, Gunshot Wounds; Crc Press, Washington,Dc;
4. Brain J. Heard;, Hand Book Of Firearms And Ballistics; John Willey,England;
5. TA, Warlow; Firearms, The Law And Forensic Ballistics; Taylor And Francis,Landon;
6. Karl G. Sellier et al ; Wound Ballistics And The Scientific Background; Elsevier,London
7. M. Johari, Identification Of Firearms, Ammunition And Firearms Injuries; BPR&D, New Delhi;
8. L V. Hogg; The Cartridges Guide - A Small Arms Ammunition Identification Manual; The Stackpole Co., Harrisburg, PA
9. Gary J. Ordog, Management Of Gunshot Wounds, Elsevier, NewYork
10. Working Procedures Manual: Ballistics, BPR&DPub.

Specialization – I: (Forensic Chemistry and Toxicology)

CUFS1091: FORENSIC PHARMACOLOGY AND PHARMACEUTICAL DRUG ANALYSIS

Credits: 04 (3+1+0)

Course Description: This course explores the principles of pharmacology and their forensic applications, focusing on pharmaceutical drug analysis, identification of controlled substances, and toxicology. It covers drug classifications, mechanisms of action, and advanced analytical techniques for detecting and quantifying compounds. Regulatory frameworks and ethical considerations in forensic pharmacology are also addressed.

Course Objectives:

1. To help students learn the basics of pharmacology and concepts of forensic pharmacology.
2. To study and understand the action of various drugs.
3. To study pharmaceutical drugs analysis.

Course Outcomes: On successful completion of this course, the students should be able to,

1. Understand the concept of pharmacology in aspect of pharmacokinetics and pharmacodynamics
2. Conceptualize the bioavailability, bioaccumulation, drug action and Drug Interactions
3. Apply of basic pharmacology principles in drug mechanism and responses
4. Identify the drug based on various factors and Perform quantitative and qualitative analysis of various drugs
5. Imply the significance of pharmacology and Pharmaceutical analysis in forensic Science

UNIT-I

Basic Principles of Forensic Pharmacy: Introduction to Pharmacology and Forensic Pharmacy, Branches of Pharmacology, Scope of Forensic Pharmacy, Pharmacopoeias IP, USP, EP, pharmacognosy, pharmacovigilance, Nature and Source of drug, forms of drugs, classification of drugs, Prodrug and soft drug concept, Drug synthesis, Route of administration of Drugs, Factor affecting the effects of Drug, Ferguson's principle, Adverse drug reactions and drug induced side effects.

UNIT-II

Concepts of Pharmacology: Pharmacokinetics, Bioavailability, Bioequivalence and Bioaccumulation, Efficacy and potency, Dose response relationship, Pharmacodynamics, Phase–I and Phase–II mechanism, Drug Therapeutic Index, Drug Receptor concept, types of receptors and mechanism of action, Pharmacokinetic drug interactions, various biological barriers, Agonism, Antagonism, Addition, Synergism, Potentiation, drug addiction and drug dependence, drug tolerance, drug hypersensitivity.

UNIT-III

Pharmacology of Different classes of controlled drugs: Pharmacology of neurotransmitters like GABA, Glutamate, Glycine, Serotonin, Dopamine, aliphatic alcohol, General Anaesthetics, Antidepressants, Sedatives, Hypnotics, antihypertensive drugs, Antidepressant, Stimulants, & hallucinogens and antipsychotics, Case Studies

UNIT-IV

Methods of Analysis of of Prohibited Drugs: Detection of prohibited drugs (anabolic steroids, peptide hormones, growth factors and mimetics, beta agonist, metabolic modulators, diuretics and masking agents and beta blockers by different techniques)

List of Practicals

1. Preparation of standard and working solutions.
2. Plotting of calibration curve and quantification using UV-Vis Spectroscopy
3. LLE & DLLME based extraction of drugs
4. FTIR based detection of various drug classes
5. Analysis of drugs and metabolites by LC-MS
6. Determining Limit of Detection & Limit of Quantitation of drug by UV-VIS
7. Multicomponent Quantitative estimation of drug by UV-VIS
8. Detection of anabolic agents in supplements by GCMS
9. Concept & Parts identification of GC, GCMS, HPLC

Reference Books:

1. Moffat, A.C. :Osselton, D. M. Widdop, B. : Clarke's Analysis of Drugs and Poisons in Pharmaceuticals, body fluids and postmortem material, 3rd ed., Pharmaceutical Press2004.
2. Bogusz, M. J.,: HandBook of Analytical Separations, Vol. 2: Forensic Science, 1st ed.,Elsevier Science ,2000.
3. Rang, P.H., Dale, M.M., Ritter, M.J.: Pharmacology, 4th ed., Harcourt/ChurchillLivingstone, 2000.
4. Paranjape, H.M., Bothara, G.K., Jain, M.M.: Fundamentals of Pharmacology, 1st ed.,Nirali Prakashan, 1990.
5. Budhiraja, R.D.: Elementary Pharmacology and Toxicology, Popular Prakashan, 2nd ed.,1999.
6. Hardman, J. G. and Limbird, L. E.,: Goodman and Gilman's The Pharmacological basis of Therapeutics, 9th ed., McGraw-Hill, 1996

CUFS1092: ADVANCED FORENSIC TOXICOLOGY

Credits: 04 (3+1+0)

Course description: This course provides an in-depth exploration of forensic toxicology, emphasizing advanced analytical techniques and the interpretation of toxicological data in legal contexts. Students will examine the pharmacokinetics and pharmacodynamics of various toxicants, including drugs, alcohol, and poisons, and their impact on human physiology. The course covers the detection, identification, and quantification of toxic substances in biological matrices using state-of-the-art instrumentation such as GC-MS, LC-MS/MS, and ICP-MS. Key topics include the role of forensic toxicologists in criminal investigations, the interpretation of toxicological results in cases of poisoning, overdose, and drug-facilitated crimes, and the legal and ethical challenges encountered in forensic toxicology.

Course Objectives

1. To help students learn basic principles of toxicology.
2. To help students learn about xenobiotics and toxic effects.
3. To study and understand concepts of mechanism of toxicity.

Course Outcomes: On successful completion of this course, the students should be able to,

1. Understand about the branches of toxicology, toxicants and its types, basics concepts of toxicology and national and international regulatory bodies.
2. Understand bioaccumulation, bioconcentration and detoxification of xenobiotics in the body, translocation of toxicants, toxicodynamic and toxicokinetic, dose response relationships and antidotal therapy
3. Gain knowledge of different heavy metals, alcohol, plant poisons, insects and animal poisons and their effects
4. Understand the mechanism of toxicity
5. Understand practical applications of toxicological principles in real-life scenarios.

UNIT – I

Concepts of Toxicology :Branches of toxicology, Toxicants and Types of Toxicants, Dose and related terms used in toxicology, Sources of poisoning, duration and frequency of exposure, modals of toxicity testing, Laws and Regulations in toxicological testing, Regulatory bodies national and International, Risk and Hazard characterization, Global Harmonization System (GHS), Good Laboratory Practice (GLP).

UNIT – II

Principles of Toxicology : Dose-effects and dose-response relationship, types of toxicity, Factors affecting toxicity – species and strain, age, sex, nutritional status, hormones, environmental factors, circadian rhythms, Enzyme Induction and Inhibition, molecular mechanism of toxicity, role of electrophiles and nucleophiles in toxicity, translocation of toxicants, toxicokinetic and toxicodynamic processes, detoxification of xenobiotics, bioaccumulation of xenobiotics, antidotal therapy.

UNIT – III

Toxic effects of Xenobiotics, mechanism of drug toxicity, Toxic effects of pesticides, mechanism of pesticide toxicity, Toxic effects of heavy metals, mechanism of heavy metal toxicity, Toxic effects of Alcohol and solvents, mechanism of poisonous liquor, Toxic effects of plant poisons, Toxic effects of insects and animal poison.

UNIT – IV

Post-mortem toxicology, Methods of poison detection, chemical tests, Instrumental methods for examination of different plant, volatile, non- volatile and metallic poisons.

UNIT –V

Toxicological analysis of decomposed material and body remains, metabolomics and biomarkers , challenges in forensic toxicological examination.

List of Practicals

1. Extraction and identification of organochlorine pesticides from biological matrices by TLC and GC-MS
2. Extraction and identification of organophosphorus pesticides from biological matrices by TLC and GC-MS
3. Extraction and identification of carbamates and pyrethroids from biological matrices by TLC and GC-MS
4. Identification of common plant poisons Oleander, Dhatura, Calotropis and Ricin etc by various analytical methods
5. Extraction of heavy metals by conventional methods and analysis by color tests.
6. Extraction and Analysis of heavy metals by microwave extraction and ICP-MS.
7. Analysis of alcohol and derivatives by head-space gas chromatography (HS-GC).
8. Analysis of non-volatile poisons by HPLC
9. Identification of non-volatile poisons by UV and TLC
10. Calculation of uncertainty measurement in blood alcohol by GC

Reference books:

1. Curry: Analytical Methods in Human Toxicology, Part II, 1986.
2. Gupta, P.K.. Fundamentals of Toxicology: Essential Concepts and Applications. India, Elsevier Science, 2016.
3. Casarett & Doll Toxicology: The Basic Science of poisons.
4. Clark, E.G.C.: Isolation and identification of Drugs, 1966
5. Curry, A.S.: Poison Detection in Human Organs, 1976
6. Curry, A.S.: Advances in Forensic Chemical Toxicology, 1972
7. Holfmann, F.G.: Handbook of Drug and Alcohol Abuse.
8. Turner: Drugs & Poisons.
9. Samford : Poisons Their Isolation Identification

CUFS1093: MODERN AND APPLIED ANALYTICAL FORENSIC CHEMISTRY

Credits: 04 (3+1+0)

Course Description: This course focuses on advanced analytical techniques and their practical applications in forensic chemistry. Students will explore modern instrumentation and methodologies for the detection, identification, and quantification of forensic evidence, including drugs, toxic substances, and trace materials. Emphasizing hands-on experience, the course bridges theory and practice, preparing students to apply cutting-edge analytical chemistry tools in real-world forensic investigations and laboratory settings.

Course Objectives

1. To help students learn advanced aspects of forensic drug chemistry.
2. To help students learn the concepts of petro-forensics and international guidelines about fire forensics.
3. To study and understand various chromatographic and spectroscopic techniques.

Course Outcomes: On successful completion of this course, the students should be able to,

1. Gain knowledge of controlled substances, narcotic drugs and psychotropic substances and forensic analysis including presumptive and confirmatory tests for drugs.
2. Understand the fire dynamics, fire chemistry and thermodynamics and to demonstrate skills required for analysis of petroleum products
3. Gain knowledge about explosives and its types, causes of explosion and analysis of residue materials in post-blast investigation.
4. Gain knowledge about chemical warfare agents and their analysis.
5. Analyze case studies and understand the practical applications of forensic chemistry in real-life scenarios.

UNIT-I

Advanced Forensic Drug Chemistry: Drug Trafficking, Forensic examination of drugs/Narcotics - Cannabis, Phenethylamines (Amphetamine, Methamphetamine), Hydroxyl derivative (Ephedrine), Ketone Derivative (Cathinone), Methoxy Derivative (Mescaline), Tertiary Amines (Cocaine and Opiates), Miscellaneous Controlled Substances(Barbiturates, Benzodiazepines, GHB, Ketamine and LSD).

UNIT-II

Presumptive/Screening and Confirmatory Methods: Colour/spot test, microscopic examination, Microcrystalline tests, Thin-Layer Chromatography, Sample Preparation before TLC Specimen, Extraction Evaluation of TLC for Drug Screening, Immunoassay Methods other instrumental techniques (HPLC, GC, GC-MS) involved in analysis.

UNIT-III

Petro Forensics: Distillation and fractionation of petroleum. Commercial uses of different petroleum fractions. Physical Properties of Petroleum Products Analytical Techniques: Quantitative and Qualitative Steps in Analysis of Petroleum, Analysis of traces of petroleum products in forensic exhibits. Case studies.

Fire Chemistry: Scientific Investigation of Fire, NFPA 921 and NFPA 1033, The chemistry and physics of combustion, Dynamics of Fire, Development of fire patterns, Separation and analytical techniques of ignitable liquid residues, Field tests, Interpretation of Data Obtained from Fire Debris, Quality Assurance in Fire debris Analysis, Report Writing and Court Testimony.

UNIT-IV

Explosives Chemistry: Introduction and assessment of explosives, Oxygen balance, Explosive Power Index, Heat and Temperature of Explosion, Pressure of explosion, Mechanism of Ignition and hot spot formation. Thermal decomposition, physical and chemical aspects of combustion, Deflagration and Detonation, Analysis of low and high explosives by different instrumental techniques, Case studies

UNIT-V

Chemical Warfare Agents: Classification, physical and biochemical properties, Biosensors.

Food Chemistry: Analysis of Lipids and fats: Physical examination of lipids, Chemical examination of lipids (Acid value, Saponification value, Ester value, Acetyl value, Iodine value), Test for hydrogenated oils and fats, Detection and Determination of rancidity, Analysis of butter and butter fats, Analysis of adulterated and non-adulterated oils

Analysis of dairy products: Milk and its products.

List of Practicals

1. Microcrystalline tests for Narcotic drugs.
2. Separation of Psychotropic substance by TLC.
3. Separation of Cannabis/Opium TLC
4. Analysis of low and high explosives by Colour Tests and TLC
5. Analysis of dye in petrol and kerosene by UV spectrophotometry and TLC
6. Estimation of protein in food samples.
7. Analysis of adulterated and non-adulterated oil by chemical/Color Test and TLC method
8. Estimation of nitrite/nitrate in water samples
9. Separation of amino acids by thin layer chromatography
10. Extraction of caffeine from tea leaves, characterization by IR

Reference Books:

1. Clarke's Analysis of Drugs and Poisons, (Formerly Isolation & Identification of Drugs) 3rd Ed. 2 Vol. Set.
2. Clark, E.G.C.: Isolation and identification of Drugs, VI and Vol. II, 1966, 1975-1986.
3. Modi, TextBook of Medical Jurisprudence Forensic Medicines and Toxicology (1999) CBS Pub. New Delhi.
4. Saferstien (1982) Forensic Science, Handbook, Vol. I, II & III, Prentice Hall Inc.

USA.

5. DFS -Working Procedure Manual- Narcotics.
6. E. Stahl (1969) Thin Layer Chromatography: A Laboratory Handbook.
7. Saferstein (1976) Criminalistics.
8. Klaassen, C. D.:Casarett and Doull's Toxicology: The Basic Science of Poisons, 5thed,McGraw-Hill, 1995.
9. Moffat, A.C.: Osselton, D. M. Widdop, B.: Clarke's Analysis of Drugs and Poisons inPharmaceuticals, body fluids and post-mortem material, 3rd ed., Pharmaceutical Press2004.
10. Bogusz, M. J., Hand Book of Analytical Separations, Vol. 2: Forensic Science, 1st ed.,Elsevier Science, 2000.
11. Siegel, J.A., Saukko, P. J., Knupfer, G.: Encyclopaedia of Forensic Sciences (Vol. 3),Academic Press, 2000.
12. Rang, P.H., Dale, M.M., Ritter, M.J.: Pharmacology, 4th ed., Harcourt/ChurchillLivingstone, 2000.
13. Paranjape, H.M., Bothara, G.K., Jain, M.M.: Fundamentals of Pharmacology, 1st ed., NiraliPrakashan, 1990.
14. Budhiraja, R.D.: Elementary Pharmacology and Toxicology, Popular Prakashan, 2nd ed.,1999.
15. Wiseman, H and Henry J.: Management Of Poisoning, A Handbook for Healthcare workers,1st ed., A.I.T.B.S, 2002.
16. Hardman, J. G. and Limbird, L. E.: Goodman and Gilman's The Pharmacological basis of Therapeutics, 9th edn., McGraw-Hill, 1996.
17. Laboratory procedure Manual, Forensic Toxicology: DFS, 2005.
18. Sunshine, I; Methods for Analytical Toxicology, CRC Press USA (1975).
19. Cravey, R.H; Baselt, R.C.: Introduction to Forensic Toxicology, Biochemical Publications,Davis, C.A. (1981).
20. Stolmen, A.; Progress in Chemical Toxicology: Academic Press, New York (1963).
21. Modi, Jaisingh, P.; Textbook of Medical

Jurisprudence& Toxicology, M.M. TripathiPublication (2001).

22. Eckert; An Introduction to Forensic Science, CRC Press.
23. Pillay, V. V.; Handbook of Forensic Medicine and Toxicology, Paras Pub., 2001.
24. Curry, A. S: Poison Detection in Human Organ.
25. James, S. H. and Nordby, J. J.: Forensic Science: An Introduction to Scientific andInvestigative Techniques, 2003.
26. Saferstein, R: Criminalistics - An Introduction to Forensic Science, Prentice Hall, 1995.
27. Sarkar, S: Fuels and Combustion, Orient Longman, 1990.
28. Verma, R. M: Analytical Chemistry – Theory and Practice, CBS Pub., 1994.
29. Svehla, G. Ed.: Vogel's Qualitative Inorganic Analysis, Longman, 1998.
30. Bassett: Vogel's Text Book of Quantitative Inorganic Analysis, Longman, 1978.
31. Vogel, A. I: Text Book of Practical Organic Chemistry including Qualitative OrganicAnalysis, ELBS, 1971.
32. Skoog, D. A., West, D. M. and Holler, F. J: Analytical Chemistry: An Introduction,Saunders College, 1994.
33. Siegel, J. A, Saukko, P. J. and Knupfer, G. C: Encyclopaedia of Forensic Sciences, Academic Press, 2000.
34. Townsends, A. (Ed): Encyclopaedia of Analytical Science, Academic Press, 2005.
35. Beveridge, A: Forensic Investigation of Explosives, Taylor & Francis, 2000.
36. Yallop, H. J: Explosion Investigation, Forensic Science Society & Scottish Academic Press,1980.
37. Narayanan, T. V: Modern Techniques of Bomb Detection and Disposal, R. A. SecuritySystem, 1995.
38. Yinon, J. and Zitrin, S: The Analysis of Explosives, Oxford: Pergamon, 1981.
39. An Introduction to Physics and chemistry of Petroleum.
40. Kinghorn: Introduction to Petrochemicals Sukumar Maiti.
41. D.W.Waples: Geochemistry in Petroleum Exploration.

Specialization – II: (Forensic Biotechnology)

CUFS1094: FORENSIC GENOMICS AND BIOCOMPUTING

Credits: 04 (3+1+0)

Course Description: This course delves into the intersection of forensic science, genomics, and computational biology. Students will explore advanced genomic techniques used for forensic analysis, and bioinformatics applications in identifying and interpreting genetic material from crime scenes. Through hands-on practicals and projects, participants will gain practical skills in biocomputing tools and develop a deeper understanding of how genomic technologies enhance criminal investigations.

Course Objectives:

1. To learn about the latest modalities in Forensic Genomics.
2. To learn the basics of STR profiling.
3. To learn about population genetics and biocomputing in relation to forensic science.

Course Outcomes: On successful completion of this course, the students should be able to,

1. Explain the methodologies for STR profiling and the significance of Y-STR and X-STR analysis.
2. Implement forensic genomic techniques for tissue identification and post-mortem redistribution analysis.
3. Analyze biological data using various sequence alignment tools and database search engines to identify patterns and similarities in genetic sequences.
4. Evaluate the utility and reliability of various biocomputing tools and databases used in forensic investigation.
5. Assess biocomputing tools, database management, phenotypic and ancestry

markers, to solve complex forensic cases.

UNIT-I

Advanced topics in STR Profiling: STR Profiling, Types of errors, Result interpretation and Report Writing, DNA Mixtures – Current status of tools and guidelines, Paternity/maternity indices, sibship indices, Advanced Y-STR and X-STR analysis and its significance in establishing paternal relationships. Non-human DNA analysis, Mitochondrial DNA analysis for humans.

UNIT-II

Forensic Genomics: Identity, Phenotypic and ancestry informative markers**,** Quality assurance and quality control in DNA forensics**,** Molecular autopsy and tissue identification by DNA and RNA**,** Post mortem redistribution**,** Various guidelines for DNA forensics work flow.

UNIT-III

Basics of Biocomputing: Biological Data: The form of biological information, Databases – Format and Annotation: Conventions for database indexing and specification of search terms, common sequence file formats, annotated sequence databases - primary sequence databases, organism specific databases, Data – Access, Retrieval and Submission: Standard search engines.

UNIT-IV

Tools used in Biocomputing: Data retrieval tools – Entrez, Submission of (new and revised) data, data submission tools, Sequence Similarity Searches: Local v/s global, Distance metrics. FASTA, BLAST and other variants of BLAST, Multiple Sequence Alignment and Whole genome analysis.

UNIT-V

Biocomputing in Forensic investigation: Genealogy and its applications in forensic genetics, Database management tools in DNA Forensics: CODIS and DNAxs, Other Databases and Online-Tools: NCBI, STR Base, STRidER, PhyloTreemt, SNPforID Browser, popSTR browser, ALFRED, scientific literature.

List of Practicals:

1. Different mathematical calculations for data analysis using Microsoft Excel.
2. DNA extraction from various forensic samples
3. Polymerase chain reaction
4. STR Profiling and report writing using simulated evidences
5. Sequence comparison using BLAST
6. Construction of a Phylogenetic tree from nucleotide and protein sequences

Reference Books:

1. Forensic DNA Typing, Second Edition: Biology, Technology, and Genetics of STR Markers 2nd Edition (2005) - John M. Butler, Academic Press, ISBN:0121479528
2. Advanced Topics in Forensic DNA Typing: Methodology (2011, 2014), John M. Butler, Academic Press, ISBN: 978-0123745132
3. Forensic DNA Profiling - A Practical Guide to Assigning Likelihood Ratios, 1st ed. (2020)- Jo-Anne Bright and Michael D. Coble, CRC Press, ISBN: 9780367029029
4. Forensic Practitioner's Guide to The Interpretation of Complex DNA Profiles, 1st ed. (2020) - Peter Gill et. al., Academic Press, ISBN: 978-0-12-820562-4
5. An Introduction to Forensic Genetics, 2ndEdition (2010) - William Goodwin, Adrian Linacre and Sibte Hadi, Wiley-Blackwell, ISBN: 978-0470710197
6. Forensic Genetics in the Governance of Crime, 1st ed. (2019) - Helena Machado and Rafaela Granja, Palgrave Macmillan, ISBN 978-981-15-2429-5
7. High-Throughput Next Generation Sequencing – Methods and applications, 1st

ed. (2011), Young Min Kwon and Steven C. Ricke, Humana Press, ISBN: 9781617790881

8. Next Generation DNA Led Technologies, 1st ed. (2016), Sharada Avadhanam et. al., Springer, ISBN: 978-981-287-669-0
9. Next Generation Sequencing – Methods and Protocols, 1st ed. (2018) - Steven R. Head et. al., Humana Press, ISBN: 978-1-4939-7514-3
10. Introduction to Genomics, 1st ed. (2020) - Akalin, Chapman and Hall/CRC, ISBN: 9780429084317-1.
11. Handbook of Statistical Genomics, 1st ed. (2019) - D.J. Balding, I. Moltke and J. Marioni, Wiley, ISBN: 9781119487845.
12. Genomes:4, 4th ed. (2017) - T.A. Brown, Garland Science, ISBN: 9780815345084
13. Bioinformatics for dummies®, J.-M. Claverie, C. Notredame n.d.
14. S. Dua, P. Chowriappa, Introduction to Bioinformatics, in: Data Min. Bioinforma., CRC Press, 2012: pp. 3–40. https://doi.org/10.1201/b13091-1.
15. W.D.R. Hodgman T. Charlie, French Andrew, Bio Instant Notes Bioinformatics, 2010.
16. W. Miller, An Introduction to Bioinformatics Algorithms, J. Am. Stat. Assoc. 101 (2006) 855–855. https://doi.org/10.1198/jasa.2006.s110.
17. P. Romero, Bioinformatics: Sequence and Genome Analysis, Cold Spring Harbor Laboratory Press, 2004. https://doi.org/10.1093/bib/5.4.393-a.
18. F.H. Stephenson, Calculations for Molecular Biology and Biotechnology, Elsevier, 2003. https://doi.org/10.1016/B978-0-12-665751-7.X5041-0.
19. T. Warnow, Bioinformatics and Phylogenetics: Seminal Contributions of Bernard Moret, 2019. https://doi.org/10.1007/978-3-030-10837-3.
20. Supratim Choudhuri, Michael Kotewicz, Bioinformatics for beginners: genes, genomes, molecular evolution, databases and analytical tools, 2014, 1st ed., Academic Press, ISBN 13:9780124104716

CUFS1095: MOLECULAR BIOLOGY AND R-DNA TECHNOLOGY

Credits: 04 (3+1+0)

Course Description:

This course provides an in-depth exploration of molecular biology, focusing on the principles and techniques of recombinant DNA (R-DNA) technology. Students will learn about the structure and function of nucleic acids, gene expression, and regulation. The course will also cover aspects of population and conservation genetics. It will provide core concepts of gene cloning, vectors, and other applications of R-DNA technology. Through a combination of lectures, and hands-on lab work, students will develop a comprehensive understanding of the impact of molecular biology and recombinant DNA technology.

Course Objectives

1. To learn about the fundamentals of molecular biology including structure of nucleic acid structures, replication, transcription, and translation.
2. To learn about the principles of population genetics and different molecular biology techniques.
3. To study the application of molecular biology and r-DNA technology in relation to forensic investigation.

Course Outcomes: On successful completion of this course, the students should be able to,

1. Demonstrate the structure, metabolism and significance of genetic material in the purview of forensic science.
2. Understand the concepts of population genetics and use different phylogenetic tools.
3. Acquire skills in performing different advanced techniques used in molecular biology.
4. Evaluate the advantages and limitations of different cloning vectors and host organisms used in r-DNA technology.

5. Utilize molecular biology techniques in construction of r-DNA.

UNIT-I

Structure and functions of Nucleic acids: Nucleosides & Nucleotides, purines and pyrimidines, Watson and Crick model of DNA structure, A, B & Z forms of DNA, Supercoiled and relaxed DNA, RNA structure and types of RNA, ribosome structure, genetic code and their properties, Organization of genome in prokaryotes and eukaryotes.

UNIT-II

Central Dogma: Mechanism of DNA replication in prokaryotes and eukaryotes. Transcription: RNA polymerases, features of prokaryotic and eukaryotic transcription, transport of RNA within eukaryotic cells. Translation: role of t-RNA in protein synthesis, initiation, elongation and termination and post translational modifications.

UNIT-III

Population and Conservation Genetics : Basic Concepts in Population Genetics**,** Hardy- Weinberg Principle and Linkage disequilibrium**,** Causes of evolution- admixture, selection, mutation, drift**.** Genetic Diversity and variations; Haplotype analysis**,** Various tools for phylogenetic analysis.

UNIT-IV

Molecular Biology Techniques : Sanger Sequencing**,** Next Generation Sequencing techniques, DNA modifying enzymes, genomic and cDNA libraries,, Biosafety guidelines and containment strategies.

UNIT-V

rDNA Technology: General introduction and concept of recombinant DNA technology. Vectors: Types of vectors and choice of vectors- Plasmids, cosmids, Lambda phage vectors, shuttle vectors, BACs and YACs**,** Choice of hosts, Expression systems in Eukaryotic cells, Yeast, Bacteria, Insect cell lines, Gene screening; methods for

transferring recombinant DNA to host cells(transformation and transfection)

List of Practicals

1. Isolation of Plasmid from bacteria
2. Restriction digestion of DNA
3. Agarose gel electrophoresis
4. Preparation of the competent cells for transformation
5. Selection of the transformed cells

Reference Books:

1. Markers 2nd Edition (2005) - John M. Butler, Academic Press, ISBN:0121479528
2. An Introduction to Population Genetics Theory and Applications. Rasmus Nielsen, Montgomery Slatkin. Publisher: Sinauer Associates, Year of Publication-2013.
3. Fundamentals of Molecular Biology (2009)- J.K. Pal, Oxford
4. Fundamentals of Forensic DNA Typing (2010)- John. M. Butler, Academic Press
5. Biochemistry - U. Satyanarayana, Elsevier
6. DNA Science: A First Course- D.A. Micklos, Cold Spring
7. Current Topics in Phylogenetics - L.P. Jakka, Random Publications
8. DNA - L. Kobilinsky, Wiley and Sons
9. An Introduction to Forensic Genetics- W. Goodwin, BlackWell
10. An Introduction to Biotechnology, W.T. Godbey, Academic Press
11. Animal Cell Biotechnology: Methods and Protocols (Second Edition)- Edited by Rolf Portner, 2007, Humana Press
12. Statistical DNA Forensics: Theory, Methods and Computation - Wing Kam Fung and Yue-Qing Hu, John Wiley & Sons, Ltd.

CUFS1096: IMMUNOLOGICAL TECHNIQUES AND FORENSIC PROTEOMICS

Credits: 04 (3+1+0)

Course Description: This course offers a comprehensive overview of immunological techniques and their applications in forensic proteomics. Students will explore key concepts in immunology, including antibody-antigen interactions, serological assays, and the use of monoclonal antibodies. The curriculum will delve into proteomics methodologies, focusing on protein analysis, and mass spectrometry, in forensic investigations. Through lectures, hands-on lab sessions, and case studies, students will gain essential skills to apply immunological and proteomic techniques in forensic science and clinical research preparing them for real-world challenges in the field.

Course Objectives:

1. To help the students learn the basic concepts of immunology
2. To learn the basic immunological techniques
3. To help students understand the various stages of proteomics

Course Outcomes: On successful completion of this course, the students should be able to,

1. Recall the fundamental concepts of the immune system.
2. Describe the structure and properties of antigens and antibodies, including the different types of antibodies.
3. Gain skills to carry out different immunological techniques
4. Analyze the mechanism of different types of hypersensitivity reactions and evaluate different vaccine development strategies.
5. Assess the applications of proteomics, including the use of protein biomarkers in forensic investigations.

UNIT-I

Overview of immunology: Phylogeny of immune system, Innate and acquired immunity, clonal nature of immune response**,** Cells and Organs of the immune system: Hematopoiesis and differentiation, B – Lymphocytes, T- Lymphocytes, Macrophages, Dendritic cells, Natural Killer cells, Lymphokine activated killer cells, Eosinophils, Neutrophils and Mast cells**,** Organization and structure of lymphoid organs; Structure and properties of Antigen and Antibodies; Types of Antibodies.

UNIT-II

Hypersensitivity and auto-immune diseases: Hypersensitivity and its types (Type I,II,III and IV); mechanism and molecular events in mast cell degranulation by IgE, Pharmacologically active mediators of Type I reactions, mechanisms behind type II, III and IV hypersensitivity reactions

Auto-immune diseases: Organ specific and systemic auto-immune disorders, different examples of auto-immune disorders

UNIT-III

Immunological techniques: Antigen-Antibodies Interaction; Different techniques to study antigen-antibody interactions: Immunodiffusion, Radioimmunoassay, Immunoelectrophoresis, ELISA, Immunohistochemistry, Flow cytometry, development of dot blot, development of monoclonal antibodies and polyclonal antibodies, hybridoma technology

UNIT-IV

Techniques in Proteomics: Extraction of protein from various body fluids, Biochemical changes in body fluids and proteins, Native PAGE, SDS-PAGE, Circular Dichroism, Iso electric focusing, Western Blotting, Mass Spectroscopy. Protein sequencing by mass spectrometry, Protein sequencing; Strategies for protein identification; Protein chips and functional proteomics; Protein-protein interaction; Protein-ligand interaction, Clinical and biomedical application of proteomics; Proteome database; Protein biomarkers and their application in forensic investigation.

Applications of forensic proteomics using human samples like blood, hair, bone, saliva, fingerprint, and urine. Case studies in Forensic Proteomics

UNIT-V

Vaccines: Overview of Vaccine Development, Concept of vaccines, types of vaccine, whole organism vaccines, recombinant vaccines, DNA vaccines, synthetic peptides and multivalent sub-unit vaccines, different strategies of vaccine development.

List of Practicals

1. Extraction of proteins from various biological samples.
2. Protein estimation by different techniques.
3. SDS-PAGE for protein analysis
4. Immunodiffusion
5. ELISA
6. Western Blotting
7. Development of dot blot
8. Analysis of protein structure using RASMOL

Reference Books:

1. J. Owen, J. Punt, S. Stranford, (2012) Kuby Immunology (8th Edition), WH Freeman and Company, USA.
2. D. Male, J. Brostoff, D. Roth, I. Roitt, (2012) Immunology (8th Edition), Saunders, Elsevier, USA.
3. K. Murphy (2011) Janeway's Immunobiology (8th Edition), Garland Science, USA.
4. A. Abbas, A. Lichtman, S. Pillai, (2014) Cellular and Molecular Immunology (8th Edition), Saunders, Elsevier, USA

Specialization – III: (Forensic Physics and Ballistics)

CUFS1097: ADVANCES IN PHYSICAL TECHNIQUES

Credits: 04 (3+1+0)

Course Description: This advanced course is designed for students seeking to deepen their understanding and mastery of physical techniques across various disciplines. Each of these tools and techniques plays a vital role in research, industry, and applied sciences like materials science, chemistry, biology, energy production, and forensic analysis.

Course Objectives:

1. To know the importance of spectroscopy and thermal techniques in processing crime scene evidence.
2. The utility of nanoscience technology in identifying chemical and biological evidences and the usefulness of lasers and its application in forensic investigation.
3. The significance of microscopy in visualizing trace evidence and comparing it with control samples.

Course Outcomes: On successful completion of this course, the students should be able to,

1. Acquire knowledge of NMR spectroscopy principles, instrumentation, and applications in forensic investigation.
2. Understand the principles, working, and applications of techniques like Atomic Absorption Spectroscopy, Raman spectroscopy, and FT-IR spectroscopy in forensic analysis
3. Understand the applications of lasers in forensic investigation, showcasing the ability to utilize laser technology for analyzing physical evidence.
4. Understand crystal analysis principles, including X-rays production, diffraction analysis, and data interpretation.

5. Understand the basics of forensic engineering, including the analysis of structural failures, composition analysis of structural materials, and investigation of multi-component failures.

UNIT-I

Nuclear Process: General introduction of radioactivity, fission, fusion, Type of radioactive decays, basic concepts of half-life including dating concepts, effects of radiation on biological substances. Introduction to principles, working and instrumentation and application for analysis of physical evidences: Nuclear Magnetic Resonance Spectroscopy (NMR), Theory of NMR, NMR, data interpretation and applications

Atomic Process: General introduction of electromagnetic spectrum, atomic and nuclear structure, band gap, energy levels, photoluminescence, absorption, transmission. Introduction to principles, working and instrumentation and application for analysis of physical evidence: Atomic Absorption Spectroscopy, Energy dispersive x-rays, Raman spectroscopy along with their data interpretation and applications.

Lasers: Characteristics of laser light, Spontaneous emission, Stimulated emission, Stimulated absorption, Population inversion and light amplification, Application in forensic investigation

UNIT-II

Molecular Process: General introduction of molecular vibration, bond length Valence electrons, ionic bond, covalent bond, and hydrogen bonds, p and d orbitals.

Introduction to principles, working and instrumentation and application for analysis of physical evidence: FT-IR spectroscopy, their data interpretation and applications.

Thermal Analysis: Principle theory and applications of Thermo gravimetric analysis, differential thermal analysis and differential scanning calorimetry.

UNIT-III

Crystal Analysis: X-rays: Production; continuous and characteristic X-rays and their spectra; principle of diffraction analysis, data interpretation and application.

Nanoscience: Basics of nanoscience, synthesis process, effects of shape, size on chemical and physical properties, introduction of forensic Nanotechnology, Utilization of nanotechnology in analysis of physical evidence, and their applications.

UNIT-IV

Introduction to Forensic Engineering and Various Types of Failures

Introduction to forensic engineering, ISI/Code of Building Construction, Structural failures: Structural Failures basics of failures analysis in case of bridge/flyover, structural material composition analysis leading to failures, testing of prototype for commercialization, an investigation view of multi components failures due to any one module manufacturing defects, etc., static loads, dynamic loads, causes of structural collapse, Reporting the results of Forensic Engineering Investigation, Role of the Legal System

Cement: Types of cement and their composition, determination of adulterants by physical, chemical and instrumental methods, examination of brick, analysis of Bitumen & road materials, analysis of cement mortar and cement concrete & stones, forensic examination of electrical appliances installations.

Legal aspects of failures detection and sampling collection after an incident – Channelization of legal procedures for arriving at investigation, some novel concept of modern technology for forensic analysis.

UNIT-V

Introduction to Microscopy: Introduction to principles, working and application: Optical microscope: Compound microscope, stereo microscope, comparison microscope, phase contrast microscope, fluorescence microscope. Electron microscope: Introduction to principles, working, sample preparation, data interpretation and application: Scanning electron microscope, transmission electron microscope. Introduction to principles, working, sample preparation, data

interpretation and application: Atomic force microscope, Scanning Tunneling Microscope.

List of Practicals

1. Examinations of physical evidence by EDXRF technique
2. Examination and analysis of various physical evidences by Comparison and Stereomicroscope
3. Examination of physical evidences by AFM.
4. Examinations of physical evidence by SEM technique
5. Synthesis, characterization and Utilization of nanomaterials for various forensic applications (silver, gold, tungsten etc)
6. Examination of various physical evidences by Nanotechnology
7. Examination of various physical evidence by ICP technique
8. Examination of Structural materials.
9. Examination of cement
10. Examinations of physical evidence using FTIR and Raman Spectroscopy.

Reference Books:

1. B. Caddy; Forensic Examination of Glass and Paints Analysis and Interpretation ISBN 0784 05749 (2001)
2. David A. Crown; The Forensic Examination of Paints and Pigments, Taylor & Francis, NY (2001)
3. J.Walls; Forensic Science-An Introduction to Scientific Crime Detection 2nd Ed.,Universal, 1st Indian Reprint(2002).
4. Richard Saferstein; Criminalistics-An Introduction to Forensic Science 5th Ed., Prentice Hall(1995).
5. Jay A.Siegel, Pekka J Saukko and Geoffrey C. Kooupfer; Encyclopedia of Forensic Science, Academic Press(2000).
6. E.R.Mengel; Forensic Physics in 2002 year book, McGraw hill Encyclopedia of Science & Technology.
7. R.W. Moncrieff; Man-Made Fibres 6th Ed.,NewnesButterworths(1975)

8. J.E.Booth; Principles of Textile Testing-An Introduction to Physical Methods of testing textile Fibres, Yarns and Fabrics. 3rd Ed., CBS Pub. &Distributors(1996).
9. Katharine Paddock Hess; Textile Fibres and their use, 6thEd.,Oxford& IBH Pub.,Co. (1974)
10. A.B. Wildman; The Microscopy of Animal Textile Fibers. Wool Industries Research Association(1954).
11. Elliot B. Grover and D.S. Hamby; Handbook of Textile testing and Quality Control, Wiley Eastern Pvt. Ltd.(1969)
12. Dorothy Catling and John Grayson; Identification of vegetable Fibers, Chapman and Hall (1982)
13. John H.Skinkle; Textile Testing- Physical, Chemical and Microscopial, 2nd Ed.,Revised and Enlarged, D.B. Taraporevala Sons and Co. (1972).
14. J. Gordon Cook; Handbook of Textile Fibers, Vol-I, Natural Fibres,5th Ed., Merrow(1993)
15. B.P. Saville; Physical Testing of Textiles, The Textile Institute CRC Press and wood head Pub., (2000)
16. AATCC Technical Manual of American Association of Textile Chemists and Colorists, Vol- 75 (2000), American Association of Textile Chemists and Colorists,USA
17. W.E. Morton and J.W. S. Hearle; Physical Properties of Textile Fibers, 3rd Ed., The textile Institute, 1993 (Re printed1997)

CUFS1098: ADVANCES IN FORENSIC BALLISTICS & ARMOUR MATERIALS

Credits: 04 (3+1+0)

Course Description: This advanced course delves into the latest developments in forensic ballistics and modern armor materials, focusing on their applications in law enforcement, military, and forensic science. Students will explore cutting-edge technologies and methodologies in firearm examination, ammunition analysis, and ballistics reconstruction, alongside the evolving design and material science of body armor, vehicle armor, and protective gear.

Course Objectives

1. Understand the advanced concepts of Forensic Ballistics.
2. To learn different instruments and analysis techniques for the identification of Firearms and ammunition.
3. Understand about the NIJ Standard protocols for the construction and testing of Armour materials.

Course Outcomes: On successful completion of this course, the students should be able to,

1. Remember the basics of firearms, firing mechanism, ammunition, gunshot residues.
2. Analyse the core concepts of internal, external and terminal ballistics for their application in case analysis.
3. Understand the details on wounds/ injuries caused by cartridge-firing mechanisms.
4. Evaluate the standards for armour materials for ballistics testing focusing on NIJ standards.
5. Remember the working of various instrumental techniques like BDAS, IBIS, Boroscope, etc and the standard protocols for the test firing and proper handling of case exhibits.

UNIT-I

Examination of Firearm exhibits: Review of firearms & its types, ammunition & its types along with examination. Recent Development in Firearms.

Gunshot Residues/ Powder Residues: Composition of GSR depending upon propellants & primer mixtures, GSR Distribution**,** Mechanism of formation of GSR, Location, source and collection of GSR, Analysis of GSR: spot test, chemical test, identification of shooter and instrumental techniques involved of GSR Analysis, Practical problems related with GSR detections.

UNIT-II

Wound Ballistics: Threshold velocity for penetration of skin/flesh/bones, preparation of gel block, penetrative in gel block and other targets, nature of wounds with various ranges and velocities with various types of projectiles, evaluation of injuries caused due to shot-gun, rifle, handguns and country made firearms and its ante-mortem & post-mortem examination, determination of range of fire.

Core concepts of Forensic Ballistics: Effects of Internal ballistics, Effect of projectile on hitting the target: function of Bullet shape, striking velocity, striking angle and nature of target, tumbling of bullets, effect of instability of bullet, effect of intermediate targets, Influence of range, Cavitations- Temporary and permanent cavities, Ricochet and its effects, stopping power.

UNIT-III

Armour Structure: Basis concepts of armour structure, types of armour, materials: Stress and Strain, Elasticity, Strength, Hardness and dynamic, Penetration Mechanics, Reactive Armour Systems, Human Vulnerability.

Types of armour: Metallic Armour Materials and Structures, Ceramic Armour, Woven Fabrics and Composite Laminates for Armour Applications, Blast and Ballistic Testing Techniques.

Test firing, Procedure for test fire, Purpose for test firing, Recovery methodology, Specifications of Firing gallery, working of automatic firing rest, Safety & Preventive measures. Characterization of bullet proof jacket

Introduction to Ballistic Resistance of Body Armor NIJ Standard: NIJ Body Armor Classification, Sample Requirements and Laboratory Configuration, Flexible Armor Conditioning Protocol, Hard Armor Conditioning Protocol, Ballistic Test Methods.

UNIT-IV

Instrumental techniques used for ballistic evidence analysis: Borescope, Comparison Microscope, Stereo microscope, traveling microscope, Scanning Electron microscope, EDXRF. Introduction to automated system of trajectory computation **(Ballistic Data Acquisition system)**: Operating system & its concepts, Universal Receiver, ICM, Target Frame.

UNIT-V

Automated management of ballistics data **(Integrated Ballistics Identification system)**: History of establishment, Brass Trax, Bullet Trax & Match Point, Limitation & Advantages, Application- comparison of bullets and cartridges- database creation and significance in forensic ballistic investigations. Management and reconstruction of cases involving firearm; Report writing and court findings

List of Practicals

1. Instrumental Examination & Analysis of GSR
2. Barrel Wash Examination
3. Instrumental techniques used for identification of origin
4. Measurement of Rifling by traveling microscope
5. Test Firing System
6. Ballistic data Acquisition system
7. Integrated ballistics identification system.
8. Testing ballistic material in line with different standards.
9. Automated Ballistic Identification System
10. Reconstruction of Deformed bullets using different techniques.

Reference Books:

1. J. Howard Mathews; Charles C. Thomas, Firearms Identification, Vols 1,2,& 3; Springfield, Illinois;
2. Hatcher, Jury And Weller, Firearms Investigation, Identification And Evidence; Stackpole Books, Harrisburg, PA
3. Vincent Di Maio, Gunshot Wounds; Crc Press, Washington,Dc;
4. Brain J. Heard;, Hand Book Of Firearms And Ballistics; John Willey,England;
5. TA, Warlow; Firearms, The Law And Forensic Ballistics; Taylor And Francis,Landon;
6. Karl G. Sellier et al ; Wound Ballistics And The Scientific Background; Elsevier,London
7. M. Johari, Identification Of Firearms, Ammunition And Firearms Injuries; BPR&D, New Delhi;

CUFS1099: AUDIO RECOGNITION AND VIDEO ANALYSIS

Credits: 04 (3+1+0)

Course Description: This course offers a comprehensive study of the techniques and technologies involved in the recognition, analysis, and interpretation of audio and video data. It focuses on the role of audio and video analysis in fields such as law enforcement, security, multimedia, and forensic investigations. Students will explore the principles behind audio signal processing, speech recognition, and sound localization, as well as video analysis techniques like motion detection, facial recognition, object tracking, and video forensics.

Course Objectives

1. Give a detailed insight about audio, video and image forensics
2. To make students understand about how multimedia evidences are collection and analyzed for forensic investigation
3. To learn about the legal admissibility of multimedia evidences

Course Outcomes: On successful completion of this course, the students should be able to,

1. Understand the basic theory of voice production and the proper handling of audio recording evidence.
2. Learn the components and approaches of speaker profiling and recognition including extraction, matching, comparison, etc
3. Learn about the various softwares and their principles for the analysis of multimedia evidences.
4. Understand the basics of video processing, enhancement and authentication.
5. Apply the knowledge of CCTV forensics in the related case examinations.

UNIT-I

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

UNIT-II

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

UNIT-III

Forensic video examination: definition, scope and significance in crime investigation, technical aspects of the video, collection, handling and preservation of video files, video analysis: frame extraction, frame by frame analysis, shot by shot analysis. Video processing and enhancement, Video authentication, Metadata analysis, hash value generation. Biometric Analysis for personal identification, facial biometrics, related case studies.

UNIT-IV

CCTV Forensics: introduction to CCTV Forensics, Acquisition of CCTV footages from the scene of crime, Handling and preservation of CCTV footages, hash value generation, extracting the data from DVR/NVR, maintaining chain of custody.

UNIT-V

Authentication and enhancement of CCTV footages, extraction of frames, Forensic tools for Enhancement and authentication of CCTV footages, legal admissibility of CCTV evidence, related cases studies.

List of Practicals

1. Recording, editing, processing, and conversion of audio files.
2. Segregation of audio files.
3. Word collection from audio files.
4. Spectrographic analysis of Voice.
5. Detection of tampering in audio files.
6. Audio restoration and speech enhancement.
7. Analysis and enhancement of video/image/CTV Footages
8. Detection of tampering in video files.
9. Detection of tampering in image files.
10. Extraction of frame from video/CCTV footages.

Reference books:

1. Hill, T. (2020). CCTV Handbook: Buying, Installing, Configuring, & Troubleshooting: A User's Guide to CCTV Security. Independently published.
2. Damjanovski, V. (2005). CCTV: Networking and Digital Technology (2nd ed.). Butterworth- Heinemann.
3. Kroener, I. (2014). CCTV: A Technology under the Radar? (1st ed.). Routledge.
4. G. (2020, March 18). Types of CCTV Cameras – The Complete Guide. BusinessWatch. https://www.businesswatchgroup.co.uk/types-of-cctv-cameras-the-complete-guide
5. Paul, D., & Puvvala, C. (2020). Video Analytics Using Deep Learning. Apress.
6. Ph.D., P. P. M. (2021). The 2022 Report on Video Analytics, Intelligence, Surveillance, Reconnaissance and Object Recognition Technologies: World Market Segmentation by City. ICON Group International, Inc.

7. Carle, B., & Jensen, R. C. (2018). Understanding Video Management Systems.
8. Wolper, V. E. (2020). Photograph Restoration and Enhancement: Using Adobe Photoshop CC 2021 Version (3rd ed.). Mercury Learning & Information
9. Forensic Speaker Identification by Phil Rose & James RRobertson
10. Forensic Voice Identification by HarryHollien
11. The Acoustic Analysis of Speech by Ray D Kent & CharlesRead

Specialization – IV (Fingerprints & Questioned Documents)

CUFS1100 : MODERN TRENDS IN FINGERPRINT SCIENCES

Credits: 04 (3+1+0)

Course Description: This course explores the latest advancements and methodologies in fingerprint science, focusing on both theoretical foundations and practical applications. Students will examine contemporary techniques in fingerprint analysis, including digital imaging, enhancement methods, and automated identification systems. The curriculum also addresses the role of fingerprints in forensic investigations. Through case studies and hands-on projects, participants will develop critical skills for analyzing and interpreting fingerprint evidence in various contexts, preparing them for careers in forensic science, law enforcement, and criminal justice.

Course Objectives:

1. To make the prospective students understand the basics of fingerprint sciences pertaining to identification.
2. Develop the students skill in fingerprint identification system irrespective of the space and place on which the fingerprints are present.
3. To develop the students with skill of using modern techniques in identification of individuals based on fingerprint sciences.

Course Outcomes: On successful completion of this course, the students should be able to,

1. Understand fundamental principles in fingerprint science and apply this knowledge to recognize and develop latent fingerprints.
2. Analyze the architecture and functioning of Automated Fingerprint Identification Systems (AFIS) and imaging systems and to assess the enhancement techniques using laser and alternate light sources.
3. Gain knowledge on digital imaging, optic methods, and chemical methods for latent print enhancement.

4. Evaluate the importance of Ridgeology and Poroscopy in individual identification.
5. Critically analyze and understand the broader applications of fingerprint science in forensic investigations.

UNIT-I

Introduction and re capsulation to fingerprint science- Functions of Fingerprints bureau Fundamental principles of fingerprint science- Anatomy of skin, Biological significance of skin- Composition of sweat, secretary glands eccrine glands apocrine glands Sebaceous glands chemical composition- Age of donor- various age groups Composition of latent print residues

Chemical developmental methods: Iodine fuming, cyanoacrylate esters acceleration procedures- Post treatment procedures Fluorescent and other chemical alternatives- Ninhydrin analogues. Silver nitrate reagent Special surfaces and situations : bloody prints, tape and sticky surfaces and skin Postmortem fingerprinting techniques

UNIT-II

Automated fingerprint Identification and imaging systems: Introduction, emerging application System architecture, sensing, fingerprint representation Minutiae feature extraction, orientation, estimation, segmentation, Ridge detection, fingerprint matching enhancement

Latent print enhancement by Laser and other alternate light sources: Using photo luminescent nanoparticles Basics of time gated fingerprint detection-Basics of phase resolved imaging Fingerprint treatments: lanthanide based procedures-Photo luminescent fluorescence and phosphorescence- Use of Nanoparticles: cadmium, Zinc, Silver salts

UNIT-III

Silver physical development of latent prints: Silver physical development process of latent prints Formation of silver physical developer particles and preparation Water and acid pretreatment Multi metal deposition process Colloidal gold solution , modified

physical developer enhancement techniques Digital imaging methods, optic methods, X ray , SEM methods Chemical methods: bleaching , intensification

Introduction to Molecular fingerprinting- importance of the molecules detected from the fingerprint residues- factors influencing them- identification characteristics with the molecular concentration

UNIT-IV

Importance of Ridgeology and Poroscopy- for individual identification- Application of the pores dimensions and ridge dimensions in the identification- scope of establishing the identification – characteristics and traits

UNIT-V

Application of Edgeoscopy- personal identification using fingerprints, Other biometric methods of identification iris scan, retinal scan. Cheiloscopy, palato prints, ear prints etc. in forensic and other sciences.

An introduction to UID aadhaar and its significance Scope of research on DNA from fingerprint residues.

List of Practicals

1. Analysis of fingerprints with microscopic techniques for the ridge dimensions with the complete identification profiling.
2. Comparison of males and females fingerprints with the specific reference to the ridge dimensions.
3. Development of latent fingerprints using Physical Method.
4. Development of latent fingerprints using Iodine Fuming.
5. Development of latent fingerprints using Ninhydrin.
6. Development of latent fingerprints using Silver Nitrate.
7. Development of latent fingerprints using Nanoparticles.
8. Understanding AFIS method of fingerprints analysis.
9. Importance of molecular fingerprints with special reference to fingerprint residues using instrumental methods.

Reference Books:

1. David R. Ashbaugh; Quantitative and Qualitative Friction Ridge Analysis, CRC Press (1999)
2. E. Roland Menzel; Fingerprint Detection with Lasers, 2nd Ed., Marcel Dekker, Inc. USA (1999)
3. James F. Cowger; Friction Ridge skin, CRC Press London, (1993)
4. Mehta, M.K; Identification of Thumb Impression & Cross Examination of FingerPrints, N.M. Tripathi Pub. Bombay (1980)
5. Moenssens; Fingerprints Techniques, Chitton Book Co. Philadelphia, NY (1975)
6. Chatterjee S.K.; Speculation in Fingerprint Identification, Jantralekha Printing Works, Kolkata (1981)
7. Cowger, James F; Friction ridge skin- Comparison and Identification of fingerprints, CRC Press, NY (1993)
8. Cook Nancy; Classifying Fingerprints, Innovative learning pub. Mento Park (1995)
9. Cossidy M.J; Footwear Identification, Royal Canadian Mounted Police, Ontario, Canada (1980)
10. J A Seigel, P.J Saukoo and G C Knupfer; Encyclopedia of Forensic Sciences Vol. I, II and III, Acad. Press (2000)
11. Smith B.C, Holland MM, Sweel DL & Dizinno. A; DNA & Forensic Odontology-Manual of Forensic Odontology, Colorado Springs, USA (1995)
12. Hillison, S; Dental Anthropology, Cambridge Univ. Press, UK (1996)
13. Kasprzak J; Possibilities of Cheiloscopy in Forensic Science (1980)
14. Iannarelli, A V; Ear Identification, Forensic Identification series, Paramount (1989).
15. Henry C. Lee & R. E. Ganesslen; Advances in Finger Print Technology, CRC Press, London (1991).
16. Saxena, B.L.; Law and techniques relating to identification of handwriting, disputed documents, finger prints, foots and detection of forgeries, Central Law Agency, Allahabad (1990)
17. Hardless, H.R; Disputed documents examination and fingerprints Identification

(with Illustrations, Sketches, Diagrams, Photos etc), Law Book Co. Allahabad (1995)

18. Menzel, E Roland; Fingerprint detection with lasers, Marcel Dekker, NY (1999)
19. Jain L C; Intelligent Biometric Techniques in Fingerprint and face recognition, CRC Press Ohio (1999)
20. Bridges B C; Criminal Investigation, Practical fingerprinting, Thumb Impressions, Handwriting expert testimony opinion Evidence, University Book Agency, Allahabd (2000)
21. Maltoni, Davide; Handbook of fingerprint recognition, Springer Verlag, NY (2003)
22. Ratha Nalini; Automatic Fingerprint recognition system, Springer Pub., NY (2004)

CUFS1101: QUESTIONED DOCUMENT & FORENSIC ACCOUNTING

Credits: 04 (3+1+0)

Course Description: This course provides an in-depth exploration of the forensic examination of questioned documents. Students will learn about the various techniques and methodologies used to analyze and authenticate handwritten, typed, or printed documents that are under investigation. Key topics include handwriting analysis, signature verification, ink and paper analysis, detection of alterations, forgeries, security features of currency notes , passport, VISA and counterfeiting. The course also covers the legal implications and procedures related to the presentation of document evidence in court. Practical lab sessions will allow students to apply theoretical knowledge to real-world scenarios, enhancing their skills in document examination.The course covers key topics such as fraud detection methodologies, asset tracing, forensic data analysis, digital forensics, and the legal aspects of financial investigations.

Course Objectives

1. Give a detailed insight about Forensic document examination
2. To make students understand basics of forensic accounting
3. To learn about the legal admissibility of document evidences

Course Outcomes: On successful completion of this course, the students should be able to,

1. Demonstrate understanding of document types and applying knowledge to handle exhibits
2. Detects forgeries, and employs basic tools in forensic document examination.
3. Analyze disguised writing, alterations in documents, and decipher secret writing.
4. Evaluate the importance of forensic linguistics and stylistics in writer identification, examine e-documents and digital signatures, and demonstrate effective opinion reporting in court.

5. Examine financial documents and analyze case studies related to whistleblowers and red flags.

UNIT-I

Types of documents-genuine, contested, questioned and forged documents, Care and Handling of Document Exhibits, Forgeries & its types, detection of forgeries in handwriting, signatures and related case studies, Basics of handwriting identification, individuality of handwriting, natural variations, determination of authorship of writer, collection of exemplars, basic tools needed for forensic documents examination and their significance.

UNIT-II

Disguised writing and anonymous letters, Examination of alterations in documents, Decipherment of secret writing, Indented writings and charred writings. Examination of seal and other mechanical impressions, Built up documents, determination of sequence of strokes, physical matching of documents

Examination of Photostat (Xerox) copies, carbon copies, fax message, typewritings, printed matter: letterpress printing, intaglio printing, offset printing, screen printing & its related concepts, printing of security documents, examination of security features: Indian currency notes, passports/visa, credit/debit cards etc, Related Case Studies.

UNIT-III

Estimating the age of document and writings, types of computer printers and their working, Examination of Computer printouts, Forensic linguistics and stylistics, its importance in writer identification Examination of e-documents and digital signatures, Opinion- Reporting to the court juxtaposed charts - evidence in the court- cross examination, Related Case Studies

UNIT-IV

Introduction to Forensic accounting, fraud triangle and other theories of fraud, Fraudster profiling, Fraud deterrence, Money laundering and its types, Laws related to

money laundering, understanding business information & financial reporting system accounting & auditing standards & procedures, evidence gathering & investigative techniques.

UNIT-V

Litigation and litigation processes, Examination of financial documents. Whistleblowers and acts for their protection, Concepts of Red flags, related case studies.

List of Practicals

1. Examination of additions, alterations, and obliterations in the documents.
2. Examination of indented handwriting.
3. Examination of sequence of intersecting strokes
4. Examination of currency notes
5. Examination of Passport
6. Examination of Stamps
7. Examination of Rubber Stamp Impressions
8. Examination of ink by TLC
9. Examination of ink by GCMS
10. Examination of ink by LCMS

Reference Books:

1. Albert S. Osborn; Questioned Documents, Second Ed.; Universal Law Publishing, Delhi
2. Koppenhaver, K. (2010). Forensic Document Examination: Principles and Practice (1st Ed.).
3. Hilton, O. (1993). Scientific examination of questioned documents (1st ed.). Boca Raton:CRC Press.
4. Harrison, W. (1958). Suspect documents.
5. Kelly, J., & Lindblom, B. (2006). Scientific examination of questioned documents. Boca Raton, FL: CRC/Taylor & Francis.

6. Ellen, D. (2006). Scientific examination of documents. Boca Raton, FL: Taylor & Francis.
7. Huber, R., & Headrick, A. (1999). Handwriting identification (1st ed.). Boca Raton: CRC Press.
8. Zimbelman, M., Albrecht, C., Albrecht, W., & Albrecht, C. (2012). Forensic accounting. South-Western

CUFS1102: FORENSIC PHOTOGRAPHY & BIOMETRICS

Credits: 04 (3+1+0)

Course Description: This course provides an in-depth exploration of the critical role that photography and biometric analysis play in forensic investigations. Students will learn how to capture, document, and analyze crime scenes and physical evidence using advanced photographic techniques. The course also introduces biometrics, covering the science and technology behind the identification of individuals through unique biological traits, such as fingerprints, facial recognition, iris scans, and DNA.In forensic photography, students will focus on the proper use of cameras, lighting, and angles to document crime scenes, injuries, and evidence with precision and clarity. Techniques such as macro photography, ultraviolet (UV) and infrared imaging, and digital enhancement will be emphasized.

Course Objectives

1. To establish a foundational understanding of optics, light, and camera functions, enabling students to comprehend the principles governing image formation.
2. Develop proficiency in camera operation, image composition, and the nuances of achieving proper focus and exposure.
3. To equip students with the knowledge and skills required for crime scene, vehicle, subject, and evidence photography in investigative situations.

Course Outcomes: On successful completion of this course, the students should be able to,

1. Acquire knowledge of the history of photography, types of cameras, and optical filters.
2. Analyze modern developments in photography, specifically digital photography and its forensic applications.
3. Gain knowledge on various biometric types and applications.
4. Critically evaluate recent advances in biometrics, considering their implications

for security.

5. Apply software for digital photography, understand crime scene photography techniques, and explore applications of IR and UV photography.

UNIT-I

Introduction to Photography, History of photography & Cameras, Types of Camera and lenses, photographic instruments: light sources, optical filters, fundamentals of light and vision, Spectral sensitivity of photographic materials, Camera exposure determination. Basic principles and techniques of Black & White and color photography, Concepts of colored photography, Linkage of cameras and film negatives.

UNIT-II

Modern developments in photography: digital photography, Image sensors, software for digital photography, Image File formats, photo shop-development- digital images processing and manipulation- forensic application. Crime scene photography, photomicrography, macro photography, Reprovit unit, photography of fingerprints and documents, IR and UV photography, Introduction to photogrammetry and its applications in Forensic Science, crime scene videography / high speed videography, Court representation and admissibility of photographs in the judicial system.

UNIT-III

Introduction to Biometrics, Types of Biometrics, Biometric applications, Traits of Physiological Biometrics: Facial recognition, Hand geometry, Fingerprints, Iris scan & Retinal Scan, Thermogram.

UNIT-IV

Behavioral biometrics, Traits of Behavioural Biometrics: Gait Pattern, Keystroke Analysis, Signature Analysis, Voice pattern Analysis, Heartbeat Analysis.

UNIT-V

Recent Advances in Biometrics for Security Prospects. Biometric Data base management – Surveillance, Physical Security, management & maintenance, Biometric privacy.

Biometric standards and application, Multimodal biometrics, performance testing and reporting.

List of Practicals

1. Identification of parts of Camera
2. Study the Depth of Field using photography
3. Evidences photography
4. Crime scene photography-long shot, medium and close ups
5. Photomicrography & Macro-photography
6. Hand Geometry
7. Facial Recognition System
8. Facial Geometry
9. Gait Pattern Analysis
10. Understand and correlate ridges of the palm as a biometric trait

Reference Books:

1. Henry Horenstein; "Black and White Photography: A Basic Manual", Little, Brown and Company., 2004
2. Henry Horenstein; "Color Photography: A Basic Manual", Little, Brown and Company., 1995
3. Ang Tom; "The Complete Photographer", Dorling Kindersley Ltd., 2010.
4. Gernsheim Helmut; "A concise history of Photography", 3rdEd., Dover Publications, 1986.
5. Freeman Michael; "The Complete Guide to Digital Photography", 4thEd., Lark Books, 1945.
6. Farrell Ian; "Complete Guide to Digital Photography", Quercus Publications, 2017.

7. Edge Martin; "The Underwater Photographer", Focal Press, 2010.
8. Bergner Joachim, E. Gelbke, W. Mehliss; "Practical Photomicrography", Focal Press, 1966.
9. White Laurie; "Advance Infrared Photography", Amherst Media, 1995.
10. Feininger Andreas; "The Complete Photographer", Prentice Hall, 1965
11. Champod, C. (2017). *Handbook of Biometrics for Forensic Science*. Springer International Publish.
12. Jain, A. K., & Ross, A. A. (2011). *Introduction to biometrics* (1st ed.). Springer.
13. Vacca, J. R. (2007). *Biometric Technologies and Verification Systems*. Elsevier - Butterworth Heinemann.
14. Fairhurst, M. (2014). *Age factors in biometric processing*. The institution of engineering and technology.
15. Boulgouris, N. V., Plataniotis, K. N., Micheli-Tzanakou, E., & Boulgouris, N. V. (2010). *Biometrics: Theory, methods, and applications*. IEEE Press.
16. Tsutsui, S. (2021). *Intelligent biometric techniques in fingerprint and face recognition*. Routledge.
17. Yang, J., & Xie, S. (2012). *New trends and developments in Biometrics*. InTech.

Specialization – V (Cyber Forensics)

CUFS1103: CYBER LAW, RISK AND COMPLIANCE

Credits: 04 (3+1+0)

Course Description: This course provides a comprehensive overview of the legal frameworks and regulatory requirements governing cybersecurity and data protection. Students will explore key concepts in cyber law, including privacy regulations, intellectual property rights, and compliance standards such as GDPR and HIPAA. Emphasizing risk management strategies, the course will examine how organizations can effectively navigate legal challenges and mitigate cybersecurity risks. Through case studies and practical exercises, participants will gain insights into the intersection of law, technology, and business, equipping them with the skills to develop robust compliance programs and respond to legal incidents in the digital landscape.

Course Objectives

1. To Learn Security Audit and Compliance
2. To understand the Process of Security Audit
3. To understand the industry standard practice for auditing

Course Outcomes: On successful completion of this course, the students should be able to,

1. Demonstrate the processes of IT security assessment
2. Examine scope for audit Identifying critical requirements for audit
3. Gain knowledge about acceptable Level of Risk and Appropriate Security Baseline Definitions, Seven Domains of a Typical IT infrastructure
4. Demonstrate Risk Analysis, Risk Identification, Risk Assessment, Risk Response
5. Understand Disaster Recovery (DR) planning, Identification of potential disaster status and IT act.

UNIT-I

What is IT security assessment? What is an IT security audit? What is compliance? How does an audit differ from an assessment? Why are governance and compliance important? What if an organization does not comply with compliance Laws? What is the scope of an IT Compliance audit?, Defining the scope for audit, Identifying critical requirements for audit, assessing IT security, Understanding Audit Plan, Audit Process, Types of IT Audits, Computer Assisted Audit Techniques, CAATs for Sampling, CAATs for Application Reviews, CAATs for Auditing Application Controls

UNIT-II

Identifying the minimum Acceptable Level of Risk and Appropriate Security Baseline Definitions, Seven Domains of a Typical IT infrastructure, Writing the IT Infrastructure Audit Report, Compliance within User Domain: Compliance law requirements and business drivers, Items commonly found in the user domain, Compliance within the workstation domain: Compliance law requirements and business drivers, devices and components commonly found in the workstation domain, Maximizing C-I-A, Compliance within LAN Domain: Compliance law requirements and business drivers, devices and components commonly found in the LAN domain, Compliance within WAN Domain: Devices and Components Commonly Found in the Domain, Penetration Testing and Validating Configurations, Compliance within Remote Access and Application Domain: Devices and Components Commonly Found in the Domain, Application Server Vulnerability Management, Application Patch Management

UNIT-III

Introduction to Risk Analysis, Risk Identification, Risk Assessment, Risk Response and Mitigation, Risk Reporting, Introduction to Business Continuity Planning (BCP), Overview of BCP Life Cycle, Need for BCP, Identifying and Selecting Business Continuity Strategies

UNIT-IV

Introduction to Disaster Recovery (DR) planning, Identification of potential disaster status, DR Strategies, Plans for Business Resumption, Category to Cyber-crime, Cyber Law, IT Act 2000 and its amendments, International Cyber Laws, Cyber Ethics,

UNIT-V

Child Sexual Abuse Material related to cyber domain, various acts related to social media, privacy and security on cyber domain, Auditing Standards and Frameworks: ISO/IEC 27001/2, COBIT, SOC Compliance, HIPAA, Case Studies.

List of Practicals

1. To study about Sys-Internals.
2. To study about Windows Logs based on scenarios.
3. To study about filter logs based on scenarios.
4. To study and implement any SIEM (Security Information & Event Management) tool.
5. To study real-time visibility across an organization's information security systems using any SIEM tool.
6. To study Event log management that consolidates data from numerous sources using any SIEM tool.
7. To perform acquisition of any drive (HDD, SSD, USB) using FTKImager.
8. To perform primary level analysis using HxDEditor.
9. Manipulating Data by Using HxD.
10. To perform detailed analysis of Forensic Image using Forensic Toolkit.

Reference Books:

1. Auditing IT Infrastructures for Compliance By Martin M. Weiss, Michael G.Solomon, Jones & Bartlet Learning, 2015
2. The IT Regulatory and Standards Compliance Handbook by Craig S. Wright, Syngress, 2015
3. Information Technology Control and Audit 5th Edition by Angel R. Otero, 2019

4. (Internal Audit and IT Audit Series) The Complete Guide to Cyber Security Risks and Controls by Anne Kohnke, Dan Shoemaker, Ken Sigler, 2016
5. PCI DSS An Integrated Data Security Standard Guide- APress By Jim Seaman, 2020
6. AICPA - Guide_ SOC 2 Reporting on an Examination of Controls at a Service Organization Relevant to Security, Availability, Processing Integrity, Confidentiality, or Privacy-Wiley, 2018
7. Bob Hayes, Kathleen Kotwica, "Business Continuity 2nd Edition", Elsevier Pub.2013.
8. Governance, risk, and compliance by Microsoft, 2019
9. IT Act 2000 and 2008 bare acts documents
10. Cyber Law in India, Satish Chandra (2017)

CUFS1104: INCIDENT RESPONSE AND DIGITAL FORENSICS

Credits: 04 (3+1+0)

Course Description: This course provides a comprehensive overview of the principles, processes, and tools involved in Incident Response and Digital Forensics. It focuses on preparing students to respond to cybersecurity incidents, conduct investigations, and analyze evidence while maintaining legal and ethical standards. The course blends theoretical knowledge with practical skills through real-world scenarios and hands-on lab exercises.

Course Objectives

1. Understand concept of Incident Response Management
2. To learn various Incident Response Management Techniques
3. Understand fundamental of Digital Forensics
4. To learn various Digital Forensics Techniques

Course Outcomes: On successful completion of this course, the students should be able to,

1. Understand Key Concepts of Information Security, Types of Computer Security Incidents
2. Understand concepts of Incident Handling Process, Real-time log capture and analysis
3. Demonstrate Digital Forensics: Definition, Process, Locard's Principle of Exchange, Branches of Digital Forensics, Handling Digital Crime Scene"
4. Understand and Analyse FAT and NTFS File Systems, Recreating FAT and NTFS Partitions, Analysing Unallocated Partitions, Registry Analysis
5. Understand the concept of Event and Log Analysis: Introduction to Windows Events

UNIT-I

Cyber Incident Statistics, Computer Security Incident, Information Warfare, Key Concepts of Information Security, Types of Computer Security Incidents, Examples of Computer Security Incidents, How to Identify an Incident, Need for Incident Response, Goals and Purpose of Incident Response, Signs of an Incident, Incident Categories, Incident Prioritization, Use of Disaster Recovery Technologies, Impact of Virtualization on Incident Response and Handling, Estimating Cost of an Incident, Incident Reporting, Incident Reporting Organizations, Vulnerability Resources, Incident Management, Incident Response Team Roles, Incident Response Team Responsibilities, Dependencies

UNIT-II

Incident Handling Process, Real-time log capture and analysis, Botnet identification and counteraction, Enterprise Solutions for Incident Response and Recovery, Timeline Analysis, Malware Handling: Safety; Documentation; Distribution, Report Writing: Reporting Standards; Report Style and formatting; Report Content, Quality Assurance, When to perform a live response, selecting a live response tool, what to collect, collection best practices, livedata collection on Microsoft windows systems, Live data collection on Unix-based systems, understanding network monitoring, Types of network monitoring, setting up a network monitoring system, network data analysis, collect logs generated from network events, Analysis methodology: Define Objectives; Where the data is stored? Outline an approach; select methods; evaluate results, investigating applications: What is application data; where is application data stored; general investigation methods; web browsers; email clients; instant message clients, Analysis of application data

UNIT-III

Digital Forensics: Definition, Process, Locard's Principle of Exchange, Branches of Digital Forensics, Handling Digital Crime Scene, Important documents and Electronic Evidence, Introduction to Evidence Acquisition: Identification, Acquisition, Labelling and Packaging, Transportation, Chain-of-Custody, Importance of Document and

Preservation, Acquisition Process; Write-Blockers, Imaging Techniques, Evidence Integrity, Standard Operating Procedures for Acquisitions and Preservation of Evidences, Introduction to Data Recovery and Carving: Importance of Data Recovery in Forensic Investigation, Carving Methods, Difference between Data Recovery and Carving,

UNIT-IV

File System Analysis: Understanding and Analysing FAT and NTFS File Systems, Recreating FAT and NTFS Partitions, Analysing Unallocated Partitions, Registry Analysis: Understanding Windows Registry, Analyzing Windows Registry, Finding Important Artefacts Related to user Activities, User/Application Configurations and Preferences; Attached Devices, Shared Locations, Recently Accessed Documents, Programs and Locations; Installed Applications and Others from Windows Registry,

UNIT-V

Event and Log Analysis: Introduction to Windows Events, Understanding Windows Events (Evt and Evtx Files). Analysing Logs of Third-Party Applications.

List of Practicals

1. To perform Brute Force attack.
2. To perform SQL Injection attack on the Lab Environment.
3. To perform File Upload attacks on the Lab Environment.
4. To perform Social Engineering attacks using SET.
5. To study capturing network packets using Wireshark (Fundamentals).
6. Analyze the packets provided in the lab using wireshark.
7. Using Sysinternals tools for Network Tracking and Process Monitoring, monitor Hard disk and virtual memory.
8. Recovering and Inspecting deleted files using any tool.
9. To study and analyse web browsing history.
10. To study cache and cookies analysis.

Reference Books: -

1. Computer Incident Response and Forensics Team Management: Conducting a Successful Incident Response by Leighton Johnson
2. Incident Handling and Response: A Holistic approach for an efficient security incident management by Jithin Aby Alex
3. Blue Team Handbook: Incident Response Edition by Don Murdoch
4. The Computer Incident Response Planning Handbook: Executable Plans for Protecting Information at Risk by N. K. McCarthy
5. Critical Incident Management: A Complete Response Guide, Second Edition by John McNall, Thomas T. Gillespie, Vincent F. Faggiano
6. Applied Incident Response by Steve Anson
7. Security Operations Center – SIEM Use Cases and Cyber Threat Intelligence by Arun E Thomas
8. Incident Response & Computer Forensics by Jason T. Luttgens, Kevin Mandia and Matthew Pepe
9. Incident Management for Operations by Chris Hawley, Rob Schnepp and Ron Vidal
10. Digital Forensics and Incident Response: Incident Response Techniques and Procedures to Respond to Modern Cyber Threats, 2nd Edition by Gerard Johansen

CUFS1105 : VULNERABILITY ASSESSMENT & PENETRATION TESTING

Credits: 04 (3+1+0)

Course Description: This course focuses on the methodologies, tools, and techniques used in Vulnerability Assessment and Penetration Testing (VAPT). It is designed to equip students with the knowledge and hands-on skills to identify, assess, and exploit vulnerabilities in systems, networks, and applications. By simulating real-world attack scenarios, students will learn how to proactively test the security posture of organizations and recommend remediation measures to mitigate risks.

Course Objectives:

1. To find the vulnerabilities and learn various vulnerability assessment techniques.
2. Learn various aspects of web application security.
3. Exploitation of potential web vulnerability.

Course Outcomes: On successful completion of this course, the students should be able to,

1. Gain knowledge in Computer Network and Vulnerability Assessments
2. Understand the Principal Footprinting and Scanning Ping Sweeping Specifying the Targets and Vulnerabilities Database Lookup
3. Gain skills in Web Application Pen Testing and various attacks and other Vulnerable Dynamic Queries in applications and systems
4. Understand the concepts of different types of attacks on systems and applications
5. Understand the types of attack executing scripts and software

UNIT-I

Introduction to Computer Network and Vulnerability Assessments: Introduction of OSI and TCP/IP model, layers and its functionality, Introduction to Vulnerability Assessment, Life cycle of Vulnerability Assessment, Vulnerability Scanners, Manual Testing, Vulnerability testing using OpenVAS, Netcat, Introduction to Unknown Vulnerability Assessment.

UNIT-II

Footprinting and Scanning: Foot printing: Mapping a Network: Why Map a (Remote) Network, Ping Sweeping: Fping, Nmap Ping Scan, OS Fingerprinting: Fingerprinting with Nmap Port Scanning : Under the Hood of a Port Scanner: TCP Three Way Handshake, Scanning with Nmap : Nmap Scan Types, TCP Connect Scan with Nmap , TCP SYN Scan with Nmap , Version Detection with Nmap , Specifying the Targets: By DNS Name , With an IP Addresses List , By Using CIDR Notation , By Using Wildcards , Specifying Ranges , Octets Lists , Combining the Previous Methods , Choosing the Ports to Scan, Nmap Examples, Port Scanning, Service Detection, Vulnerabilities Database Lookup

UNIT-III

Web Application Pen Testing: Brute-force, Dictionary-based Enumeration. Cross Site Scripting ,XSS Actors, Vulnerable Web Applications, Users, Attackers, Finding an XSS, Reflected XSS Attacks, Reflected XSS Filters, Persistent XSS Attacks, Persistent XSS Attack Examples, Cookie Stealing via XSS,DOM XSS SQL Injections: SQL Statements, SELECT Example, UNION Example, SQL Queries Inside Web Applications, Vulnerable Dynamic Queries, Finding SQL Injections, Example - Finding SQL Injections, From Detection to Exploitation, Boolean Based SQL Injections, Exploiting a Boolean Based SQL Injection, Scripting Boolean Based SQL Injections, UNION Based SQL Injections, Exploiting UNION SQL Injections, SQL Injection (Blind), SQL Map with all options.

UNIT-IV

Password Attacks - Brute Force Attacks: A Brute Force Algorithm, Brute Force

Weaknesses, Dictionary Attacks, Performing a Dictionary Attack, Weaknesses of Dictionary Attacks, Mangling Words, John the Ripper, Unshadow, Brute Force with John the Ripper, Dictionary Attacks with John the Ripper, Installing Password Dictionaries, Rainbow Tables, Rainbow Tables Limitations, Ophcrack,

UNIT-V

Burp Suite : Intercepting Proxies, Intercepting Proxy Example, Proxy Server Example, Burp Proxy, Burp Proxy Configuration, Burp Repeater, Command Execution, Cross Site Request Forgery, File Inclusion, File Upload, Insecure Captcha.

List of Practicals

1. TCP scanning using NMAP
2. Port scanning using NMAP
3. TCP / UDP connectivity using Netcat
4. How to install OpenVAS in Linux System?
5. Network vulnerability using OpenVAS
6. How to install DVWA in Linux System / Windows ?
7. Web application testing using DVWA
8. Manual SQL injection using DVWA
9. XSS using DVWA
10. Automated SQL injection with SqlMap

Reference Books:

1. Computer Networks, Fifth Edition, Andrew S. Tanenbaum, David J. Watherall, Prentice Hall.
2. Web Application Security, A Beginner's Guide by Bryan Sullivan, Vincent Liu, McGraw Hill Education Publication (2011).
3. Hands-On Bug Hunting for Penetration Testers A Practical Guide to Help Ethical Hackers Discover Web Application Security Flaws By Joseph Marshall, Packt Publication (2018).
4. The Web Application Hacker's Handbook: Finding and Exploiting Security

Flaws by Dafydd Stuttard, Marcus Pinto, 2nd Edition, Wiley Publication (2007).

5. The Penetration Tester's Guide to Web Applications By Serge Borso, Artech House Publication (2019).
6. Web Application Security Exploitation and Countermeasures for Modern Web Applications by By Andrew Hoffman,O'Reilly Media Publication (2020)
7. Developing Web Applications By Ralph Moseley, M.T. Savaliya, Wiley Publication.

Sp***ecialization – VI:*** ***(Crime Scene Management)***

CUFS1106 : BASICS OF CRIME, EVIDENCE AND LAW

Credits: 04 (3+1+0)

Course Description: This introductory course examines the fundamental principles of criminal law and the role of evidence in the justice system. Students will explore key concepts such as the definition of crimes, the types of evidence, and the rules governing its admissibility in court. The curriculum covers essential legal frameworks, investigative procedures, and the ethical considerations involved in criminal investigations. Through case studies and discussions, participants will develop a foundational understanding of how evidence is collected, preserved, and presented, preparing them for further studies in criminal justice, law enforcement, or legal studies.

Course Objectives:

1. To learn about the importance of crime and causes of criminal behavior.
2. Understand the significance of evidence in crime.
3. To know about working of the forensic establishments in India and abroad and the elements of criminal justice system

Course Outcomes: On successful completion of this course, the students should be able to,

1. Understand criminal behavior, its causes, theories, modus operandi, criminal profiling, and the concept of corpus delicti.
2. Acquire knowledge of various laws, including the Code of Criminal Procedure (CrPC), Indian Evidence Act, and Indian Penal Code (IPC)
3. Comprehend the medico-legal aspects, including the PM report, dying declaration, and expert testimony.
4. Understand the definition and classification of crime scene evidence as well as the importance of maintaining the chain of custody.

5. Understand the roles and functions of various organizations such a police academies, the NIA, Fingerprint Bureaus, NCRB, CBI, INTERPOL and others, in the criminal justice system.

UNIT-I

Basis of Crime: Introduction to Crime, Essentials of a crime (Actus reus & Mens Rea), Causes and consequences of crime, Theories of Crimes. Crimes against Property and Person. Traditional Crimes, Modern Crimes, Cyber assisted Crimes. Terrorism and Insurgency, Crime and Politics. Media, Technology and Crime. Transnational Crimes. Basic Concepts of Victimology. Juvenile delinquency. Social change and crime.

UNIT-II

Crime & Criminal behavior: Definition of Crime; Various types of crime: White Collar Crimes Economic Crimes, Organized crimes, Environmental Crimes, Cyber Crimes, Terrorism, Victimless Crimes, Hate Crimes, Honour Crimes; Criminal behavior-cause and theories; Modus Operandi; Criminal profiling; Corpus Delicti.

UNIT-III

Law: Law, types of Law, Important Provisions of Code of Criminal Procedure- FIR, Complaint, Sec. 291, 292, 293, Framing of Charges, Bailable and Non-Bailable offence, cognizable and non- cognizable offence, summons, warrant, Investigation, inquiry and trial. Important Provisions of Indian Evidence Act, 1872- Section 32, 45, 46, 47, 57, 58, 60, 65, 65B, 73, 135, 136, 137, 159.

Important Provisions of Indian Penal Code, 1860- Definitions, General Exceptions, Relevant provisions. IPC 302, 304, 306, 307, 309, 375, 376, 377, 498 and Cr PC 174. Medico Legal Aspects – PM report, Dying Declaration & Expert Testimony.

UNIT-IV

Evidence: Definition of Evidence, Classification of crime scene evidence – Physical and trace evidence, Collection, labelling, sealing of evidence, Hazardous evidence, Preservation of evidence, Chain of Custody, Sample Warden.

Organizations: Police Academies, National investigation agency, Police & Detective Training Schools, Government of Questioned Documents Examiners, Fingerprint Bureaus, National Crime Records Bureau, National Investigation Agency, Central Bureau Of Investigation, Crime and Criminal Tracking Network & Systems, Research and Analysis Wing, INTERPOLE, Bureau of Police Research & Development, and other agencies involved in the criminal investigations, agencies referred for the additional information and requisite examinations

List of Practicals:

References Books:

1. S.H. James and J.J. Nordby, Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton (2005).
2. D.E. Zulawski and D.E. Wicklander, Practical Aspects of Interview and Interrogation, CRC Press, Boca Raton (2002).
3. 3. R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004).
4. J.L. Jackson and E. Barkley, Offender Profiling: Theory, Research and Practice, Wiley, Chichester (1997).
5. R. Gupta, Sexual Harassment at Workplace, LexisNexis, Gurgaon (2014).
6. Criminology , Victimology and Penology by N.V. Paranjape, Central Law Publications 2014

CUFS1107: CONCEPTS OF CRIME SCENE MANAGEMENT

Credits: 04 (3+1+0)

Course Description: This course provides a comprehensive introduction to forensic science, covering the fundamentals of crime scene management, evidence analysis, report writing, and court testimony. Details about branches of forensic science and the role of police organizations in criminal investigations, practical aspects of crime scene management, including securing the scene, documenting evidence and reconstructing the crime has been focused on. Additionally, report writing, court testimony, and ethical considerations in forensic science is also overviewed in the respective course.

Course Objectives

1. To know about the importance of Crime Scene Management and significance of report writing in any investigation.
2. Understand the usefulness of reconstruction in any criminal investigation.
3. To study different medicolegal aspects in various criminal cases.

Course Outcomes: On successful completion of this course, the students should be able to,

1. Grasp the definitions and fundamental concepts in forensic science, including its historical development and organizational structure.
2. Understand the essentials of securing a crime scene, emergency procedures, and the dos and don'ts in crime scene management.
3. Understand the stages and types of crime scene reconstruction, including the analysis of pattern evidence such as bloodstain patterns, glass fracture patterns, fire burn patterns, and tire/skid mark patterns.
4. Understand the admissibility of expert testimony in court, pre-court preparation, and the ethical considerations in forensic science.
5. Gain insights into medicolegal aspects related to victims and the deceased at crime scenes

UNIT-I

Forensic Science: Definitions and concepts in forensic science. Scope of forensic science. Need of forensic science, Basic, Principles & Significance, History & Development of Forensic Science, Organizational structure of Forensic Science, Frye case and Daubert standard, labs in Central & State, Hierarchical set up of Central Forensic Science Laboratories, State Forensic Science Laboratories, Branches of Forensic science, Police structure, Organization set up of police structure.

UNIT-II

Crime Scene Management: Defining the Scene of crime, Managing a crime scene & its hierarchy, Role of First Responding Officers, Securing the Crime scene, Emergency & First Aid, Dos and Don'ts in Crime Scene, Documenting initial crime scene information.

Processing of Crime scene: Documentation/ Note taking of crime scene, crime scene Photography, Sketch drawing of scene of crime, Search Patterns of a crime scene, use of video and CCTV, Chain of custody.

Reconstruction of crime scene: Introduction to Crime Scene Reconstruction, Nature of Reconstruction, Basic Principles of Reconstruction, Stages in Reconstruction, Types of Reconstruction, Pattern Evidence in Reconstruction (Bloodstain Pattern Analysis for Reconstruction, Glass Fracture Patterns, Fire Bum Patterns, Tire and Skid Mark Patterns), Writing A Reconstruction Report.

UNIT-III

Report writing: General aspects of report, Processing of the repost, Panchnama, Report Writing. Case studies & report writing of crime scene visits.

Court testimony- admissibility of experts' testimony, pre court preparation and court appearance, examination in chief, cross examination and re-examination. Ethics in forensic science.

UNIT-IV

Preventive Forensics: Types of Situational Crime Prevention, A problem oriented policies, concepts of crime prevention, forensic intelligence: surveillance, CCTV,

Introduction to big data, types of big data, analysis and forensic implication of big data.

UNIT-V

Understanding medicolegal aspects of victim and deceased at the scene of Crime: Time of death, various types of injuries and wounds. Antemortem hanging, Postmortem hanging, Antemortem drowning, Postmortem drowning, Antemortem burning, postmortem burning. Visit to the medico legal institute for understanding autopsy and various samples drawn during the time of autopsy examination like Visra, V.S slide, V.S. swab, Blood and Urine samples. Ballistics: Classification of firearms, Range of fire, Line of fire and Wound ballistics.

List of Practicals

1. Collection of physical evidences at the scene of crime
2. Packaging of physical evidences at the scene of crime
3. Moot court
4. Crime Scene Management at the scene of crime
5. Sketching of scene of crime
6. Reconstruction and evaluation of scene of crime
7. Searching Methods on crime scene
8. Forensic Ballistics: Cartridge examination, Bullet examination
9. Case studies and Report Writing

Reference Bookss:

1. M. Byrd, Crime Scene Evidence: A Guide to the Recovery and Collection of Physical Evidence, CRC Press, Boca Raton (2001).
2. T.J. Gardener and T.M. Anderson, Criminal Evidence, 4th Ed., Wadsworth, Belmont (2001).
3. S.H. James and J.J. Nordby, Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton (2005).
4. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's, Techniques of Crime Scene Investigation, CRC Press, Boca Raton (2013).

5. D.E. Zulawski and D.E. Wicklander, Practical Aspects of Interview and Interrogation, CRC Press, Boca Raton (2002).
6. R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004).
7. J. Howard Mathews; Charles C. Thomas, Firearms Identification, Vols 1,2,& 3; Springfield, Illinois;
8. Hatcher, Jury And Weller, Firearms Investigation, Identification And Evidence; Stackpole Books, Harrisburg, P A
9. Vincent Di Maio, Gunshot Wounds; Crc Press, Washington, Dc;
10. Brain J. Heard;, Hand Book Of Firearms And Ballistics; John Willey, England;
11. TA, Warlow; Firearms, The Law And Forensic Ballistics; Taylor And Francis, Landon;

CUFS1108: ADVANCE TECHNIQUES IN CRIME SCENE MANAGEMENT

Credits: 04 (3+1+0)

Course Description: This course discusses advanced forensic techniques and technologies used in criminal investigations. Topics on which the course shed light on encompasses crime detection devices, such as UV, IR, X-rays and their applications in forensic analysis, principles of laser technology and its applications in holography and forensic investigations. Additionally, the course delves into the depth of forensic psychology and investigation techniques, including criminal profiling, polygraph analysis, and brain fingerprinting, also covering the fundamentals of digital photography, image processing, and the legal aspects of digital evidence.

Course Objectives:

1. Understand the importance of Crime Detection Devices in processing crime scene evidence.
2. To know the utility of Lasers and Photography in identifying crime scene evidence.
3. Understand the significance of kits for in field investigation and usefulness of photography and videography for recording the crime scenes.

Course Outcomes: On successful completion of this course, the students should be able to,

1. Demonstrate a comprehensive understanding of UV, IR, and X-Ray devices, Detective Dyes and their practical applications in crime detection.
2. Acquire in-depth knowledge of laser characteristics, stimulated emission, and population inversion, as well as the components of lasers.
3. Gain insight into forensic psychiatry, criminal profiling, and various forensic psychology techniques such as polygraph (lie detector), narco analysis, and brain fingerprinting.
4. Gain expertise in Digital Photography and Imaging.
5. Gain proficiency in the use of crime scene kits, understanding their types,

applicability, and utility in crime scene investigations

UNIT-I

Crime Detection Devices: UV, IR, X-Rays, their nature and applications, Detective Dyes, Neutron Radiography, Speed Detection Devices, Tools: Basic Kits, Investigator's Kit, Tools used in Mobile laboratory.

UNIT-II

Lasers: Characteristics of laser light, Spontaneous emission, Stimulated emission, Stimulated absorption, Population inversion and light amplification, Essential components of the laser, Holography: Formation of a hologram, Reconstruction of the hologram, Requirements, Application in forensic investigation

Forensic psychology and investigation techniques: Forensic psychiatry (insanity), criminal profiling, Polygraph (Lie detector), Narco analysis, Brain fingerprinting, forensic hypnosis, Voice stress analysis and speaker profiling.

UNIT-III

Photography: Digital photography, software for digital photography, file formats - jpg, gif, bmp, tiff, raw etc., digital watermarking, digital imaging, photogrammetry, radiography, photomicrography, microphotography, Scope of photography in various disciplines of forensic science-finger prints, foot prints, physics, chemistry, biology, ballistics, computer forensics etc. CCTV image enhancement, processing of digital images and its manipulation. Case studies. Laws relating to digital evidence and its admissibility.

UNIT-IV

Digital Imaging: Digital Imaging of Crime Scene, 3-D scanning technique, Tele forensic Technology for crime scene investigation, Technology innovation in crime scene management, Case studies & report writing of crime scene visits, 3D simulation of crime scene, Automatic evidence marker.

UNIT-V

Crime Scene Kits: General introduction to the types of crime scene kits, their applicability and utility on crime scene, general introduction of mobile forensics van, crime scene reporting and report writing.

List of Practicals

1. Introduction to different kits used for crime scene investigation.
2. Use of a 3D scanner at the crime scene.
3. Examination of physical evidence under Stereomicroscopic.
4. Examination of physical evidences under Comparison Microscope.
5. Examination of physical evidences under Tool Scan Imaging System.
6. Photography of physical evidences at different distances.
7. Examination of physical evidences using Spectroscopic techniques.
8. Examination of physical evidences using chromatographic techniques.
9. Forensic psychology investigation techniques: Lie detector

Reference Books:

1. J.Walls; Forensic Science-An Introduction to Scientific Crime Detection 2nd Ed.,Universal, 1st Indian Reprint (2002).
2. Richard Saferstein; Criminalistics-An Introduction to Forensic Science 5th Ed., Prentice Hall (1995).
3. Jay A.Siegel, Pekka J Saukko and Geoffrey C. Kooupfer; Encyclopedia of Forensic Science, Academic Press (2000).
4. R.Mengel; Forensic Physics in 2002 year book, McGraw hill Encyclopedia of Science & Technology.
5. Jenkins and White; Fundamentals of Optics; Mc Graw Hill; Fourth Ed, (I) James, S.H. And Nordby, J. J.; Forensic Science; An Introduction to Scientific And Investigative Techniques, CRC Press USA.
6. Forensic Photography: A Practitioner's Guide By Nick Marsh, 2014.
7. Fundamentals of Forensic Photography: Practical Techniques for Evidence Documentation on Location and in the Laboratory By John Sidoriak, 2017.

BASKET II:

DISCIPLINE-SPECIFIC ELECTIVE COURSES

CUFS1114 : FORENSIC ENGINEERING

Credits: 04 (3+0+1)

Course Description: This course is designed to introduce the field of forensic engineering, focusing on the investigation and analysis of structural failures and accidents. Detailed elaboration of the principles of scientific investigation, including observation, data collection, and evidence preservation along with various aspects of structural failure analysis, such as examination of structural components, building code compliance, material testing, and design review is encorporated. Additionally, the course delves into fire and explosion investigations, exploring the chemistry of fire, classification of fire types, and the techniques used to determine the origin and cause of fires, as well as motor vehicle accidents, including primary causes, analytical tools, and accident reconstruction methods.

Course Objectives:

1. To learn the relation between engineering and forensic investigations
2. To define the structure and its material using Standards like ISO.
3. Understand the investigation process in cases of structural failure and motor vehicle accidents.

Course Outcomes: On successful completion of this course, the students should be able to,

1. Understand the basics of forensic engineering and scientific investigations
2. Analyse different structural parameters and failures.
3. Analyse different materials and their properties used in construction of structures.
4. Understand the behaviour of fire for the investigation of arson cases.
5. Evaluate the process of analysis and reconstruction of motor vehicle accidents.

UNIT-I

Introduction: Introduction to forensic engineering and scientific investigation. Investigation and observation of collapsed structures and causes of failure Examination of structural parameters (beam, column, slab, foundation, ties, reinforcements and reinforcement cover etc.), with reference to building code of construction applicable at the time of construction of structures and I.S standards

UNIT-II

Structural Analysis: Examination of the approved design and comparison of the design and structural parameters Examination of the basic materials like cement, sand, brick, grit, steel, quality of water, cube rest and curetting etc. Sampling of the materials with relevant information required for the investigation (column, beam, slab, mortar, bricks, reinforcement steel, soil and basic materials used in the construction,

UNIT-III

Photograhic documentation: Significance of the accident scene, the selection of appropriate cameras for capturing the necessary details, ways to select items to be photographed, the meticulous process of accident scene documentation, and the subsequent analysis and verification of the photographs.

UNIT-IV

Fire and explosion investigation: Chemistry and behaviour of fire Classification of fires Origin and cause of fire Motor vehicle fire- investigation Explosion investigation Reconstruction and report writing Collection and preservation of fire and explosion evidence. Case studies

UNIT-V

Motor vehicle accident Introduction Primary causes of accidents. Analytical tools used to evaluate accidents Converting scene data into event sequence Measurement of speed of the vehicle Reconstruction of the scene Collection and preservation of the

evidences

Project Component:

1. Investigate the cause of structural failure in buildings, bridges, or other constructions.
2. Reconstruct vehicle accidents using forensic engineering principles.
3. Study materials that have failed under stress, corrosion, or fatigue.
4. Analyze incidents involving fires or explosions to determine the origin and cause.
5. Investigate construction defects leading to legal disputes or safety concerns.

Reference books:

1. Dahiya. M.S. (2009): Crime scene management –A scientific approach
2. Kirk (2000): Vehicular accident Investigation and reconstruction
3. Noon (2000): Forensic Engineeering Investigation
4. Carper (2000): Forensic Engineering
5. James, Nordby (2005): Forensic Science an introduction to scientific investigative techniques

CUFS1115 : SCIENTIFIC PROTOCOLS FOR FIRE INVESTIGATION

Credits: 04 (3+0+1)

Course Description: This course provides an in-depth exploration of the scientific methods and protocols used in fire investigation. Students will learn about the principles of fire behavior, origin determination, and the analysis of fire-related evidence. The curriculum covers critical topics such as the use of forensic techniques, fire scene reconstruction, and the application of relevant legal standards. Emphasizing hands-on training, participants will engage in practical exercises to develop skills in evidence collection, documentation, and reporting.

Course Objectives:

1. To make students learn about the importance of forensic and scientific investigation in fire and arson investigation cases.
2. To make students learn about the analysis of ignitable residues and evaluation of ignition sources.
3. To define and explain the core concepts of fire science, including its historical context.

Course Outcomes: On successful completion of this course, the students should be able to,

1. Comprehend the chemistry and physics behind combustion and investigate the chemistry and behavior of fire, exploring states of matter and flammable limits.
2. Examine the development of fire patterns and fire modeling and analyze ignition processes, including spontaneous and chemical ignition.
3. Apply a scientific approach to investigate fire incidents, emphasizing modern fire analysis techniques.
4. Introduce separation and analytical techniques for analysis of ignitable liquid residues (ILR) with a focus on identifying products like gasoline and distillates.
5. Understand reporting procedures, quality assurance, and reaching conclusive evaluations in fire investigations.

UNIT-I

Fire and science: Introduction, arguments, national fire protection association 921(NFPA) Fire and arson, motives and pathology of arson Scientific approach to fire investigation, modern fire analysis

Chemistry and Physics of combustion Fire and energy, basic chemistry, chemistry and behavior of fire State of matter and behavior of gases, liquids and solids, stereo chemistry and Flammable limits.

Fire dynamics- Introduction, ignition, spontaneous and chemical ignition Flames and flam abilities, compartmental fire (house fire) Development of fire pattern, fire modelling

UNIT-II

Fire and Arson Investigation Introduction, need and presumption of accidental causes, planning of investigation, survey and documentation, Determination of origin and cause of fire, Reconstruction, inventory, avoiding spoliation Mythology of arson investigation (sources of error in fire and arson investigation) Eliminating accidental cause, investigating fatal fire and vehicular fire Origin determination, hypothesis development and testing of hypothesis.

Evidence collection, preservation. Reporting procedures and conclusion Professional practice of fire investigation

UNIT-III

Analysis of ignitable residues and evaluation of ignition sources Introduction, Evolution of separation and analytical techniques and standard methods Isolation of the residue, Analysis of ILR (ignitable liquid residue)

Criteria for identification -Identification of gasoline, distillates and other classifiable products Improving sensitivity and estimation of the degree of evaporation Reporting procedures, quality assurance and conclusion Evaluation of ignition sources Introduction- Joint examination of physical evidence appliances and electrical components Testing of ignition scenario, spontaneous ignition tests, Conclusion

Project Component:

1. Study the development and spread of fire in a controlled environment.
2. Reconstruct a suspected arson scene and determine its cause.
3. Identify and classify residues from fire scenes.
4. Assess potential ignition sources in fire cases.
5. Determine the cause of fires in vehicles.

Reference Books :

1. Scientific protocols for fire investigation John J. Lentini CRC press
2. Practical fire and arson investigation David R. Redsicker, John J.O ' Connor CRC press
3. Crime scene management – a scientific approach; M. S. Dahiya

CUFS1116 : CCTV FORENSICS

Credits: 04 (3+0+1)

Course Description: The CCTV Forensics course is designed to provide a comprehensive understanding of how Closed-Circuit Television (CCTV) footage is used in digital forensics to investigate incidents, support legal proceedings, and enhance security measures. This course focuses on the forensic techniques, legal considerations, and analytical methods required to extract, analyze, and present evidence from CCTV systems. Students will gain hands-on experience in working with different CCTV technologies and tools to uncover critical visual evidence from video recordings.

Course Objectives:

1. To make students learn about the importance of CCTV camera in crime detection and prevention
2. To make students learn about components of CCTV camera
3. To learn about the techniques of effective surveillance to safeguard our public and private spaces

Course Outcomes: On successful completion of this course, the students should be able to,

1. Learn about the different types of CCTV cameras.
2. Remember the sensors used by CCTV cameras- CCD and CMOS sensors.
3. Understand the working mechanism of a Video Management System.
4. Develop skills on handling, preservation and management of CCTV footages as evidence.
5. Understand various Video Analytics used for crime detection and prevention.

UNIT-I

Introduction to CCTV camera: definition, its types: Dome shaped, Bullet Cameras, C-Mount Cameras, PTZ Pan Tilt & Zoom Cameras, Day/Night Cameras, Infrared/night vision Cameras, Network Cameras, Wireless Cameras, High Definition (HD) Cameras, Discreet cameras, Fish eye Cameras, varifocal Cameras, Drone cameras, components of CCTV camera: analog camera, IP based camera, monitoring station, cables, DVR, NVR, storage mechanism, Image sensors: CCD and CMOS sensors.

UNIT-II

Introduction to Video Management System, its components, working mechanism, Benefits of Utilizing a VMS, CCTV topology, design, network, integration, bandwidth.Acquisition of CCTV footages from the scene of crime,

UNIT-III

Handling and preservation of CCTV footages, hash value generation, extracting the data from DVR/NVR, maintaining chain of custody. Authentication and enhancement of CCTV footages, extraction of frames, Forensic tools for Enhancement and authentication of CCTV footages, legal admissibility of CCTV evidence, related cases studies

UNIT-IV

Introduction to video analytics: Smart video content analysis, uses of video analytics, video synopsis, automatic license plate recognition, crowd detection, face recognition, indoor people tracking, object detection, motion detection, vertical motion detection, left and removed item detection, outdoor people and vehicle tracking.

UNIT-V

Auto-tracking, behavior tracking, loitering detection, traffic monitoring, future of video analytics. Concept of active CCTV surveillance and monitoring techniques.

Project Component:

1. Study and compare the functionality, applications, and technical specifications of various CCTV camera types.
2. Authenticate and enhance CCTV footage for legal admissibility.
3. Create a CCTV network design for a specified area (e.g., a campus or office).
4. Use video analytics tools to detect and analyze specific events in CCTV footage.
5. Analyze traffic patterns and human behavior using CCTV footage and video analytics tools.

Reference books:

1. Hill, T. (2020). CCTV Handbook: Buying, Installing, Configuring, & Troubleshooting: A User's Guide to CCTV Security. Independently published.
2. Damjanovski, V. (2005). CCTV: Networking and Digital Technology (2nd ed.). Butterworth-Heinemann.
3. Kroener, I. (2014). CCTV: A Technology under the Radar? (1st ed.). Routledge.
4. G. (2020, March 18). Types of CCTV Cameras – The Complete Guide. BusinessWatch. https://www.businesswatchgroup.co.uk/types-of-cctv-cameras-the-complete-guide/
5. Paul, D., & Puvvala, C. (2020). Video Analytics Using Deep Learning. Apress.
6. Ph.D., P. P. M. (2021). The 2022 Report on Video Analytics, Intelligence, Surveillance, Reconnaissance and Object Recognition Technologies: World Market Segmentation by City. ICON Group International, Inc.
7. Carle, B., & Jensen, R. C. (2018). Understanding Video Management Systems.
8. Wolper, V. E. (2020). Photograph Restoration and Enhancement: Using Adobe Photoshop CC 2021 Version (3rd ed.). Mercury Learning & Information.

CUFS1117 : ANTI-DOPE FORENSICS

Credits: 04 (3+0+1)

Course Description: Anti-Dope Forensics explores the science and techniques behind detecting and analyzing doping substances in sports. The course covers drug metabolism, sample collection, analytical methods, and the interpretation of test results. It emphasizes the role of anti-doping agencies, legal frameworks, and ethical considerations. Students will also examine case studies and learn about advancements in doping detection. This course equips learners with practical skills for contributing to fair play in sports.

Course Objectives:

1. To provide a comprehensive understanding of doping in sports and its forensic implications.
2. To equip students with knowledge of pharmacodynamics, pharmacokinetics, and the legal framework governing doping control.
3. To develop practical skills in the testing, analysis, and interpretation of doping-related evidence using advanced analytical techniques.

Course Outcomes: On successful completion of this course, the students should be able to,

1. Gain knowledge about different drugs used in case of doping
2. Understand the importance of pharmacokinetics and pharmacodynamics of doping drugs
3. Gain skills on testing different drugs from body fluids and understanding guidelines for dope testing
4. Emphasize the importance of maintaining professionalism, confidentiality, and impartiality in anti-doping work.
5. Encourage students to engage in research and innovation within the field of anti-doping, including the development of new detection methods and strategies

UNIT-I

Introduction to Anti-Dope Forensics & Drugs of Abuse in Sports: Overview of doping and its impact on sports integrity. Classification of sports under anti-doping norms. Common dope drugs: stimulants, anabolic steroids, growth hormones, diuretics, synthetic oxygen carriers, insulin, and gene doping. Therapeutic use exemptions and emerging trends in medicines and technologies.

UNIT-II

Pharmacovigilance and Legal aspects: Pharmacodynamics and pharmacokinetics of dope drugs. Protecting athlete health and maintaining clean sports practices. Role of healthcare providers in anti-doping at sporting events. National and international anti-doping laws. Regulatory agencies: NADA (National Anti-Doping Agency) and WADA (World Anti-Doping Agency). Importance of doping education and awareness campaigns.

UNIT-III

Testing & Analysis: Dope testing protocols for humans and animals. Role of body fluids (blood, urine, saliva, sweat) in drug analysis. Guidelines for dope testing and laboratory accreditation. Effective testing programs and international standards. Case studies on doping incidents and their resolution.

UNIT-IV

Analytical Techniques in Anti-Dope Testing: Advanced analytical methods: GC-MS, LC-MS, and immunoassays. Sample preparation techniques for biological specimens. Identification and quantification of doping substances. Sensitivity and specificity in analytical detection. Quality assurance and reporting in anti-doping laboratories.

UNIT-V

Ethical and Future Perspectives in Anti-Doping: Ethical considerations in doping control and athlete rights. Legal admissibility of doping evidence in sports tribunals. Role of education in preventing doping practices. Advancements in gene doping

detection and forensic technologies. Future challenges in anti-doping efforts and maintaining integrity in sports.

Project Component:

1. Study and compare the functionality, applications, and technical specifications of various CCTV camera types.
2. Authenticate and enhance CCTV footage for legal admissibility.
3. Create a CCTV network design for a specified area (e.g., a campus or office).
4. Use video analytics tools to detect and analyze specific events in CCTV footage.
5. Analyze traffic patterns and human behavior using CCTV footage and video analytics tools.

Reference Books:

1. W. Goodwin, A. Linacre, H. Sibte, An Introduction to Forensic Genetics, John Wiley & Sons, England, 2007, pp. 17-25.
2. World Anti-Doping Agency (WADA), The World Anti-Doping Code, Montreal, 2009 (accessed April 2011) http://www.wada-ama.org.
3. At-a-Glance - About Anti-Doping." World Anti-Doping Agency. N.p., 04 July 2014. Web. 18 Apr. 2016.
4. At-a-Glance - The Doping Control Process." World Anti-Doping Agency. N.p., 04 July 2014. Web. 18 Apr. 2016.
5. Reardon, Claudia L., and Creado, Shane. "Drug Abuse in Athletes." Substance Abuse and Rehabilitation (2014): 95-105. Web. 29 Feb. 2016.
6. 2016 Prohibited List." World Anti-Doping Agency. N.p., 29 Sept. 2015. Web. 18 Apr. 2016.
7. Moston, S., &Engelberg, T. (2016). Detecting Doping in Sport (1st ed.). Routledge. https://doi.org/10.4324/9781315718514.

CUFS1118 : NANO-BIOTECHNOLOGY

Credits: 04 (3+0+1)

Course Description: This course delves into the intersection of nanotechnology and biotechnology, exploring how nanoscale materials and devices can enhance biological processes and applications. Students will study fundamental concepts in nanomaterials, nanofabrication techniques, and their applications in areas such as drug delivery, diagnostics, and tissue engineering. The curriculum emphasizes both theoretical foundations and practical approaches, including laboratory work to design and analyze nanobiotechnological solutions.

Course Objectives

1. To understand the fundamental principles of nanotechnology and its application in forensic science.
2. To explore the various synthesis methods and characterization tools for nanomaterials.
3. To analyze the applications of nanoparticles in molecular imaging, drug delivery, diagnostics, and environmental remediation.

Course Outcomes : On successful completion of this course, the students should be able to,

1. Comprehend the fundamentals of nanotechnology, including the history, development, and properties of nanomaterials.
2. Understand various nanoparticle synthesis techniques and their biological production methods.
3. Apply different characterization techniques (e.g., electron microscopy, atomic force microscopy) to analyze nanomaterials.
4. Evaluate the application of nanoparticles in forensic science, diagnostics, and environmental remediation.
5. Assess the ethical and safety considerations related to the use of nanotechnology in forensic applications.

UNIT-I

Introduction to Nanotechnology and Nanomaterials: Overview of Nanotechnology: Definition, history, and development of nanotechnology. Synthesis of Nanoparticles: Physical synthesis methods of nanoparticles. Biological Production of Nanoparticles: Use of microorganisms like fungi, bacteria, yeast, and actinomycetes in nanoparticle synthesis. Properties and Characteristics of Nanomaterials: Overview of the unique properties of nanomaterials such as high surface area, reactivity, and size-dependent behaviors.

UNIT-II

Characterization Tools for Nanomaterials: Microscopy Techniques: Introduction to optical microscopy, electron microscopy (TEM and SEM), scanning probe microscopy, and atomic force microscopy. Fluorescence Microscopy: Application and working principles of fluorescence microscopy. DNA and Carbon Nanostructures: Overview of DNA-based nanostructures, DNA-protein nanostructures, and carbon nanotubes. Nano-Engineering Materials: Nanorods, fullerenes, and other important nanomaterials.

UNIT-III

Applications of Nanomaterials in Forensics and Life Sciences: Molecular Imaging: Application of nanoparticles as molecular imaging probes, including quantum dots.
Nanoparticles as Therapeutic Drug Carriers: Role of nanoparticles in drug delivery and gene therapy. Diagnostics and Life Science Applications: Use of nanoparticles in diagnostics, biosensing, and medical devices. Environmental Remediation: Nanoparticles as tools for cleaning the environment, including remediation of heavy metals. Nanoparticles as Sensors: Application of nanoparticles in the detection of chemical and biological agents.

UNIT-IV

Nanomaterials in Forensic Science: Nanotechnology in Forensic Investigations: Role of nanoparticles in crime scene analysis and evidence collection. Nanomaterials in DNA Profiling: Application of nanotechnology in improving DNA analysis techniques and the accuracy of forensic results. Forensic Toxicology: Utilization of nanomaterials for the detection of drugs, poisons, and toxins in forensic samples. Trace Evidence Analysis: Nanotechnology's role in enhancing the detection and analysis of trace evidence (e.g., fibers, hair, and particles).

UNIT-V

Future Directions and Ethical Considerations: Emerging Trends in Nanotechnology: New developments and future prospects in the application of nanotechnology in forensics. Ethical Implications: Ethical considerations regarding the use of nanomaterials, including privacy, safety, and potential misuse in forensic investigations. Regulations and Standards: Overview of the regulatory frameworks and standards for the use of nanotechnology in forensic and life sciences.

Project Component:

1. Synthesis and Characterization of Nanoparticles: A project that involves synthesizing nanoparticles using biological or physical methods and analyzing their properties using electron microscopy or fluorescence microscopy.
2. Application of Nanoparticles in Forensic Analysis: A study on the use of nanoparticles for detecting toxic substances or enhancing the resolution of forensic samples.
3. Environmental Remediation Using Nanomaterials: Developing a project on the use of nanoparticles for cleaning polluted environments or water, focusing on heavy metal detection and remediation.
4. DNA Nanostructures for Forensic Identification: Investigating the use of DNA-based nanostructures in improving the accuracy and speed of DNA profiling.
5. Quantum Dots for Molecular Imaging in Forensics: Exploring the use of

quantum dots as molecular imaging probes to enhance forensic imaging capabilities in crime scene investigation.

Reference books:

1. Bionanotechnology - Lessons from nature - David S. Goodshell, Wiley-Liss, ISBN: 978- 047141719-4
2. Nanobiotechnology: Concepts, Applications and Perspectives- Christof M. Niemeyer and Chad A. Mirkin, Wiley, ISBN:978-3527306589
3. Nanoscale Materials in chemistry, 2nd edition - Kenneth J. Klabunde and RyanM. Richards, John Wiley and Sons Inc., ISBN:978-0470222706

CUFS111: MODERN CRYPTOGRAPHY AND STEGANOGRAPHY

Credits: 04 (3+0+1)

Course Description: This course provides a comprehensive introduction to cryptography and network security, covering fundamental concepts, algorithms, and techniques. Depth of symmetric and public-key cryptography, including key management protocols, one-way functions, and digital signatures has been comprehended. The course delves into the mathematical foundations of cryptography, such as number theory and information theory, and examines classic algorithms like DES and modern cryptographic primitives like RSA and DSA. Additionally, overview about cryptanalysis and steganalysis, understanding the techniques used to analyze and attack cryptographic systems.

Course Objectives:

1. Understanding Foundations of Cryptography
2. Understand the role of cryptography in securing data transmission over networks, protecting sensitive information, and preventing unauthorized access.
3. Explore steganography as a covert communication method. Understand the Information Theory

Course Outcomes : On successful completion of this course, the students should be able to,

1. Understand cryptographic concepts, algorithms, and protocols, including symmetric and asymmetric key cryptography, digital signatures, hash functions, and their applications in securing data.
2. Learn about how to design and implement secure communication systems, ensuring confidentiality, integrity, and authenticity of transmitted and stored information.
3. Embed and extract hidden information within digital media files while maintaining the covertness of the communication.

4. Evaluate the security of cryptographic systems.
5. Apply Cryptography and Steganography in Practical Scenarios

UNIT-I

Introduction: Basic Terminology, Protocols, Communication using Symmetric Cryptography, Introduction to One-way Functions, Public-Key Cryptography, Introduction to Digital Signatures, Random and Pseudo Random Sequence Generators. Introduction to Basic, Intermediate, Advanced and Esoteric Protocols.

UNIT-II

Cryptographic Keys and Algorithms Introduction**, Key Length:** Symmetric Key, Public-Key. **Key Management:** Generating, Transferring, Verifying, Using, Updating, Storing, Destroying, Lifetime, Backup, Compromised Keys. **Algorithms:** Types, Modes and Use & Awareness among athletes.

UNIT-III

Cryptographic Algorithms Mathematical Background: Introduction to Information Theory, Number Theory, Factoring, Prime Number Generation. **DES:** Background, Description, Security, Cryptanalysis, Variants. **One-Way Hash Functions:** MD, SHA, Other one-way functions. **Public-Key Algorithms:** RSA, DSA, and others.

UNIT-IV

Steganography: Basic Concepts: Definition, Purpose, Types (LSB, Spread Spectrum, Transform Domain). Steganographic Techniques: Least Significant Bit (LSB) Substitution, Spread Spectrum Steganography, Transform Domain Steganography (DCT, DWT)

UNIT-V

Cryptanalysis and Steganalisys: Introduction to Cryptanalysis and Steganalysis, Introduction to tools used technologies used in Cryptanalysis, Introduction to tools used technologies used in Steganalysis, Different Attacks and their outcome.

Project Component:

1. Implement symmetric cryptography algorithms (like AES) and public-key cryptography algorithms (like RSA) for secure communication.
2. Develop a system that allows users to generate and verify digital signatures using public-key cryptography.
3. Create a tool for embedding hidden messages within an image or audio file using Least Significant Bit (LSB) substitution, spread spectrum, or transform domain techniques (DCT/DWT).
4. Build a cryptanalysis toolkit for evaluating the strength of encryption algorithms.
5. Develop a system that can detect hidden messages in image, audio, or video files using steganalysis techniques.

Reference Books

1. Applied Cryptography by Bruce Schneier Cryptology Unlocked by ReinhardWobst
2. Break the Code: Cryptography for Beginners by BudJohnson
3. Modern Cryptography: Applied Mathematics for Encryption and Information Security by Chuck Easttom
4. Cryptography Engineering: Design Principles and Practical Applications by Niels Ferguson, Bruce Schneier and TadayoshiKohno
5. Introduction to Modern Cryptography by Jonathan Katz and YehudaLindell
6. Modern Cryptography: Theory and Practice by WenboMao
7. Steganography in Digital Media: Principles, Algorithms, and Applications by JessicaFridrich
8. Investigator's Guide to Steganography by GregoryKipper
9. Hiding in Plain Sight: Steganography and the Art of Covert Communication by EricCole
10. Data Hiding: Exposing Concealed Data in Multimedia, Operating Systems, Mobile Devices and Network Protocols by Michael T. Raggo and ChetHosmer

11. Noiseless Steganography: The Key to Covert Communications by AbdelrahmanDesoky
12. Digital Watermarking and Steganography by Ingemar Cox, Matthew Miller, Jeffrey Bloom,Jessica Fridrich and TonKalker
13. Steganalysis by means of Artificial Neural Networks: Steganography detection in JPEG files by means of Artifical Neural Networks using Huffman coding by Jiri Holoska and ZuzanaKominkovaOplatkova

CUFS1120 : DISASTER VICTIM MANAGEMENT

Credits: 04 (3+0+1)

Course Description: This course explores the management of disaster victims through a humanitarian lens, focusing on ethical considerations, compassion, and community resilience. Students will examine the principles of humanitarian response, including the assessment of needs, trauma-informed care, and culturally sensitive practices. The curriculum covers essential topics such as crisis intervention, coordination with NGOs, and the role of international frameworks in disaster response. Through case studies and practical exercises, participants will develop skills to effectively support victims and facilitate recovery while promoting dignity and empowerment. By the end of the course, students will be equipped to implement humane and effective strategies in disaster victim management, ensuring a holistic response to emergencies.

Course Objectives:

1. To provide a comprehensive understanding of disaster types, their impacts, and the techniques used in disaster management, including risk assessment and vulnerability analysis.
2. To explore the principles and practices of Disaster Victim Identification (DVI), emphasizing ethical considerations, safety protocols, and advanced identification methods.
3. To develop an understanding of the ethical, legal, and technological aspects of disaster management and their roles in post-disaster response, recovery, and resilience.

Course Outcomes: On successful completion of this course, the students should be able to,

1. Analyze and assess different types of disasters and their impact on a national and international scale, using risk assessment and GIS technology.
2. Acquire the skills to carry out Disaster Victim Identification (DVI), including the

use of advanced forensic techniques such as DNA analysis and fingerprinting

3. Understand the ethical norms and principles in disaster management and apply international humanitarian law to ensure ethical decision-making during crises.
4. Evaluate and implement technological tools (e.g., GIS, drones, AI) for enhancing disaster preparedness, response, and recovery operations.
5. Demonstrate the ability to develop strategies for building disaster resilience at the community level and evaluate real-world case studies of disaster management.

UNIT-I

Disaster and Disaster Management: Introduction, Types of disaster, Classification of Disasters, national and International Impact of Disasters; Causes, Effects and Practical examples for all disasters.

Disaster Management Techniques: Risk and Vulnerability Analysis, Its concept and Reduction, Early and Advance Warming Systems, Understanding climate risk, Mapping of risk assessment, Decision making for risk reduction, Problems in risk assessment, Geographical Information System (GIS).

Disaster preparedness and Response: Overview and Understanding of Disaster Preparedness, Early Warnings and Safety Measures of Disaster, Resource Management- Financial, Medical, equipment, communication, Human, transportation, Food and essential commodity, Directing and controlling functions, Role of Government, International and NGO Bodies

UNIT-II

Fundamentals of DVI: Principle and Guideline of DVI, Different expertise and equipment's, Composition of Investigation team (DVI team), Health and personnel safety.

Scene Processing and Recovery: Process of DVI operation on site and Mortuary, Handling and preservation of Human and non-human remains, Documentation, Body labelling, Disaster photography/videography and their kits, Different types of

coordination centre.

Investigative Process: Establishing Identifiers, Biological Profiling of Primary and Secondary Identifiers (Fingerprint, Teeth and DNA), Advance Techniques (Radiology, Scanners, 3D printers), Different AM data collection and documentation, Different type of PM examination and Documentation, Digital data maintenance software, Reconciliation and Repatriation

UNIT-III

Humanitarian Approach: Concept and Nature of ethics; Role and purpose of ethics; ethical norms and principles; International Humanitarian Law; Disaster Policy: The International Decade for Natural Disaster Reduction, Disaster Policy (National Policy on Disaster Management), Disaster Management Act 2005. National Disaster Management Plan, Role of Media and its importance, role of Fire Services, Para-military, Armed forces, presently challenging aspect of disaster management in India.

UNIT IV

Response, Recovery, and Resilience: Post-Disaster Response Strategies, Disaster Recovery Phases and Techniques, Building Resilience in Affected Communities, Government and International Agency Response Roles, Infrastructure Restoration and Rebuilding Communities, Psychological First Aid and Trauma Care, Legal and Social Issues in Disaster Recovery, Role of Local Communities in Disaster Resilience, Case Studies on Effective Disaster Response and Recovery

UNIT V

Technological Innovations in Disaster Management: Role of Technology in Disaster Preparedness, Response, and Recovery, Use of Drones, Remote Sensing, and Satellite Technology in Disaster Management, Real-Time Data Collection and Monitoring for Disaster Response, Use of Artificial Intelligence and Machine Learning in Risk Assessment, Communication Systems: Social Media, Mobile Apps, and Emergency Response Networks, Geographic Information Systems (GIS) for Mapping and Risk

Analysis, Training, Simulation, and Virtual Reality for Disaster Preparedness

Future Trends in Disaster Management Technology

Project Component:

1. To assess disaster-prone areas using GIS technology and develop a risk assessment model.
2. To simulate DVI operations, focusing on body recovery, documentation, and the use of advanced identification techniques like DNA and fingerprinting.
3. To explore the ethical considerations and legal frameworks in disaster management and response.
4. To evaluate the role of drones, satellite imagery, and AI in real-time disaster response and recovery efforts.
5. To analyze community-based initiatives and their impact on disaster recovery and resilience.

References:

1. Murthy D.B.N. (2012) Disaster Management, Deep and Deep Publication PVT. Ltd. New Delhi.
2. Staggs, S. (2005). Crime scene and evidence photographer's guide. Staggs Pub.
3. Global perspective on disaster victim identification series, CRC Press (Latest Edition)

CUFS1121 : MACHINE LEARNING FOR DATA SCIENCE

Credits: 04 (3+0+1)

Course Description:

This course provides a comprehensive overview of machine learning along with briefing the essential tools and techniques to build predictive models. The curriculum covers fundamental concepts, including data preparation, model building, evaluation, and feature engineering. Overview of algorithms for classification and regression tasks, as well as unsupervised learning methods for discovering patterns in data. Additionally, the course delves into the architecture and applications of artificial neural networks, a powerful class of models capable of learning complex relationships.

Course Objectives:

1. Understand the machine learning concepts ,algorithm & techniques
2. Acquire hands on experience in implementing machine learning models
3. Learn to effectively apply ML Tools

Course Outcomes: On successful completion of this course, the students should be able to,

1. Gain a comprehensive understanding of the fundamental concepts and principles of machine learning.
2. Acquire hands-on proficiency in implementing and deploying a variety of machine learning algorithms, such as decision trees, support vector machines, neural networks, and ensemble methods.
3. Acquire the skills to preprocess and clean datasets effectively, handle missing data, and perform feature engineering to enhance the quality of input features.
4. Develop the ability to choose appropriate algorithms, analyze results, and communicate findings effectively to stakeholders.
5. Understand the techniques for evaluating machine learning models, including metrics such as accuracy, precision, recall, and F1-score.

UNIT-I

Data Science: Definition of data science, Importance and, applications of data science, Components of data science: (Data collection, Data cleaning, Data analysis, Data visualization), Data science lifecycle: (Problem definition, Data acquisition, Data preparation, Modeling, Evaluation, Deployment)

UNIT-II

Introduction to Machine Learning : Overview of human learning, How do machine learn, learning problem, types of Machine Learning : Supervised learning, unsupervised learning, reinforcement learning, Applications of Machine Learning, Issues in Machine Learning, Tools in Machine Learning

UNIT-III

Preparing to model : Basic types of data in Machine learning, Exploring structure of data, data quality and remediation, Data Preprocessing

Modeling and Evaluation : Selecting a model, training a model, model representation evaluating performance of model

Basics of Feature Engineering: Feature and Feature Engineering, Feature transformation: Construction and extraction, Feature subset selection

UNIT-IV

Supervised Learning – classification and regression : Classification model, classification learning steps, Classification algorithms : k-Nearest Neighbour, Decision tree, Random forest, Support Vector Machine; Regression model, Regression algorithm : Simple linear regression, Multiple linear regression, logistic linear regression

Unsupervised Learning : Supervised vs. Unsupervised Learning, Applications, Clustering, Association rules

UNIT-V

Artificial Neural Network : Overview of biological and artificial neuron, Types of activation functions, Architecture of neural network, learning process in ANN,

back-propagation algorithm, deep learning

Project Component:

1. To demonstrate the full data science lifecycle, including problem definition, data acquisition, preparation, modeling, evaluation, and deployment using a real-world dataset.
2. To compare and contrast supervised and unsupervised learning algorithms, implementing classification and clustering techniques on various datasets.
3. To explore the techniques of feature engineering and transformation, building predictive models, and evaluating their performance to enhance machine learning outcomes.
4. To create and evaluate regression models (linear, multiple, and logistic regression) using machine learning algorithms, and compare their predictive accuracy.
5. To build and train an artificial neural network using a deep learning approach, applying it to a dataset for pattern recognition and prediction tasks.

Reference books:

1. Saikat Datt, Subramanian Chandramouli, Amit Kumar Das, “Machine Learning”, Pearson
2. Andreas C. Muller and Sarah Guido, “Introduction to Machine Learning with Python: A Guide for Data Scientists”, O'Reilly Media
3. Ethem Alpaydin, "Introduction to Machine Learning, third edition”, The MIT Press.

CUFS1122 : FORENSIC JOURNALISM

Credits: 04 (3+0+1)

Course Description: This course on Forensic Journalism introduces students to the fundamentals of journalism, focusing on investigative reporting, legal issues, and the role of mass media in shaping public opinion. It explores the impact of new media, citizen journalism, and the challenges posed by fake news in the digital era. Students will develop essential skills for ethical reporting, news analysis, and the use of emerging technologies like drones in journalism.

Course Objectives:

1. To introduce students to the scope, definition, and key concepts of journalism, and the role of mass media in society.
2. To equip students with the skills necessary for reporting, editing, and investigative journalism, with a focus on legal and ethical frameworks.
3. To familiarize students with the impact of new media, citizen journalism, and challenges like fake news in modern communication.

Course Outcomes: On successful completion of this course, the students should be able to,

1. Understand the key concepts and theories of journalism, including its role in shaping public opinion and democracy.
2. Report and edit news stories effectively, following journalistic structure and standards.
3. Gain insights into legal and ethical issues related to journalism, particularly in crime and investigative reporting.
4. Explore the rise of new media and its role in social change, freedom of expression, and national security.
5. Develop skills to identify and counter fake news, with a focus on citizen journalism and mobile journalism.

UNIT-I

Introduction to Journalism: Scope and Definition of Journalism; Role and Responsibilities of Mass Media; Types of Communication Models; Types of Mass Communication Theories; Public Opinion and Democracy; The media scene: The characteristics of the Indian Press; The present state of Print Media, Electronic media, Cyber Media; A brief look into the Government media organizations.

UNIT-II

Reporting and Editing: Defining news: news value, elements of news; Structure of news: five W's (Who, What, When, Why, Where) and one H (How); Selection of information, writing introduction/lead, body, different types of introduction/lead, organizing the news story; Understanding beats and their categories (Political, Health, Crime, Art and Culture); City reporting, Crime reporting: sources and related laws, Legal reporting; Investigative Reporting: Analysis of documents, Database of public records, Research into social and legal issues; Other Specialized reporting: Defense, Science & Technology etc.

UNIT-III

Legal and Investigative Journalism: Investigative Journalism and Its Importance, Legal Aspects of Journalism: Ethics, Defamation, and Legal Reporting, Analysis of Documents: Database of Public Records, Research into Social and Legal Issues; Crime Reporting: Sources and Legal Framework; Specialized Investigations: Political, Environmental, and Legal Reporting

UNIT-IV

New Media Studies: Revolutionary change in communication; rise of new media in contemporary era; New media as a tool for social change, freedom of expression vs. privacy, largest ungoverned space on earth; National Security and New Media, The Role of New Media in Cybersecurity: Guarding Against Cyber Attacks, Hacking, and Fraud, Strengthening National Integration through New Media

UNIT-V

Citizen Journalism: Concept, Case studies, Mobile Journalism; Types of Fake News: Parody, False connection, Misleading Content, False Content, Impostor Content, Manipulated Content, Fabricated Content; Detecting Fake News and Web portals: Targeted, Propaganda, Organized, Sensitization, Opinionated; Drone Journalism.

Project Component:

1. A project involving in-depth research into a current legal issue, utilizing public records and expert interviews to construct a comprehensive report.
2. Analyze a real-life case study of citizen journalism, exploring its impact on public opinion and democracy.
3. A project where students analyze different types of fake news (e.g., misleading content, fabricated stories) and propose strategies for detection.
4. Research and present a report on the role of new media in national security, focusing on cybersecurity, online fraud, and digital defense strategies.
5. Explore the use of drones in journalism through a case study or field experiment, examining the benefits and challenges of drone technology in news gathering.

Reference Books:

1. Fiske, John., Introduction to Communication Studies, Methew, London 1982.
2. Schramm, Wilbur, The process and Effects of Mass Communication, 1971.
3. Mitchell V Charnley (K Holt, Reinnhart and Winston), Reporting
4. Lewis James, The Active Reporter, Vikas
5. The Active News room (International Press Institute) Noah Wardrip-Fruin and Nick Montfort (eds),
6. The New Media Reader, The MIT Press, Cambridge, 2003.
7. Christopher Callhan, A Journalist Guide to the Internet: The Net as a Reporting Tool, Pearson/Allyn and Bacon, 2007.
8. Jagdish Chakraborty, Cyber Media Journalism: Emerging Technologies, Authors Press, New Delhi, 2005.

CUFS1123 : BASIC CONCEPTS OF DIGITAL FORENSICS

Credits: 04 (3+1+0)

Course Description: This course introduces the foundational principles and methodologies of digital forensics, focusing on the identification, preservation, analysis, and presentation of digital evidence. Students will explore various types of digital devices and storage media, as well as the legal and ethical considerations involved in digital investigations. The curriculum includes topics such as data recovery, forensic imaging, and tools used for analyzing computer systems, mobile devices, and networks. Through hands-on labs and case studies, participants will gain practical experience in conducting forensic investigations and preparing reports for legal proceedings.

Course Objectives:

1. To know the background of internal communication of computers.
2. To familiarize students with the standard models for the layered approach OSI and TCP/IP to communication between machines in a network and the protocols of the various layer.
3. To make students understand about how multimedia evidences are collected and analyzed for forensic investigation and to know about the legal admissibility of multimedia evidences

Course Outcomes: On successful completion of this course, the students should be able to,

1. Evaluate the Number Systems and logical operations
2. Understand computer architecture and secondary storage devices
3. Understand the basics of operating systems and computer networks
4. Gain knowledge about voice identification/speaker recognition,
5. Understand the concept related to Video/Image Forensics

UNIT-I

Number Systems and logical operations: Binary, Octal, Decimal and Hexadecimal, Conversion and Operations on Binary Number Systems, Representing Information in Hexadecimal and Binary, Logical operations on binary number system.

UNIT-II

Computer Architecture: Components of computer, Input Devices, Central Processing Unit, Primary and secondary Storage Devices, Output Devices.

Secondary Storage Devices: Understanding Disk, Volume and Partition, HDD and SSD Structures.

UNIT-III

Basics of Operating Systems: Role of Operating System, Boot Process, Introduction to Process and Memory Management**.** Windows OS Architecture **-** FAT and NTFS File Systems.

Computer Network: Basic concepts of Computer Network, Open System Interconnection (OSI) and TCP/IP reference model, Protocols and functionalities of each layer, types of connections, networking devices

UNIT-IV

Audio Forensics- Introduction to voice identification/speaker recognition, Speech Enhancement, Speaker profiling: Segregation of Speech samples, auditory analysis/listener's approach, spectrographic approach or voiceprint analysis, automatic speaker recognition technique. Audio Authentication.

UNIT-V

Video/Image Forensics- Video processing and enhancement, Video authentication, Metadata analysis, hash value generation. Video analysis: frame extraction, frame by frame analysis, shot by shot analysis. Technical aspects of the video, collection, handling and preservation of video files, Introduction to CCTV Forensics.

List of Practicals

1. Explore and list the steps required to type in an Indian language using UNICODE.
2. Encode the word 'COMPUTER' using ASCII and convert the encode value into binary values.
3. To study about types of IP addresses.
4. To study about ports and protocols of networks.
5. To study about the DNS information.
6. Recording, editing, processing, and conversion of audio files.
7. Speech acquisition and Spectrographic analysis of Voice.
8. Detection of tampering in audio & video files.
9. Audio restoration and speech enhancement.
10. Analysis and enhancement of video/image/CCTV Footages

Reference Books:

1. Practical Guide to Computer Forensics Investigations, A (Pearson IT Cybersecurity Curriculum (ITCC)) 1st Edition by Darren R. Hayes
2. Learn Computer Forensics: A beginner's guide to searching, analysing, and securing digital evidence 1st Edition by William Oettinger
3. Investigating Windows Systems 1st Edition by Harlan Carvey.
4. Computer Systems_ Digital Design, Fundamentals of Computer Architecture and Assembly Language
5. Carle, B., & Jensen, R. C. (2018). Understanding Video Management Systems.
6. Wolper, V. E. (2020). Photograph Restoration and Enhancement: Using Adobe Photoshop CC 2021 Version (3rd ed.). Mercury Learning & Information
7. Forensic Speaker Identification by Phil Rose & James RRobertson
8. The Acoustic Analysis of Speech by Ray D Kent & CharlesRead
9. Damjanovski, V. (2005). CCTV: Networking and Digital Technology (2nd ed.). Butterworth- Heinemann.

BASKET III: INTERNSHIP IN FORENSIC SCIENCE

A.	**CUTM1089 Summer Internship / CUTM1090 Minor Project**	**Credits: 02** **Duration:** 02-04 weeks
B.	**CUTM 1111 Internship in 2nd year:**	**Credits: 04** **Duration:** 04-08 weeks

Course Description:

The **Internship** in Forensic Science provides students with practical experience in a professional forensic setting, enabling them to apply their academic knowledge to real-world forensic challenges. Students will work alongside forensic experts on cases and projects related to crime scene investigation, forensic analysis, legal processes, and evidence management. This course bridges the gap between academic learning and professional practice, preparing students for a career in forensic science by exposing them to various aspects of forensic investigations, laboratory analysis, and judicial reporting.

Course Objectives:

1. To provide students with hands-on experience in applying forensic science concepts and techniques in real-world forensic investigations.
2. To develop professional skills and competencies relevant to the forensic science industry, including laboratory analysis, crime scene management, and expert testimony.
3. To facilitate the integration of academic knowledge with practical scenarios, fostering a deeper understanding of forensic investigation and the criminal justice system.

Course Outcomes:

Upon successful completion of the internship, students will be able to:

1. Apply theoretical knowledge of forensic science to real-world forensic investigations, including evidence collection, analysis, and reporting.

2. Develop and implement effective strategies for crime scene processing, forensic analysis, and legal procedures in a professional setting.
3. Gain practical experience in a professional forensic environment, improving both technical skills (e.g., forensic techniques, laboratory protocols) and soft skills (e.g., communication, teamwork, and project management).
4. Evaluate and contribute to the development of forensic policies, procedures, and best practices within the forensic organization or laboratory.
5. Demonstrate professional growth and preparedness for a career in forensic science through reflective practice and constructive feedback from industry mentors

BASKET IV:

RESEARCH

CUFS1110: RESEARCH METHODOLOGY

Credits: 04 (3+0+1)

Course Description:

This course provides comprehensive coverage of the principles and practices of research methodology. It aims to equip students with the necessary skills to conduct independent research, including literature review, research planning, data collection and analysis, and effective communication of research findings. The course also addresses ethical issues, intellectual property rights, and the components essential for writing research papers and theses.

Course Objectives:

1. To understand the various types of research and methodologies involved in conducting effective and reliable research.
2. To develop the skills required to collect, analyze, and interpret data accurately and effectively.
3. To learn the essential components and best practices for writing research papers and theses, as well as understanding ethical issues and intellectual property rights.

Course Outcomes:

On successful completion of this course, students will be able to:

1. Conduct comprehensive literature reviews to inform and support research.
2. Develop and execute detailed research plans and designs.
3. Apply appropriate data collection methods and analyze data using statistical tools.
4. Write structured and well-documented research papers and theses.
5. Understand and address ethical issues, intellectual property rights, and copyright in research.

UNIT I

Basics of Research: Objectives and types of research: Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, and Conceptual vs. Empirical; Research Formulation: Literature review and development of hypothesis; Research design and methods: Developing a research plan - Exploration, Description, Diagnosis, and Experimentation; Determining experimental and sample designs

UNIT II

Data Analysis Methods: Data Collection and Analysis: Methods of data collection – Sampling methods and data processing; Data Analysis: Types of data, Basic concept of frequency distribution, Measure of central values – Mean, median, and mode, Measure of dispersion, Range, mean deviation and standard deviation, Probability theory and classical definition of probability, Bayes theorem of probability, Conditional probability and coincidence probability; Statistical Analysis: Chi-square test, ANOVA, SPSS; Types of Errors and Interpretation of Findings

UNIT III

Scientific Reports and Thesis Writing: Reporting and thesis writing: Structure and components of scientific reports and thesis; Significance and different steps in the preparation; Illustrations, Bibliography; Presentations: Oral and Poster; Importance of effective communication in scientific research

UNIT IV

Ethical Issues and Intellectual Property Rights: Basics of ethical issues in research; Understanding intellectual property rights and copyright; Ethical standards and practices in research; Plagiarism and how to avoid it; Legal aspects of research and intellectual property

UNIT V

Advanced Research Techniques and Tools: Advanced research methodologies and their applications; Use of software tools in research: SPSS, R, NVivo; Multivariate analysis techniques; Meta-analysis and systematic reviews; Emerging trends and future directions in research methodology

Project Component:

1. Calculation of mean, median, and mode, standard deviation, variance, perform chi-square test and T-test and student's T-test on a set of values from Minor Project
2. Write a review article

Reference Books:

1. Research Methodology: Methods and Techniques by C.R. Kothari, Gaurav Garg, New Age International Publishers.
2. Research Design: Qualitative, Quantitative, and Mixed Methods Approaches by John W. Creswell, J. David Creswell, SAGE Publications.
3. The Craft of Research by Wayne C. Booth, Gregory G. Colomb, Joseph M. Williams, University of Chicago Press.
4. Practical Research: Planning and Design by Paul D. Leedy, Jeanne Ellis Ormrod, Pearson.
5. Publication Manual of the American Psychological Association by American Psychological Association.
6. Research Methodology, by Sinha, S.C. and Dhiman, A.K., 2002. EssEss Publications.
7. Research Methods: the concise knowledge base by Trochim, W.M.K., 2005; Atomic Dog Publishing. 270p.
8. Research Methods: A Process of Inquiry, Allyn and Bacon by Anthony, M., Graziano, A.M. and Raulin, M.L., 2009.

CUFS1113: CAPSTONE PROJECT AND THESIS

Credits: 16

Duration: 4 months (approximately 300 hours)

Course Description:

The Capstone Project and Thesis course is the culmination of the M.Sc. Cyber Security and Digital Forensics program, designed to integrate and apply the knowledge and skills acquired throughout the coursework. Students will undertake a comprehensive research project or a practical, industry-relevant project that addresses a significant problem or challenge within the field. This course emphasizes independent research, critical analysis, and practical application, culminating in a formal thesis and project presentation. The Capstone Project and Thesis aim to demonstrate the student's ability to conduct high-quality research, solve complex problems, and contribute to the field of cybersecurity and digital forensics.

Course Objectives:

1. To enable students to apply advanced research methods and problem-solving techniques to a significant project or thesis topic in cybersecurity or digital forensics.
2. To develop students' ability to conduct independent research, including data collection, analysis, and interpretation, culminating in a well-documented thesis.
3. To enhance students' skills in presenting and communicating their research findings and project outcomes effectively to both academic and professional audiences.

Course Outcomes:

Upon successful completion of the Capstone Project and Thesis course, students will be able to:

1. Demonstrate proficiency in conducting independent, original research or practical projects that address significant problems in cybersecurity or digital forensics.
2. Apply advanced analytical and methodological skills to develop and execute a research plan or project strategy.
3. Produce a high-quality thesis that adheres to academic standards and showcases the ability to critically evaluate and synthesize research findings.
4. Effectively communicate research findings and project results through a formal thesis and oral presentation.
5. Demonstrate the ability to manage and complete a substantial research or project task within a set timeframe, exhibiting project management and organizational skills.