COURSE STRUCTURE AND SYLLABI

of

M.Sc. Forensic Science

Centurion UNIVERSITY

Shaping Lives...
Empowering Communities...

SCHOOL OF FORENSIC SCIENCES

(Affiliated with National Forensic Sciences University)

SYLLABUS –2022

M.Sc. Forensic Science (With Specialization)

National Forensic Sciences University

Knowledge | Wisdom | Fulfilment

An Institution of National Importance
(Ministry of Home Affairs, Government of India)

Sector-9, Gandhinagar, Gujarat State - 382007

PROGRAM OBJECTIVE

The Universal Declaration of Human Rights directs the member nations to create such conditions under which the ideals of free human beings, enjoying civil and political freedom from fear and want, can be achieved. The Constitution of India, through its various articles, strives to ensure security and safety of citizens in accordance with the principles of Universal Declaration of Human Rights. However, crime is a violation of these principles.

In a country like India, where majority of population is uneducated, social set up is heterogeneous, public-police relations are not very cordial, poverty is rampant and unemployment widespread, it is not surprising that crime rate is increasing exponentially.

If we have to create conditions conducive to harmonious development, we must mitigate the crime rate. This can best be achieved by relying on the support of forensic science system. Unfortunately, in our country, forensic science is not viewed as a core investigative skill in crime detection. In fact, there is a lack of understanding of the forensic process itself. In majority of serious crime cases, hi-tech measures are being adopted by perpetrators of crime. The counter measures have to be more sophisticated to surpass them.

This calls for strengthening the foundations of forensic science at national level.

Our mission as a Forensic science program is to develop professional, ethical graduates whose competence in problem-solving, legal analysis and application, quantitative reasoning, investigation and scientific laboratory procedures can be applied to immediate employment or advanced study.

Programme Outcome (PO): Forensic Science postgraduate will be able to:

POs	Outcomes
PO1	**Basic and Discipline specific knowledge:** Apply the knowledge of basic and applied sciences, engineering, social sciences and arts in various forensic problems**.**
PO2	**Problem Analysis:** Identify and analyze forensic problems using standard methods based on scientific approach**.**
PO3	**Modern tool usage:** Understand, select, and apply appropriate techniques, resources, and modern scientific techniques with an understanding of its merits and limitations**.**
PO4	**Effective Communication:** Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology**.**
PO5	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the forensic practices.
PO6	**Forensic practices for society and criminal Justice setup:** Understand and analyze the impact of forensic solutions to the society and criminal justice setup.
PO7	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in a multidisciplinary setting.
PO8	**Lifelong learning**: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of Technological change.

PSO (Program Specific Outcomes)

Sl No.	Program Specific Outcomes
PSO1	Understand the basic and advanced techniques in various disciplines of forensic science.
PSO2	Analyze the forensic samples using basic and state-of-the-art techniques of various disciplines of forensic science.
PSO3	Evaluate the results of various techniques and make decisions on simple or complex forensic problems
PSO4	Design and develop research based solutions of complex forensic problems.

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Course Structure

1. Core Courses

Sr. No.	Course Code	Course Name	Credits (T+P+Pj)
1.	CUTM2509	Introduction to Forensics, Psychology, Law and Statistics	4+0+0
2.	CUTM2510	Instrumental Techniques	4+1+0
3.	CUTM2511	Forensic Physics and Crime Scene Management	4+1+0
4.	CUTM2512	Finger Prints and Questioned Documents	4+1+0
5.	CUTM2513	Forensic Biology and Biochemistry	4+1+0
6.	CUTM2514	Quality Management, Narcotic Drugs, Explosives and Forensic Chemistry	4+1+0
7.	CUTM2515	Forensic Medicine and Anthropology	4+1+0
8.	CUTM2516	Forensic Serology and DNA Profiling	4+1+0
9.	CUTM2517	Forensic Toxicology and Pharmacology	4+1+0
10.	CUTM2518	Forensic Ballistics and Computer Forensics	4+1+0
11.	CUTM2526*	Pharmacology and Pharmaceutical Drug Analysis	4+3+0
12.	CUTM2527*	Concepts of Toxicology	4+3+0
13.	CUTM2528*	Modern and Applied Analytical Forensic Chemistry	4+3+0
14.	CUTM2529*	Molecular Biology and Genetics	4+3+0
15.	CUTM2530*	Biotechnology in Pharmaceutical Sciences	4+3+0
16.	CUTM2531*	Environmental Biotechnology	4+3+0
17.	CUTM2532*	Advance in Physical Techniques	4+3+0
18.	CUTM2533*	Concepts of Conventional and Modern Ballistics	4+3+0
19.	CUTM2534*	Audio Recognition and Video Analysis	4+3+0
20.	CUTM2535*	Modern Trends in Fingerprints Sciences	4+3+0
21.	CUTM2536*	Questioned Documents and Forensic Accounting	4+3+0
22.	CUTM2537*	Forensic Photography and Biometric Traits	4+3+0
23.	CUTM2538*	Cyber Law and IRM	4+3+0
24.	CUTM2539*	Digital Forensics	4+3+0
25.	CUTM2540*	Vulnerability Assessment and Penetration	4+3+0
26.	CUTM2541	Major Project	0+0+24
* Specialization Core Courses			

2. Elective Courses

Sr. No.	Course Code	Course Name	Credits (T+P+Pj)
1.	CUTM2519	Forensic Engineering	4+0+0
2.	CUTM2520	Fire Investigation	4+0+0
3.	CUTM2521	Explosive Analysis	4+0+0
4.	CUTM2522	Nanobiotechnology	4+0+0
5.	CUTM2523	Forensic Voice, Multimedia Comparison And Evidence Evaluation	4+0+0
6.	CUTM2524	Modern Cryptography and Steganography	4+0+0
7.	CUTM2525	Research Methodology	4+0+0
* To be opted in third semester			

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Semester-I

CUTM2509- Introduction to Forensics, Psychology, Law and Statistics

Course Objective: To understand the Basic knowledge of Psychology, Law and Statistics in Forensic science.

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

CO	Statements
CO-1	Understand criminal mind, their Modus Operandi.
CO-2	Understand the Law used in Forensic science.
CO-3	Get idea about statistical analysis and can use in forensic science.

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

Forensic Photography: Definition of photography, Cameras and its working, attachments of camera, 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 Indian Evidence Act: 32, 45, 46, 47, 57, 58, 60, 73, 135, 136, 137, 159, Sections of Criminal Procedure code:53,53A, 54, 291, 292, 293.311A
- Sections of Indian Penal Code: Offences against person: 299, 300, 302, 304B, 306, 319, 320, 326, 339, 340, 351, 359, 362, 375, 377. Offences against property: section 378, 383, 390, 405, 415, 441, 463, 471, 499, 503, and 511.
- Indian constitution article 20,21

UNIT-III

- **Crime:** Definition, types of crimes, causes of crime, Theories and prevention of crime, characteristics of criminal
- **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. Ethics in forensic science.

UNIT-IV

- **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 equipments.
- **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. G. G. G. Aitken and D. A. Stoney; The use of statistics in Forensic Science, Ellis Harwood Limited, England
3. James, S.H. And Nordby, J. J.; Forensic Science; An Introduction To Scientific And Investigative Techniques, CRC Press USA
4. O' Hara & Osterberg: An Introduction to Criminalistics.
5. Forest; Forensic Science: An Introduction.
6. Lee, Honry; Advances in Forensic Science.

7. Sharma JD: Vidhivigyan Avem Vish Vigya.
8. Sharma JD: Apradh Ka Vaigyanik Anveshan.
9. Sharma BR: Forensic Science in Criminal Investigation And Trials.
10. Mordby, J Deed Reckoning – The Art Of Forensic Science Detection, CRC Press LLC, Boca Raton FL, CRC Press
11. Ram Ahuja: Criminology, Rewal Publ. Jabalpur
12. Indian Penal Code
13. Indian Evidence Act.
14. ISO/IEC 17025:2005, NABL 113,113A, 131, guidelines of NABL.

CUTM2510- Instrumental Techniques

Course Objective: To familiarize the students about the different instruments and their techniques used for analysis in Forensic Science.

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

CO	Statements
CO-1	Understand the process for analysis of different evidences.
CO-2	Gain skill on using different instruments, understanding the working of the instruments.
CO-3	Identify the different instruments required for respective evidences and analyse the results and prepare the reports to administer the court of law.

UNIT- I

Spectroscopic Methods:

- Electromagnetic radiations
- General properties of electromagnetic radiations: Wave and Quantum mechanical properties Interaction of EMR with matter
- Electronic spectra and molecular structure
- Internal standards and standard addition calibration methods
- Ultraviolet and visible spectroscopy: Instrumentation and Applications.

UNIT- II

Molecular and Atomic Spectroscopy:

- Infrared Spectroscopy: Molecular vibration, Theory of IR absorption, IR Sources and Instrumentation, FT-IR Applications.
- Raman Spectroscopy: Theory of Raman & FT-Raman spectroscopy, Instrumentation, Applications.
- Instrumentation and Applications of Flame emission spectrometry, Atomic absorption spectrometry and Atomic Fluorescence Spectrometry

UNIT- III

Emerging and Hyphenate Spectroscopy:

- Mass Spectroscopy: Theory, Instrumentation and Applications.
- Inductively coupled plasma-Mass Spectroscopy: Theory, Instrumentation and Applications.
- X-Ray Spectroscopy: Theory, Types, Instrumentation, Applications and Applications.

- Nuclear Magnetic Resonance Spectroscopy: Theory, Instrumentation and Applications.

UNIT- IV

Separation and Detection Techniques

- Introduction to Chromatography: Partition, Adsorption, Ion exchange, Size Exclusion Chromatography, their principle and types of chromatography. Forensic applications of Chromatography.
- Gas Chromatography: Principle, instrumentation and applications. Gas-liquid and gas-solid chromatography, GC – MS, GC – MS – MS (Tandem).
- Gas Chromatography – Head Space: Principle, instrumentation and applications.
- High Performance Liquid Chromatography: Principle, instrumentation and applications, LC – MS, LC – MS – MS (Tandem)

UNIT- V

General Principles of Biological / Biochemical Analysis

- pH and Buffers, Physiological solution

Centrifugation Techniques

- Basic principle of sedimentation, various types of centrifuges, Density Gradient Centrifugation, Preparative Centrifugation, analysis of sub-cellular fractions, Ultra centrifuge- Refrigerated Centrifuges**.**

Microscopy

- 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), Transmission Electron Microscope (TEM)

Practicals

1. Experiments on UV absorption of drug/dyes/Chemicals.
2. Experiments on IR spectroscopy of Paints / Drugs / Organic compounds.
3. Comparison of polythene films by IR spectrophotometry.
4. Identification of drugs / solvents by Gas Chromatography and Gas Chromatography – Mass Spectrometry (GC-MS).
5. Identification and Estimation of Volatile Substances by chemical and Gas Chromatography – Head Space technique (GC-HS).

Reference Books:

1. D.A.Skoog, F.J.Holler and T.A.Neman, Harcoust 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 Honry: An Introduction to Forensic Science
19. Egon Stahl: Thin Layer Chromatography

CUTM2511–Forensic Physics & Crime Scene Management

Course Objective: To understand the management of crime scene, formulation of hypothesis and processing of evidence to FSL.

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

CO	Statements
CO-1	Visit the crime scene, conduct the investigation, process the evidences and send to FSL.
CO-2	Reconstruct a crime scene and form a hypothesis based on the findings from the crime scene.
CO-3	Analyse the different types of physical evidences like glass, paint, soil found in the crime scene.

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
- Digital Imaging of Crime Scene, 3-D scanning technique
- Searching techniques of Crime scene, Processing of physical evidence-discovering, recognizing and examination of physical evidences
- Collection, Safety measures for evidence collection
- Preservation, Packaging, sealing, labeling and forwarding of physical evidences, Maintaining the chain of custody, Probative value of physical evidences, Reconstruction of scene of crime.
- Introduction to physical evidences, Types of physical evidences, Classification and Role of physical evidences 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 equipments, their utility on crime scene
- Technology innovation in crime scene management
- 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

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

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

Bite marks

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

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

UNIT-IV

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

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

UNIT-V

Speaker identification:

- Speaker identification and tape authentication: voice production theory, Speech signal processing and pattern recognition, acoustic parameters of sound, analogue to digital conversion, Frequency and time domain representation of speech signal, fast Fourier transform, Authentication of audio-video signal, Interpretation of voice evidence and Case studies.

Practicals

Forensic Physics

1. Density gradient analysis of soil samples.
2. Determination of density of glass by specific gravity bottle method
3. Restoration of erased identification marks.
4. Determination of refractive index of glass and liquid.
5. Comparison of broken glass bangles.
6. Physical matching of broken pieces of different objects.
7. Determination of tensile strength of rope/dupatta.
8. Physical examination of paint samples by microscopic method
9. Comparison of tool marks.

Crime Scene Management

1. Forensic crime Scene Management
2. Sketching and photography of scene of crime
3. Collection and packing of physical clues at the scene of crime
4. Reconstruction and evaluation of scene of crime.

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 Sarvar Prakashan
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. Vol 7;
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, Bulterwest, London
9. Raymond C Murray & John C.F Tedrew; Forensic Geology; Prentice Hall, New Jersey
10. Working Procedure Manual: Physics BPR&D Publication
11. B. Caddy; Forensic Examination of glass and paints analysis and interpretation ISBN 0784 05749
12. Philip Rose; Forensic Speaker Identification; Taylor & Francis Forensic Science series, London
13. Bengold& Nelson Morgan; Speech and Audio Signal Processing; John Wiley and Sons, USA
14. 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
15. Ray D. Kent and Charles Read; Acoustic analysis of speech
16. Phil Rose & James R Robertson; Forensic speaker identification

CUTM2512 – Fingerprints and Questioned Documents

Course Objective: To impart knowledge of fingerprint and questioned document and to understand the role of individual characteristics and identification of Friction Ridges.
To equip the students with skills to analyse the fingerprints and questioned documents.
Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Know about the importance of fingerprint pattern and their characteristics. Also can perform analysis of fingerprints and identification of individuals on the basis of fingerprint patterns.
CO-2	Demonstrate the importance of document evidences and the techniques involved in their examination process.
CO-3	Gain knowledge on modern trends and recent technologies used for examining and matching fingerprints
CO-4	To develop fingerprints based on physical and chemical methods.
CO-5	To examine the different documents and find out the contents and characteristics of the documents. Opine about the authenticity of the documents. Detect the forgery in the documents.

UNIT- I

- History of Fingerprint Science, main function of FPB
- Development of Fingerprint Science
- Composition of sweat and secretion of sweat. Pattern types & Ridge characteristics
- Ridge tracing, Ridge counting

UNIT- II

- Various systems for FP classification.
- Henry classification system, numerical value, symbol, primary classification, secondary classification, sub-secondary classification and final classification, NCIC classification, AFIS classification.

UNIT- III

- Development, Identification & Presentation of FP
- Known prints & Rolled impressions, Direct or Inked prints.
- Development of Latent Prints & Lifting techniques
- Physical & chemical Methods: Powder techniques & Various chemical techniques, Processing of Post developed prints.
- Finger print comparison & Identification.
- Introduction to AFIS

UNIT- IV

- Nature and problems of document examination,
- Care of documents, classification of documents,
- Procurements of standards- admitted / specimen writings,
- Handling and packing of documents,
- Preliminary examination of documents,
- Principles of hand writing & signature identification.
- Forgeries & its types and their detections
- Physical matching of Documents

UNIT- V

- Examination of alterations, erasers, overwriting, addition and obliterations.
- Decipherment of secret, indented and charred documents,
- Photography of questioned documents.
- Determination of sequence of strokes
- Examination of counterfeit currency notes, passport, credit card, visa, seal and other mechanical impressions
- Examination of typescripts, xerox and computer printouts
- Instrumental techniques used for document examinations

Practicals

Questioned Documents

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 writing inks by TLC.
8. Examination of sequence of intersecting strokes

Fingerprints:

1. To take plain and rolled finger prints and to identify the patterns.
2. To perform ridge tracing and ridge counting.
3. To identify ridge characteristics.
4. To compare the fingerprints.
5. To develop latent finger prints with powders, fuming and chemical methods.
6. Preparation of Foot print cast
7. AFIS

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 Press London.
4. Mehta, M.K: Identification of Thumb Impression & Cross Examination of Finger Prints, N .M. Tripathi (P) Ltd, Bombay
5. Moenssens: Finger Prints Techniques, Chitton Book Co. Philadelphia, New York.
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; CRC Press, Boca Raton, New York.
8. Cook Nancy: Classifying finger prints -Innovative learning publication Mento Park
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 and III, Acad. Press

11. Smith, B.C, Holland MM, Sweel, DL & Dizinno. A; DNA & Forensic Odontology -Manual of Forensic Odontology, Colorado Springs, USA
12. Hillison, S; Dental Anthropology, Cambridge Univ. Press, UK.
13. Kasprzak, J; Possibilities of Cheiloscopy in Forensic Science.
14. Medlin H 0: Ear print Identification, Solve Crime Military Police Journal.
15. lannarelli A V. Ear Identification, Forensic .Identification series, Paramount.
16. Henry C. Lee & R. E. Ganesslen, Advances in Finger Print Technology, CRC Press, Boca Raton, London.
17. Rev. ED.; Ordway Hilton; Scientific Examination. I of Questioned Documents, Elsevier, New York;
18. Albert S. Osborn; Questioned Documents, Second Ed.; Universal Law Publishing, Delhi;
19. Albert S. Osborn; The Problem of Proof~ Second Ed.; Universal Law Publishing, Delhi;
20. Charles C. Thomas, Typewriting Identification I.S.Q.D.; Billy Prior Bates; Springfield, Illinois, USA
21. Charles C. Thomas, I.S.Q.D. Identification System for Questioned Documents; Billy Prior Bates Springfield, Illinois, USA
22. Wilson R. Harrison; Suspect Documents -Their Scientific Examination; Universal Law Publishing, Delhi
23. Hard less, H.R: Disputed Documents, handwriting and thumbs -print identification: profusely illustrated, Low Book Co., Allahabad
24. Morris, Ron, N: Forensic handwriting identification, Acad Press, London
25. Kurtz Sheila: Graphotypes a new plant on handwriting, analysis, Crown Publishers Inc., USA
26. Lerinson Jay; Questioned Documents, Acad Press, London

CUTM2513- Forensic Biology and Biochemistry

Course Objective: To impart knowledge about the significance of biological evidences, basics of cell biology, biochemistry of carbohydrates, proteins. To learn about the DNA structure and significance of forensic botany as well as forensic entomology.

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

CO	Statements
CO-1	Understand the significance of biological evidences and the method for their collection and preservation
CO-2	Differentiate between the stages of cell division and identify them. They will be able to understand the biochemistry of carbohydrates and proteins.
CO-3	Demonstrate the central dogma and the inheritance of characters in the DNA.
CO-4	Gain skills about the different botanical and entomological evidences and their forensic significance.

UNIT - I

Introduction of Forensic Biology and Biological Evidences

- Importance of biological evidences in forensic investigation
- Different domain of biology in investigative sciences
- Types of biological evidences
- Importance of biological evidences in forensic investigation
- Procedure for collection and preservation of biological samples

UNIT - II

Cell Biology

- Introduction of plant and animal cell. Different eukaryotic and 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

UNIT - III

Biochemistry

- Types and properties of amino acids, structure of proteins and their importance in forensic investigation.
- Chemistry of Carbohydrates - Definition, classification and biological importance.
- Chemistry of Lipids - Definition, classification and biological importance.
- Recent developments in Biochemistry in Forensic Investigation

UNIT - IV

Introduction to Inheritance and DNA

- Principle of inheritance and diversity
- Organization of genome in prokaryotes and eukaryotes
- Chemical structure of DNA and RNA
- Overview of Central Dogma

UNIT - V

Forensic Botany and Entomology

- Various types of woods, seeds, leaves and their forensic importance
- Study and identification of pollen grains and starch
- Morphological and anatomical characteristics of plants yielding drugs of abuse like opium, Cannabis, Coca plant, Psilocybe mushrooms, Tobacco
- General Entomology, Importance of insects in forensic investigations, life cycles of insect to determine time since death

Practicals

1. Microscopic examination of different types of wood
2. Microscopic characterization of different spores
3. Microscopic examination of diatoms
4. Staining and visualization of Barr Bodies.
5. Identification of Forensically important insects
6. Collection of biological sample and maintaining their chain of custody

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. Lehninger Principles of Biochemistry 6th Edition (2012) – Nelson and Cox, W.H. Freeman, ISBN: 978-1429234146
5. Molecular Biology of the Cell, 6th Edition (2014) – Bruce Alberts, et al., Garland Science, ISBN: 978-0815341055
6. Forensic DNA Typing, Second Edition: Biology, Technology, and Genetics of STR Markers 2nd Edition (2005) - John M. Butler, Academic Press, ISBN:0121479528
7. Forensic Science: An Introduction to Scientific and Investigative Techniques – Stuart H. James, Jon J. Nord by, CRC Press, ISBN:0849327474

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Semester-II

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CUTM2514- Quality Management, Narcotic Drugs, Explosives and Forensic Chemistry

Course Objective: To learn about the quality management and assurance protocols. Knowledge of drugs, explosives materials and their analysis.

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

CO	Statements
CO-1	Acquire knowledge about the significance of quality management and quality assurance
CO-2	Identify and detect NDPS drugs using various methods and techniques.
CO-3	Gain skill for the analysis of residue material of any explosive and also detection of the cause of the explosion.
CO-4	Skill to identify and Examine the quality of different product as per BIS standards.

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, Procedure for sample selection, collection, preservation, packaging, identification, storage and transport

Traceability and Validation of new methods, measurement of uncertainty, Equipment maintenance and calibration, Evaluation of materials and reagents, sample and data handling in the laboratory, sample disposal, Assessment, interpretation and reporting of results

Proficiency testing, external quality assessment programmes, internal audit/External audit, MRM

Training and conferences

UNIT- II

Narcotic drugs & psychotropic substances

Introduction to Controlled Substances, Classification of controlled substances, Precursor chemicals, Narcotic raids and clandestine drug laboratories evidences and forensic examination Mandatory provisions of NDPS Act, 1985

NDPS Drugs, Classification of Drugs

Commonly abused drugs, Drug dependence and Drug Tolerance

Designer Drugs, Analysis of Drug of abuse by various chemical and instrumental methods

UNIT- III

Explosives

Introduction, classification and chemistry of explosives

Various types of IEDs and their reconstruction

Mechanism of explosion and their effects

Systematic examination of explosive and explosion residues (organic and inorganic) by chemical and instrumental techniques and interpretation of results

Explosives Act and Explosive Substance Act

UNIT- IV

Fire

Introduction to Fires, Types of Fires, and Causes of fire, Patterns of fire

Thermodynamics of fire

Accelerants and incendiary devices, Forensic Analysis of Fire Debris by Instrumental methods

Forensic Analysis of petroleum products

Introduction to petroleum products and adulteration in petroleum products Analysis of Petrol, Kerosene and Diesel as per BIS Specifications

UNIT- V

Forensic Analysis of beverages

Introduction to Alcoholic and non-alcoholic beverages

Analysis of alcoholic beverages, country made liquor, illicit liquor and medicinal preparations containing alcohol as constituents.

Analysis of non-alcoholic beverages like tea, coffee

Bribe Trap Cases:

Examination of Chemicals (Phenolphthalein) used in Bribe trap cases.

Inks : Forensic Examination of inks by various techniques, Dating and aging of inks
Polymers: Forensic examination of plastics and Adhesives.
Adulterated Food Analysis
Analysis of samples taken under Food Adulteration Act
Fibers and Forensic Chemical Analysis
Introduction to fibers, Classification of fibers, Analysis by microscopy, melting point and solubility testing of fibers, Chromatography, Spectroscopy and elemental analysis of fibers.

Practicals

1. Identification of NDPS drugs by color test and TLC.
2. Identification of acidic and basic drug by UV/TLC
3. Detection of low explosives by chemical/color test and TLC
4. Examinations of petroleum products as per BIS specifications.
5. Identification of alcohol by chemical/color test.
6. Analysis of phenolphthalein in bribe trap cases
7. Identification of adulterants in some common food samples by chemical methods/color test (Turmeric, chilli, ghee, honey, pulses, sugar, salt etc.)
8. Analysis of ink by TLC
9. Analysis of polythene by FTIR
10. Analysis of NDPS drugs by instrumental methods.

Reference Books:

1. Maudham Bassett etal; Voget's Textbook of Quantitative Chemical Analysis, 6th Ed. Longman Essex
2. I. I. Finar: Oraganic Chemistry vol. II pearson Educatiopn (Sigapore)
3. R. T. Morrison, Rn.N Boyd; Organic Chemistry, 6th Ed. Prentice Hall, New Delhi
4. Brean S. Furniss Etal; A.I.Vogel Textbook Of Practical Oraganic Chemistry, Addison Wesley Longman, Edinburg
5. A. Burger; Medicinal Chemistry, Vol. Ii, Wiley Interscience, Ny
6. D A Skoog, D.M. West, F.J. Holler; Analytical Chemistry – An Introduction, 7th Ed. Saunders College Pub, Philadelphia, USA
7. Boudreau JE, Etal; Arson & Arson Investigation, Survey & Assessment National Institutes Of Law Enforcement, U.S. Deptt Of Justice, U.S. Govt Printing Press
8. Dettean J D; Kirk's Fire Investigation, 5th Ed. Prentice Hall, Eaglewood Cliffs, N. J.
9. Yinon Jitrin; Modern Methods & Application In Analysis Of Explosives, John Wiley & Sons, England
10. Working Procedure Manual – Chemistry, Explosives And Narcotics, BPR&D Pub.

11. C.A. Watson; Official And Standardized Methods Of Analysis, Royal Society Of Chemistry, UK
12. Feigl; Spot Test In Inorganic Analysis, Elsevier Pub. New Delhi
13. Feigl; Spot Test In Organic Analysis, Elsevier Pub. New Delhi
14. Silverman; Organic Chemistry 0f Drug Design & Drug Action, Elserier Pub. New Delhi
15. Abraham Burger; Medicinal Chemistry & Drug Discovery, 6 Vol Set, 6th Ed John Wiley & Sons, NY.
16. NDPS Act, 1985.

CUTM2515–Forensic Medicine & Anthropology

Course Objective: To learn about the medico legal aspects of death and injuries, wild life forensics, importance of forensic anthropology in identification of individuals.

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

CO	Statements
CO-1	Identify different stages of post-mortem changes, determine time since death, manner of death and cause of death;
CO-2	Identify the race, age and sex of an individual from bones, skull or dentition found in cases of mass disaster or as a form of evidence.
CO-3	Skills to analyse the signs and symptoms for different post-mortem and anti-mortem examinations; different types of injuries and their medico-legal aspect.
CO-4	Demonstrate about wildlife forensics, major type of crimes occurring and different steps taken by the government to protect them.

UNIT-I

Forensic Medicine /Medicolegal Investigation

Objectives of medicoloegal investigation, Death and its causes, types of death , Signs of death, Post mortem changes- classification, Determination of cause of death, manner of death, Estimation of time since death, Post mortem biochemistry of the body fuids-Modern techniques used for the estimation of time since deaths, Exhumation – medicolegal autopsy

UNIT-II

Forensic Anthropology: Introduction to forensic anthropology, Scope & Need, Forensic Anthropometry, osteometry, Identification of individuals (living), Identity of missing person by superimposition techniques x Facial reconstruction method, Portrait parley.

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.

Forensic odontology- Identification of individuals from teeth. Ages of eruption and other individual characteristics, Basics of anatomy and physiology with forensic perspective .

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

Medico legal Aspects of Age – Criminal responsibility of child-evidences deposition, Anti Child labour act, ILO conventions, Child abuses, examination protocols

UNIT-III

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

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 elderly people, Abortion & Infanticide, Deaths from starvation.

UNIT-IV

General and medico legal aspects of injuries/ traumatology - Mechanical Injuries: Abrasions, Bruises, Lacerations, Incised wounds, Stab wounds, Firearm injuries, Defense injuries, fabricated injuries. Vital clues for establishing the mannerof deaths due to various injuries

Traffic accident injuries: vehicular injuries, railway injuries & aircraft injuries. Thermal injuries: Heat and cold -Burns and scalds, Deaths due to electrocution- lightning ,Electricity,
Deaths due to explosions.- establishing the causes of deaths and vital clues/evidences to becollected Deaths due to Chemical trauma.

UNIT-V

Wild life Forensics: Importance of Wildlife species in ecosystem. Endangered and Rare species-wildlife management, different methods of killing and poaching of the wildlife animals. Scientific methods of investigation – identity. Wildlife animals –examination of physical evidences like hair, nails, teeth, ivory, horn, footprints (pugmarks) etc by conventional and modern methods. Wildlife Protection Act

Practicals

1. Microscopic examination of hairs – identification of species origin.
2. Microscopic examination of diatoms.
3. Examination of skeletal remains- Long bones- Femur, Humerus,
4. Identification of individuals by long bones and stature estimation
5. Determination of sex and age from Skull with mandible
6. Determination of sex from pelvis and sacrum.
7. Identification of individuals by dental examination
8. Anthropometry.- Identification of individuals (in living)
9. Postmortem examination in various Asphyxial deaths.
10. Postmortem examination of various homicidal/ accidental injuries

Reference Books:

1. Modi JS: Medical Jurisprudence and Toxicology
2. Taylor: Medical Jurisprudence
3. Parikh CK: Text book of Medical Jurisprudence and Toxicology
4. Keith Simpson & Bernard Knight: Forensic Medicine
5. C.M.V. Cox Medical Jurisprudence and Toxicology
6. K.S. N. Reddy: Text book of Forensic Medicine &Toxicology
7. Apurba Nandi: Text book of Forensic Medicine
8. Krishan Vij: Text book of Forensic medicine
9. Bisbing, Englewood Cliffs, New Jersy, Printice Hall
10. Forensic Hair Investigation : Forensic Science Progress, Vol II – Seta S. Sato, H & B Miyake, Springer – Verlag, Berlin
11. Laboratory Procedure Manual - Forensic Biology (2005), Directorate of Forensic Science, MHA, New Delhi
12. The forensic Identification and Association of Human Hair in Forensic Science Handbook –
13. Text book of Forensic medicine and toxicology –V.V.Pillay

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CUTM2516– Forensic Serology and DNA Profiling

Course Objective: To acquaint the students about different body fluids and their analysis. Impart the knowledge of DNA profiling and individualisation.

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

CO	Statements
CO-1	Acquire skills to identify, characterise and analyse the various body fluids using different serological techniques found in a crime scene.
CO-2	Demonstrate the different conventional and modern techniques for DNA isolation, extraction, quantitation and purification of DNA. Understand the basic concept of individualization and uniqueness of DNA in identification of individuals.
CO-3	Identify individuals based on DNA Profiling technique.
CO-4	Understand the significance of microbiology in forensic science and how it can be involved in evidence 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
- Presumptive and confirmatory test for blood.

UNIT- II

Identification of Saliva and Other Biological Fluids

- Biological characteristics of saliva and its identification
- Composition of semen , vaginal secretion and its forensic importance
- Different Tests for identification of Semen & Vaginal Secretion
- Composition of Urine and its identification
- Other biological fluids and its detection

UNIT- III

Basics of DNA extraction and Quantification

- Conventional techniques for DNA isolation
- Modern techniques and equipment for DNA extraction and purification
- Different methods of DNA quantitation
- DNA separation techniques

UNIT- IV

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

Unit - V

Forensic Microbiology

- Scope of microbiology in forensic investigation
- Sterilization techniques - Physical agents: Dry heat, wet heat and cold sterilization, filtration, radiation; Chemical agents (Disinfectants, antibiotics, alcohols) and their mechanisms.
- Microbial diversity and its application in forensic investigation.
- Different methods for isolation of microorganisms from forensic samples like vomit, stool, stomach wash and residual food.

Practicals

1. Physical, biochemical and spectrophotometric examination of blood stains.
2. Examination of seminal stains by crystal tests, biochemical and microscopical analysis.
3. Examination of saliva and its stains.
4. Biochemical and microscopic examination of urine.
5. Determination of origin of species from biological fluids.
6. Blood group typing of biological fluid stains by absorption elution, absorption inhibition and mixed agglutination techniques.
7. Isolation of DNA from blood and its quantification.
8. Collection and extraction of DNA using FTA card

Reference Books:

1. The examination and Typing of Blood Stains in the crime laboratory – B J Culliford, U. S. Dept. of Justice, Washington D. C.
2. Blood Group Serology – Boorman KE, Dodd BE and LOncoln PJ, Chuchill Livingstone Inc. New York.
3. Laboratory Procedure Manual - Forensic Serology (2005), Directorate of Forensic Science, MHA, New Delhi.
4. Laboratory Procedure Manual – DNA Profiling (2005), Directorate of Forensic Science, MHA, New Delhi.
5. Molecular Biology of the Cell, 6th Edition (2014) – Bruce Alberts, et al., Garland Science, ISBN: 978-0815341055
6. Forensic DNA Typing, Second Edition: Biology, Technology, and Genetics of STR Markers 2nd Edition (2005) - John M. Butler, Academic Press, ISBN:0121479528
7. Forensic Science: An Introduction to Scientific and Investigative Techniques – StuartH. James, Jon J. Nord by, CRC Press, ISBN:0849327474
8. Genes XI (2012) – Benjamin Lewin, Jones & Bartlett Learning, ISBN: 978-1449659851
9. Kuby Immunology6th Edition– Kindt, Goldsby and Osborne, W.H. Freeman and Co. ISBN: 978-0716767640
10. Lehninger Principles of Biochemistry 6th Edition (2012) – Nelson and Cox, W.H. Freeman, ISBN: 978-1429234146
11. Microbiology 5th Edition – Pelczar et. al., McGraw-Hill Inc., ISBN: 978-0074623206
12. Prescott's Microbiology 9th Edition (2013) - Joanne Willey, Linda Sherwood, Christopher J. Woolverton, McGraw-Hill Education, ISBN: 978-0073402406
13. An Introduction to Forensic Genetics 2ndEdition (2010) - William Goodwin, Adrian Linacre and Sibte Hadi, Wiley-Blackwell, ISBN: 978-0470710197

CUTM2517– Forensic Toxicology and Pharmacology

Course Objective: To educate students about basic concepts of types of poisons, their mode of action, signs and symptoms involved. To learn about pharmacokinetics and pharmacodynamics.
Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Demonstrate the forensic significance of different toxicological evidences, their collection, preservation and analysis
CO-2	Detect type of poison in the body or body fluids
CO-3	Skill to extract and identify drugs/poison from biological samples by using conventional or modern techniques.
CO-4	Analyse the drug interaction and bioavailability of the drug in the body and their metabolites.

UNIT- I

- Introduction and concepts of forensic toxicological examination and its significance**.**
- Law relating to poisons.
- Introduction to Poisons, form of poisons, classification and methods of administration of poison
- Mode of action of poison, Diagnosis and management of poisoning cases.
- Factors affecting the effect of poison and medico-legal aspects in poisoning cases

UNIT- II

- Collection and preservation of biological evidences (viscera and /or body fluids) and circumstantial evidences in fatal and survival cases. Submission of samples to the laboratory, postmortem examination, specific analysis plan / approach to toxicological examinations of poisoning samples. Classification of matrices.
- Isolation and Extraction of poison/ drug by various classical and modern methods using instrumental techniques.

UNIT- III

- Method of analysis of Inorganic poisons (metallic, non metallic and anions).
- Method of analysis of Neutral poison.
- Method of analysis of Basic drugs / poisons.
- Method of analysis of Acidic drugs / poisons.
- Method of analysis of volatile poisons.

UNIT- IV

- Insects and animal poisons and their examination.
- Plant poisons: Classification and analysis by chemical and instrumental techniques.
- Mechanical poisons and their examination.
- Analytical aspect of toxicological evidence.
- Toxicological analysis of decomposed materials.
- Interpretation of toxicological findings and preparation of reports.

UNIT- V

Forensic pharmacology

- Forensic pharmacological studies, absorption, distribution, pharmacokinetics and metabolism, pathways of drug metabolism, drug toxicity, excretion of drugs and poisons.
- Detection of poison on the basis of their metabolic studies.

Practicals

1. Systematic extraction and detection of poisons and drugs from visceral samples by various suitable chemical and instrumental techniques.
2. Detection of metallic poisons from viscera samples and food samples.
3. Identification of vegetable poisons of Forensic interest.

Reference Books:

1. Modi JS: Medical Jurisprudence and Toxicology
2. Taylor: Medical Jurisprudence
3. Parikh CK: Medical Jurisprudence and Toxicology
4. Keith Simpsen & Bernard Knight: Forensic Medicine
5. Poison, CJ, DJ Gee, B. Knight: Forensic Medicine
6. Reddy: Forensic Medicine
7. Laboratory Procedure Manual- Forensic Toxicology, DFS, MHA, New Delhi
8. Pharmacology and Therapeutics-Bhandarkar& Satoskar
9. Medical Pharmacology- Tripathy
10. Essentials of Toxicology- Ellenhorn

CUTM2518– Forensic Ballistics and Computer Forensics

Course Objective: To impart the knowledge of firearms and projectile and basic understanding of digital platform and cyber laws.

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

CO	Statements
CO-1	Gain understanding about the knowledge of different firearms, ammunitions, and projectile.
CO-2	To understand the computer parts, digital platform, cyber-crime and cyber laws.
CO-3	Gain skills to analyse and detect gunshot residue, gunshot powder, class and individual characteristics of firearms and ammunitions.
CO-4	Identify the range of fire using modern methods and also different wounds caused by firearms.

UNIT- I

- **Firearms** characteristics & classification of firearms, History and background of firearms, Functional assembly & Operating principle of firearms, Characteristics & Working mechanism of Standard: Rifled firearms, Small arms, Shot guns & Non-standard: Improvised, Country made, Imitative firearms, identification of origin.
- **Ammunition** & its constructional parts, 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.

UNIT- II

- 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.

UNIT- III

- **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 / flash / 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.
- **Analysis of GSR** –Composition of GSR, Location & Collection, Mechanism of formation, Chemical & Instrumental techniques involved in analysis, Shooter Identification technique.

- **Determination of range of fire** & its related phenomena, Techniques involved in ballistic studies, Stereo and comparison microscopy, BDAS, IBIS.

UNIT- V

- **Computer Forensics:**
  Introduction to Computer and its components, Computer Storage Media, Windows and Unix File Storage, Introduction to Cyber crime and Cyber Law, Terms: Internet, hacking, virus, obscenity, pornography, program manipulation, Software piracy, attacks, phishing etc, case studies.

Practical

Forensic Ballistics:

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 GSR.

Cyber forensics:

1. Imaging of hard disc, restoration of deleted files, password cracking, e-mails tracking.

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, P A
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, P A
9. Gary J. Ordog, Management Of Gunshot Wounds, Elsevier, New York
10. Working Procedures Manual: Ballistics, BPR&D Pub.
11. S.K.Sharma, cyber laws and crime.
12. Fry & Nystron,security monitoring, O. reilly
13. Tipton Krause, Information security management, Aner Bach
14. Schneiner, hacking the code, Syngrers.

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Semester-III

Specializations

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Specialization In Forensic Chemistry & Toxicology

CUTM2526 - Pharmacology and Pharmaceutical Drug Analysis

Course Objective: To learn about the concepts Drug, analysis of drug. Understanding of drug therapy, abuses and interaction of drug with the body.

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

CO	Statements
CO-1	Understand about the drug, factors, bioavailability, and responses of drugs.
CO-2	Understand the different agents of drugs, designer drugs and NDPS substances.
CO-3	Perform qualitative and quantitative analysis of various drugs.
CO-4	Demonstrate the concepts of pharmacokinetics and pharmacodynamics.

UNIT- I

Basic Principles of Pharmacology

- Introduction to Pharmacology
- Pharmacopoeias IP, USP, EP
- Drug & Drug Receptor mechanisms
- Pharmacodynamics
- Factor affecting the effects of Drug
- Post mortem redistribution

UNIT- II

Pharmacokinetics

- L-ADME
- Bioavailability and Bioaccumulation
- Dose response relationship
- Drug Interactions like Agonism, Antagonism, Addition, Synergism, Potentiation
- Adverse drug reactions and pharmacogenetics
- Drug concentration and pharmacological response
- Drug dependence and drug abuse

UNIT- III

Pharmacology and Pharmaceutical Analysis

- Aliphatic alcohols
- General and local Anesthetics
- CNS Stimulants
- Sedative, Hypnotics and Pharmacotherapy of sleep disorders
- Drugs effective in convulsive disorders

UNIT- IV

Pharmacology and Pharmaceutical Analysis

- Antipsychotic Agents
- Antidepressant drugs
- Antiseizure Drugs
- Drugs of Abuse
- Tranquillizers
- Narcotic Drugs and Psychotropic Substance
- Schedule and Nonscheduled Drugs
- Designer Drugs
- Doping Drugs
- Hallucinogens

UNIT- V

Pharmacology and Pharmaceutical Analysis

- Chemotherapeutic Drugs
- Antibacterial
- Antifungal agents
- Antiviral agents
- Antiprotozoal Drugs
- Disinfectants, Antiseptics and Sterilants

Practicals

- Qualitative and quantitative analysis of Pharmaceuticals by various chemical and instrumental techniques.

Reference Books:

1. Klaassen, C. D.,:Casarett and Doull's Toxicology: The Basic Science of Poisons, 5th ed, McGraw-Hill, 1995.
2. 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.
3. Bogusz, M. J.,: Hand Book of Analytical Separations, Vol. 2: Forensic Science, 1st ed., Elsevier Science ,2000.
4. Siegel, J.A., Saukko, P. J., Knupfer, G.,: Encyclopedia of Forensic Sciences (Vol3), Academic Press, 2000.
6. Rang, P.H., Dale, M.M., Ritter, M.J.: Pharmacology, 4th ed., Harcourt/Churchill Livingstone, 2000.
7. Paranjape, H.M., Bothara, G.K., Jain, M.M.: Fundamentals of Pharmacology, 1st ed., Nirali Prakashan, 1990.
8. Budhiraja, R.D.: Elementary Pharmacology and Toxicology, Popular Prakashan, 2nd ed., 1999.
9. Wiseman, H and Henry J.: Management Of Poisoning, A Handbook for Healthcare workers, 1st ed., A.I.T.B.S, 2002
10. Hardman, J. G. and Limbird, L. E.,: Goodman and Gilman's The Pharmacological basis of Therapeutics, 9th ed., McGraw-Hill, 1996
11. Laaboratory procedure Manual, Forensic Toxicology: DFS, 2005
12. Sunshine, I ; Methods for Analytical Toxicology, CRC Press USA (1975)
13. Cravey, R.H; Baselt, R.C.: Introduction to Forensic Toxicology , Biochemical Publications, Davis, C.A. (1981)
14. Stolmen, A.; Progress in Chemical Toxicology: Academic Press, New York (1963)
15. Modi, Jaisingh, P.; Textbook of Medical Jurisprudence& Toxicology, M.M. Tripathi Publication (2001)
16. Eckert; An Introduction to Forensic Science, CRC Press
17. Pillay, V. V.; Handbook of Forensic Medicine and Toxicology, Paras Pub., 2001
18. Curry, A. S: Poison Detection in Human Organ
19. James, S. H. and Nordby, J. J.: Forensic Science: An Introduction to Scientific and Investigative Techniques, 2003.
20. Saferstein, R: Criminalistics - An Introduction to Forensic Science, Prentice Hall, 1995.
21. Sarkar, S: Fuels and Combustion, Orient Longman, 1990
22. Verma, R. M: Analytical Chemistry – Theory and Practice, CBS Pub., 1994
23. Svehla, G. Ed.: Vogel's Qualitative Inorganic Analysis, Longman, 1998.
24. Bassett: Vogel's Text Book of Quantitative Inorganic Analysis, Longman, 1978
25. Vogel, A. I: Text Book of Practical Organic Chemistry including Qualitative Organic Analysis, ELBS, 1971.

CUTM2527 - CONCEPTS OF TOXICOLOGY

Course Objective: Concepts of poison and toxic materials. Understanding of toxic agents and their risk assessments.

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

CO	Statements
CO-1	Gain knowledge on toxicology domains, different toxic substances and their effects
CO-2	Gain skills in demonstrating the analytical methods of toxicology and its application
CO-3	Understand bioaccumulation and biotransformation of xenobiotics in the body
CO-4	Ability to detect and identify the poison by various analytical techniques from biological and non-biological matrices.

UNIT-I

Introduction to Toxicology

- History, scope and applications
- Types of Toxicology
- Principle of Toxicology
- Mechanism of Toxicology
- Risk Assessment and Safety evaluation of chemicals

UNIT-II

Disposition and Translocation of Toxicants

- Exposure of Toxicants
- Translocation of Toxicants
- Bioaccumulation of Xenobiotics
- Biotransformation of Xenobiotics
- Antidotal therapy

UNIT-III

Toxic Agents

- Toxic effects of Pesticides
- Toxic effects of Metals
- Toxic effects of Solvent
- Toxic effects of Plants
- Toxic effects of Insects & Animal poisons

UNIT-IV

Analytical Toxicology

- Introduction
- Provision of analytical toxicology services
- Samples and sampling techniques
- Choice of analytical method
- Method implementation, development and validation
- Quality control and quality assurance
- Applications of analytical toxicology

UNIT-V

Applications of Toxicology

- Clinical Toxicology
- Environmental Toxicology/ Ecotoxicology
- Forensic Toxicology/ Postmortem Toxicology
- Industrial/Occupational Toxicology
- Food Toxicology
- Behavioral toxicology
- Preventive toxicology
- Descriptive Toxicology
- Mechanistic Toxicology
- Regulatory Toxicology
- Genetic Toxicology
- Systemic Toxicology

Practical

1. Systematic extraction, isolation, purification and identification of volatile, acidic, basic and neutral drugs by various analytical techniques.
2. Extraction and detection of metallic poisons from biological and non biological matrices.
3. Identification of plant poisons by chemical and microscopic methods.

Reference books:

1. Curry: Analytical Methods in Human Toxicology, Part II, 1986.
2. Casarett & Doll Toxicology: The Basic Science of poisons.
3. Clark, E.G.C.: Isolation and identification of Drugs, 1966
4. Curry, A.S.: Poison Detection in Human Organs, 1976
5. Curry, A.S.: Advances in Forensic Chemical Toxicology, 1972
6. Holfmann, F.G.: Handbook of Drug and Alcohol Abuse.
7. Turner: Drugs & Poisons.
8. Samford : Poisons Their Isolation Identification
9. Stoleman: Progress in Chemical Toxicology.
10. Sunshine, I: Guidelines for Analytical Toxicology Programme, Vol-I, CRC press, 1950.
11. Sunshine, I: Handbook of Analytical Toxicology, press, 1969.
12. Mule, S. J. et al. : Immunoassays for Drugs subjects to ab, CRC Press, 1974
13. Connors, K.: A text book of Pharmaceuticals analysis, Interscince, New York, 1975

CUTM2528 -Modern and Applied Analytical Forensic Chemistry

Course Objective: Understanding of nuclear forensics, detection and measurement of radioactive substances. Understanding of drug chemistry, NDPS laws and analytical method. Understanding the chemistry of fire and explosives.

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

CO	Statements
CO-1	Demonstrate the importance and application of radioisotopes and other aspects of forensic nuclear chemistry.
CO-2	Gain knowledge on components of controlled substances, doping drug, chemical warfare agents and their analysis
CO-3	Identify and detect the cause of fire and explosion and analyse the residue materials.
CO-4	Skill to detect the adulteration in food and identify the adulterated material in food.

UNIT-I

Forensic nuclear chemistry

Introduction to nuclear forensics, nuclear threats, Nuclear explosive devices, Radioactivity, Radioactive decay rates and Half lives, Methods of detection and measurement of radio actives (G.M and Scintillation Counter). Applications of Radioisotopes.

Activation analysis:

Neutron activation analysis, principle, technique, applications and steps involved in neutron activation analysis.

Isotope dilution analysis:

Principle, types of isotope dilution analysis, typical applications of isotope dilution analysis.

UNIT-II

Forensic Drug Chemistry

Introduction to Drugs, Controlled Substance Act, Forensic examination of drugs/Narcotics (Cannabis), Phenethylamines (Amphetamine, Methamphetamine), Hydroxyl derivative (Ephedrine) Ketone Derivative (Cathinone), Methoxy Derivative (Mescaline) Tertiary Amines (Cocaine and Opiates) Tryptamines

(Psilocin and Psilocybin) Anabolic Steroids, Miscellaneous Controlled Substances (Barbiturates, Benzodiazepines, GHB, Ketamine and LSD)

Sample Preparation, Extraction Techniques- Chemical-color test, Microcrystal techniques and other instrumental techniques involved in analysis.

UNIT-III

Petroleum Chemistry

Paraffins, , Iso-olefins, Olefin Hydrocarbons, Naphthenes,Cycloparaffins or Aromatic Hydrocarbons, Sulphur Compounds, Nitrogen Compounds, Oxygen Compounds, Organo-Metallic Hydrocarbons; H/C Ratio of Hydrocarbons;

Physical Properties of Petroleum Products : Density, Viscosity, Surface Tension, Color, Fluorescence, Cloud Point, Pour Point, Aniline Point, smoke point, boiling point, Optical Properties, Flash Point, Refractive Index and Calorific Value, Determination of Cetane and Octane number, **Analytical Techniques**: Quantitative and Qualitative Steps in Analysis of Petroleum

Fire Chemistry

Scientific Investigation of Fire, NEPA 921 and NEPA 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, Kinetics of Explosive Reactions, Analysis of low and high explosives by different instrumental techniques, Quality control, Proficiency Testing, Interpretation and Significance of Results

Chemical Warfare Agents

Classification, physical and biochemical properties, toxic effects detection by Biosensors and various instrumental Techniques

UNIT-V

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.

Practicals

1. Microcrystalline tests for drugs
2. Separation of alkaloids, glycosides, tryptamines by TLC
3. Separation of Psychotropic substance by TLC
4. Separation of Cannabis/Opium by TLC
5. Separation of lipids by TLC
6. Analysis of high explosives by color test and TLC.
7. Extraction of caffeine from tea leaves, characterization by IR.
8. Estimation of protein in food samples.
9. Analysis of calcium and magnesium in milk.
10. Analysis of fire residues by GC
11. Analysis of adulterated and non-adulterated oil by chemical/Color Test and TLC method
12. Analysis of dye in petrol and kerosene by UV spectrophotometry and TLC
13. Estimation of nitrite/nitrate in water samples
14. Separation of amino acids by thin layer chromatography
15. Analysis of NDPS drugs and explosives by instrumental techniques.

Reference Books:

1. Klaassen, C. D.,:Casarett and Doull's Toxicology: The Basic Science of Poisons, 5th ed, McGraw-Hill, 1995.
2. 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.
3. Bogusz, M. J., Hand Book of Analytical Separations, Vol. 2: Forensic Science, 1st ed., Elsevier Science, 2000.
4. Siegel, J.A., Saukko, P. J., Knupfer, G.,: Encyclopedia of Forensic Sciences (Vol3), Academic Press, 2000.
5. Rang, P.H., Dale, M.M., Ritter, M.J.: Pharmacology, 4th ed., Harcourt/Churchill Livingstone, 2000.
6. Paranjape, H.M., Bothara, G.K., Jain, M.M.: Fundamentals of Pharmacology, 1st ed., Nirali Prakashan, 1990.
7. Budhiraja, R.D.: Elementary Pharmacology and Toxicology, Popular Prakashan, 2nd ed., 1999.
8. Wiseman, H and Henry J.: Management Of Poisoning, A Handbook for Healthcare workers, 1st ed., A.I.T.B.S, 2002
9. Hardman, J. G. and Limbird, L. E.,: Goodman and Gilman's The Pharmacological basis of Therapeutics, 9th edn., McGraw-Hill, 1996
10. Laaboratory procedure Manual, Forensic Toxicology: DFS, 2005
11. Sunshine, I ; Methods for Analytical Toxicology, CRC Presss USA (1975)
12. Cravey, R.H; Baselt, R.C.: Introduction to Forensic Toxicology , Biochemical Publications, Davis, C.A. (1981)

13. Stolmen, A.; Progress in Chemical Toxicology: Academic Press, New York (1963)
14. Modi, Jaisingh, P.; Textbook of Medical Jurisprudence& Toxicology, M.M. Tripathi Publication (2001)
15. Eckert; An Introduction to Forensic Science, CRC Press
16. Pillay, V. V.; Handbook of Forensic Medicine and Toxicology, Paras Pub., 2001
17. Curry, A. S: Poison Detection in Human Organ
18. James, S. H. and Nordby, J. J.: Forensic Science: An Introduction to Scientific and Investigative Techniques, 2003.
19. Saferstein, R: Criminalistics - An Introduction to Forensic Science, Prentice Hall, 1995.
20. Sarkar, S: Fuels and Combustion, Orient Longman, 1990
21. Verma, R. M: Analytical Chemistry – Theory and Practice, CBS Pub., 1994
22. Svehla, G. Ed.: Vogel's Qualitative Inorganic Analysis, Longman, 1998.
23. Bassett: Vogel's Text Book of Quantitative Inorganic Analysis, Longman, 1978
24. Vogel, A. I: Text Book of Practical Organic Chemistry including Qualitative Organic Analysis, ELBS, 1971.
25. Skoog, D. A., West, D. M. and Holler, F. J: Analytical Chemistry: An Introduction, Saunders College, 1994.
26. Siegel, J. A, Saukko, P. J. and Knupfer, G. C: Encyclopedia of Forensic Sciences, Academic Press, 2000.
27. Townsends, A. (Ed): Encyclopedia of Analytical Science, Academic Press, 2005.
28. Beveridge, A: Forensic Investigation of Explosives, Taylor & Francis, 2000.
29. Yallop, H. J: Explosion Investigation, Forensic Science Society & Scottish Academic Press, 1980.
30. Narayanan, T. V: Modern Techniques of Bomb Detection and Disposal, R. A. Security System, 1995.
31. Yinon, J. and Zitrin, S: The Analysis of Explosives, Oxford: Pergamon, 1981
32. An Introduction to Physics and chemistry of Petroleum
33. Kinghorn: Introduction to Petrochemicals Sukumar Maiti
34. D.W.Waples : Geochemistry in Petroleum Exploration
35. A.L.Waddams : Petroleum Geochemistry and Geology Chemicals from Petroleum
36. Day& Underwood :Analytical Chemistry
37. H. J. Arnikar Essentials of Nuclear Chemistry, 4th Edition Wiley Eastern (1987).
38. H. J. M. Bowen. Buttler and Tanner Chemical Applications of Radioisotopes, (1969).
39. G Friedlander, T. W. Kennedy, E. S. Macias and J. M. Miller, Introduction of Nuclear and Radiochemistry, 3rd Edition, John Wiley (1981).
40. P.D.Vowels and D.W: Experiments in Environmental chemistry.

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Specialization In Forensic Biotechnology

CUTM2529 - Molecular Biology and Genetics

Course Objective: To understand the basic concepts of immunology, the central dogma involved in inheritance of genetic characters, and population genetics. Also understanding of conventional and modern methodologies in forensic DNA analysis.

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

CO	Statements
CO-1	Demonstrate the significance of immunological studies and metabolism of gentic material in the purview of forensic science.
CO-2	Understanding of Bioinformatics, population structure and DNA databases.
CO-3	Gain skill in extraction and estimation of DNA from different sources. Genotyping of the DNA with different markers and interpretation of the result to aid the police officials and court of law.
CO-4	Extraction and estimation of proteins from different sources. Analysis of protein structure using RASMOL software.

UNIT – I

Immunology

- Antigen – Epitope, essential factors for antigenicity, haptenes and adjuvant.
- Immunoglobulin – structure, classes of immunoglobulin, antigen – antibody reactions and their techniques in serological analysis.
- Application of various polymorphic enzymes and proteins in criminal investigation.
- Antigen Processing and presentation
- Production of Monoclonal and polyclonal antibodies, hybridoma technology
- Autoimmunity and hypersensitivity
- HLA typing and its forensic importance.
- Vaccines
- Lectins and their forensic significance

UNIT - II

DNA, RNA and Protein Metabolism

- Organization of genome in prokaryotes and eukaryotes
- Florescence in situ hybridization (FISH) for genome analysis and Chromosome micro dissection
- Key historical experiments of DNA metabolism
- Enzymes and accessory proteins involved in DNA replication, Mechanism of DNA replication in prokaryotes and eukaryotes.
- Gene transcription and post transcriptional modification in prokaryotes and eukaryotes.
- Translation in prokaryotes and eukaryotes, post translational modification, Synthesis of secretary and membrane proteins, import into nucleus, mitochondria, chloroplast and

- peroxisomes. Receptor mediated endocytosis.
- Operon concept-Lac and Trp operon.

UNIT - III

Population Genetics and Bioinformatics

- Concept of population structure
- Indian population structure
- Hardy-Weinberg equilibrium
- Causes of evolution- admixture, selection, mutation, drift
- Linkage disequilibrium
- Phylogenetic tools
- Paternity/ maternity indices, sibship indices
- Population Genetics in Forensic DNA typing
- Factors affecting accuracy of Forensic DNA typing
- Principles of sequence alignment and its tools
- Forensically important databases – BOLD, Hapmap, STRBase, DNA databases

UNIT - IV

Advanced Methodologies in Forensic DNA Analysis

- Fundamentals of RFLP and PCR based DNA typing.
- STR genotyping
- Result of STR marker analysis and its interpretation.
- Single Nucleotide Polymorphism (SNP) and its applications in forensic investigation
- LCN typing
- Mitochondrial DNA analysis in Forensic investigation.
- Y-STR analysis and its significance in establishing paternal relationships.
- Non-human DNA analysis

UNIT - V

Recent Developments and future Directions in DNA profiling

- Methods of DNA sequencing
- Prediction of physical characteristics, such as eye, hair, and skin color based solely on DNA
- Molecular autopsy
- Genetic genealogy in the genomic era
- Evolving technologies in forensic dna analysis
- Forensic tissue identification with nucleic acids: Classical, RNA based and DNA methylation based approaches

Practicals

1. Different mathematical calculations for data analysis using Microsoft Excel.
2. Extraction of proteins from various biological samples.
3. Protein estimation by different techniques
4. SDS-PAGE for protein analysis
5. DNA extraction from various forensic samples
6. Polymerase chain reaction
7. STR Genotyping and interpretation
8. Sequence comparison using BLAST
9. Construction of Phylogenetic tree from nucleotide and protein sequences.
10. Analysis of protein structure using RASMOL

Reference Books:

1. Introduction to Practical Molecular Biology, P.D. Dabre, John Wiley & Sons Ltd., New York, 1988.
2. Molecular Biology of the Gene, 7th Edition (2013), James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Losick, Benjamin Cummings ISBN: 978-0321905376
3. Molecular Cell Biology 7th Edition (2012) - Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Anthony Bretscher, Hidde Ploegh, Angelika Amon, Matthew P. Scott, W. H. Freeman, ISBN: 978-1429234139
4. Genes VIII – Benjamin Lewin, Oxford University Press, ISBN: 0-19-879276-X
5. Molecular Biology and Biotechnology. A comprehensive desk reference, R.A. Meyers (Ed.) VCH Publishers, Inc, New York, 1999.
6. Gene Cloning and DNA Analysis: An Introduction 7th Edition (2016) - T. A. Brown, Wiley-Blackwell, ISBN: 978-1119072560
7. Lehninger Principles of Biochemistry 6th Edition – Nelson and Cox, Macmillan Publishers, ISBN: 978-1464109621
8. Kuby Immunology 6th Edition– Kindt, Goldsby and Osborne, W.H. Freeman & Co. ISBN: 978-0716767640
9. Introduction to Bioinformatics, 3rd Edition – Arthur Lesk, Oxford University Press, ISBN: 978-0199208043
10. An Introduction to Genetic Analysis, 6th Edition – Anthony J. F. Griffiths et. al., W.H. Freeman and Co. ISBN: 978-716726043
11. Bioinformatics – A practical guide to the analysis of genes and proteins, 3rd Edition – Andreas D. Baxevanis and B.F. Francis Oullette, Wiley-Liss, ISBN: 978-0471478782
12. Bioinformatics for Beginners: Genes, Genomes, Molecular Evolution, Databases and Analytical Tools, 1st Edition (2014) - Supratim Choudhury, Academic Press, ISBN: 978-0124104716

CUTM2530 - Biotechnology in Pharmaceutical Sciences

Course Objective: Concepts of recombinant DNA technology, bioprocessing, animal and plant biotechnology and industrial microbiology. To understand the importance of regulatory affairs and IPR.

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

CO	Statements
CO-1	Gain knowledge on recombinant DNA technology and genetically modified organism.
CO-2	Understanding of quality control and assurances, regulatory affairs and intellectual property rights.
CO-3	Gain skills to isolate DNA from different sources and GMO detection.
CO-4	To handle blotting techniques and identification and detection of production of industrial products.

UNIT-I

Introduction to Recombinant DNA technology

- DNA modifying enzymes
- Cloning strategies: Genomic libraries, cDNA libraries, single gene cloning.
- RAPD, RFLP and AFLP
- Vectors: Types of vectors and choice of vectors- Plasmids, cosmids,lamda phage vectors, shuttle vectors, BACs and YACs
- Transformation and Transfection
- Expression systems in Eukaryotic cells, Yeast, Bacteria, Insect cell lines, Gene screening
- Biosafety guidelines and containment strategies

UNIT-II

Bioprocess and Bio-chemical engineering

- Bioreactor design: Body construction, aeration and agitation, operation and applications
- Microbial Growth: measurement, batch and continuous culture and its kinetics
- Downstream processing: recovery and purification of products
- Strains improvement
- Fermentation economics

UNIT-III

Animal and Plant biotechnology

- Cell lines: Definition, development, maintenance and management, established cell lines andtheir characteristic features.
- Transgenic animals- Creating transgenic animals, Example of transgenic animals-Dolly, Insects, Primates, mice
- Somaclonal and gameto clonal variation: applications and limitations.
- Transgenic Plants: Herbicide eesistant, insect Resistant, drought/stress resistant, delayed ripening, Ti Plasmid and T-DNA transfer.
- Gene therapy: potential approach to gene therapy
- Southern blotting, Northern blotting, Western blotting, Iso-electric focusing
- Overview of Stem cells and its applications

UNIT-IV

Biotherapeutics and industrial microbiology

- Introduction to industry important recombinant proteins, recombinant protein stability,
- Improvised recombinant protein secretion,
- Introduction to industrially important primary and secondary metabolites from plants and microbes
- Microbial production: Antibiotics, acetic acid, lactic acid, wine, beer, SCP

UNIT-V

Regulatory affairs and IPR

- Basic principles of quality control (QC) and quality assurance (QA)
- Guidelines for QA and QC: raw materials, products and validation
- Introduction to pharmacopoeia
- Intellectual Property Rights
- Importance of protecting scientific discoveries
- IPR policy of Government of India
- Patent: Qualification (novel, commercial and non-obvious), jurisdiction of patent laws, Indian and international patent laws, filing procedures.

Practicals

1. Validation of various instruments and glasswares
2. Isolation of bacteria by different methods.
3. Genomic and Plasmid DNA Isolation from bacteria
4. Restriction digestion of DNA
5. RAPD/AFLP for GMO detection
6. Agarose gel electrophoresis
7. Western Bloting
8. Preparation of the competant cells for transformation
9. Selection of the transformed cells
10. Growth curve of *E. Coli* and determination of growth rate and generation time.
11. Microbial production of citric acid.

Reference Books:

1. Pharmaceutical Biotechnology : Concepts & Applications – Gary Walsh (Wiley)
2. Modern Industrial Microbiology and Biotechnology – Nduka Okafor (Science Publisher)
3. Biotechnology and Biopharmaceuticals – Rodney J.Y.H.O and Milo Gibaldi (Wiley)
4. Biotechnology in Healthcare – Gavin Brooks (PLP)
5. Gene Therapy: Protocols - Joseph M. Le Doux (Humana Press)
6. Biotehnology – Applying the genetic revolution – David P. Clark and Nanette J. Pazdarnik, Academic Press, ISBN: 978-0121755522
7. Molecular Biotechnology: Principles and Applications of Recombinant DNA, 4th Edition – Bernard G. Glick, Jack J. Pasternak and Cheryl L. Patten, ASM Press, ISBN: 978-1555814984
8. Plant, Gene and Crop Biotechnology, 2nd Edition – Maarten J. Chrispeels and David E. Sadava, Jones and Bartlett Publishers, ISBN: 978-0763715861
9. Biotechnology – U. Satyanarayana, Books and Allied (P) Ltd., ISBN:
10. Plant Tissue Culture by MK Razdan & SS Bhojwani (1996) Elsevier
11. Freshney, Culture of Animal Cells, 5th Edition, Wiley-Liss, 2005
12. Ed. John R.W. Masters, Animal Cell Culture - Practical Approach,3rd Edition, Oxford University Press, 2000.

CUTM2531 - Environmental Biotechnology

Course Objective: Understanding the component of environment, waste analysis and detection of illegal waste, EPA

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

CO	Statements
CO-1	Demonstrate the methods involved in analysis of the component of pollutants and materials.
CO-2	Gain knowledge of waste management and detection of waste material in the environments.
CO-3	Gain skills to identify the adulterated material in food and examine the food quality.
CO-4	Understand the different steps undertaken by the government to protect the environment

UNIT-I

Introduction to environmental biology

- Basic components of environment
- Concept of ecosystem, abiotic andbiotic componants.
- Environmental polution: Air, water, and soil pollution.
- Environmental monitoring: environmental impacts and their assessments using bioindicators,
- Biomarkers, biosensors and toxicity testing
- Air, water and soil sampling
- Analyses of samples by physical, chemical and biological methods

UNIT-II

Waste treatment strategies

- Classification and characterization of waste
- Principles and mechanisms of waste treatment
- Nitrification and denitrification – microbial fundamentals and application
- Aerobic processes: Activated sludge, oxidation ditches, trickling filters, towers, rotating discs, rotating drums, oxidation ponds.
- Anaerobic processes: Anaerobic digestion, anaerobic filters, up flow anaerobic sludge blanket reactor.
- Economics and special aspects of waste treatment

- Examples of treatment schemes for waste waters of dairy, tannery, sugar and antibiotic industry
- Biotechnology in reduction of CO_2 emission

UNIT-III

Environmental Forensic

- Introduction and applications of environmental forensic
- Principles and methods of chemical fingerprinting(crude oil and refined products)
- Forensic techniques used in environmental litigation
- Environmental forensic microscopy
- Case studies in environmental forensic

UNIT-IV

Biodegradation and bioremediation

- Principle and mechanism of biodegradation,
- Biodegradation of xenobiotic compounds (Lignin, Hydrocarbons, Detergents, Dyes and pesticides)
- Phytoremediation: Use of plants for removal of organic and metallic pollutants
- Microbial interaction with metallic elements, metal toxicity, molecular mechanism of metal resistance and metal extraction
- Biosurfactants: Microbial production and application
- Biodetorioration – Principles, prevention and control

UNIT-V

Environmental protection and conservation

- Status and Scope of biotechnology in environmental protection.
- Non-conventional energy sources.
- Various environmental standards: air, water and noise quality.
- Environment protection Act: environmental laws, policies, ethics.
- Environmental protection agencies

Practicals

1. Microbial analysis of air.
2. Microbial examination of food : Milk, Chutney and packed food materials
3. Estimation of BOD.
4. Physical characterization of waste
5. Chemical characterization of waste : chlorides, sulphate, iron, acidity, alkalinity, phosphate, copper, TS, TDS, TSS
6. Biodegradation of hydrocarbon
7. Biotransformation of metals
8. Bacterial decolorization of dye

Reference Books:

1. Microbial Biotechnology: A. N. Glazer and H. Nikaids
2. Molecular Biotechnology: Gleek and Pasternack.
3. Biotechnology: A Text Book of Industrial Microbilogy, T. D.Brock.
4. Prescott & Dunn's Industrial Microbiology – G. Reed, CBS Publishers & Distributors, ISBN: 978-8123910017
5. Environmental Biotechnology - Alan Scragg, Pearson Education Limited
6. Biotechnology, a comprehensive treatise - Rehm H J and Reed G, VCH Verleg
7. Introduction to environmental biotechnology by A K Chaterjee, PHI, India
8. Environmental Forensics: Contaminant Specific Guide- Robert D. Morrison, Academic Press, ISBN: 978-0125077514
9. Introduction to Environmental Forensics, 2nd Edition - Robert D. Morrison, Academic Press, ISBN: 978-0123695222
10. Environmental Science – A Global Concern, 7th Edition – W. P. Cunningham et al., McGrow Hill Higher Education, ISBN: 978-0070294264
11. Environmental Engineer's Handbook, 2nd Edition – David H. F. Liu et al., Lewis Publication, ISBN: 978-0849399718

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Specialization In Forensic Physics and Ballistics

CUTM2532- ADVANCES IN PHYSICAL TECHNIQUES

Course Objective: To learn about various analysis techniques used in Forensic Physics. To get the concept of ballistics and audio – video analysis.

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

CO	Statements
CO-1	Demonstrate about thermogravimetric analysis and characteristics of lasers and x-rays.
CO-2	Gain skills to examine and identify particles related to forensic nanotechnology and Forensic Engineering
CO-3	Gain understanding of radioactivity, nuclear physics and aspects of NMR.

UNIT-I

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

Density gradient analysis, Specific Gravity analysis, Abbe's and Digital Refractometer, Micro-chemical analysis, TLC.

Introduction to principles and application for analysis of physical evidences: IR spectroscopy, Raman spectroscopy, FT-IR spectroscopy, Atomic Absorption Spectroscopy.

UNIT-II

Lasers: Characteristics of laser light, Spontaneous emission, Stimulated emission, Stimulated absorption, Einstein coefficients, Population inversion and light amplification, Essential components of the laser, Ruby and He-Ne laser (principles only). Holography: Formation of a hologram, Reconstruction of the hologram, Requirements, Application In forensic investigation

X- rays: Production; continuous and characteristic X-rays and their spectra; Mosley's law; diffraction of X-rays by crystals; Bragg's law; Compton Effect**.**

UNIT-III

Natural Radioactivity & Radioactive Decays: Type of radioactive decays, theory of radioactive disintegration, radioactive constants, Mean life of a radio element, Activity of radioactive sources, Radioisotopes – their production &uses and forensic applications

Nuclear Reactions: Types of nuclear reactions, conserved quantities of nuclear reaction, energies of nuclear reaction–Q-value & its experimental determination. Exoergic & endoergic reactions, Weapons of mass destruction, forensic significance

Nuclear Magnetic Resonance Spectroscopy (NMR): Theory of NMR, Environmental effect on NMR, NMR spectrophotometers, Proton NMR, C-13 NMR, and other nuclei, their Applications.

UNIT-IV

Introduction to Microscopy, Types of Microscopes, Principles and Working of microscopes, Forensic Applications

Forensic Nanotechnology, introduction to Nano particles, Nano tubes, Utilization of nanotechnology in analysis of physical evidences, selectivity particles with compatibility and feasibility.

Case studies related to physical evidences and short circuit analysis.

UNIT-V

Forensic Engineering

Introduction to forensic engineering, ISI/Code of Building Construction, Structural failures, static loads, dynamic loads, causes of structural collapse, 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.

Practical

1. Examinations of physical evidence by EDXRF technique
2. Examinations of RI of physical evidence by Abbe's and Digital Refractometer.
3. Examination and analysis of various physical evidences by Comparison and Stereomicroscope
4. Examination of physical evidences by AFM.
5. Examinations of physical evidence by SEM technique
6. Synthesis, characterization and Utilization of nanomaterials for various forensic applications (silver, cadmium)
7. Examination of various physical evidences by Nanotechnology
8. Examination of various physical evidence by ICP technique.
9. Examination of Structural materials.

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.,Newnes Butterworths (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, 6th Ed.,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. Tarapore vala 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 printed 1997)
18. Roger Brown; Handbook of Polymer Testing- Physical Methods, Marcel Dekker, Inc. (1999)

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CUTM2533 - Concepts of Conventional & Modern Ballistics

Course Objective: To learn about concepts of Ballistics, GSR and various Standards of V50, STANNG 4500, NIG .06

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

CO	Statements
CO-1	Identifications and Examination of Ammunitions Range of Fire.
CO-2	Analysis and Examination of GSR Material with various Standards
CO-3	Identify and determine different firearm injuries

UNIT-I

- Ballistics & its forensic aspects, Arms Act **Conventional Concepts of firearms**: their classification and characteristics, various components of small arms, smooth bore and rifled firearms.
- **Operational features of firearms:** Barrel, body, Firing pin, Breech face, trigger, cork, and firing mechanism, measurement of strength of barrel & trigger pull.
- **Rifled Firearms**: Caliber, Rifling, purpose of rifling, types of rifling and methods to produce rifling to produce rifling,
- **Smooth bore firearms**: Bore, Choking& types of choking, Methods of choking purpose of choking, method of choking, purpose of choking.
- **Illegal firearms**: AK-47, SKS and M16/AR15 Assault Rifles
- Techniques of dismantling / assembling of firearm, improvised / country-made / imitative firearm and their constructional features.
- **Conventional Concepts of Ammunition**: Types of ammunition- classification and constructional features of different types of cartridges, types of primers and priming composition, propellants and their compositions, velocity and pressure characteristics under different conditions, various types of bullet and compositional aspects, latest trends in their manufacturing and design projectile, identification of origin, improvised ammunition and safety aspects for handling firearm and ammunition.

UNIT-II

- **Core concepts of Internal Ballistics**: Definition, ignition of propellants, shape and size of propellants, manner of burning, various factors affecting the internal ballistics: lock time, ignition time, barrel time, erosion, corrosion and gas cutting, equation of motion of projectile, Density of loading, Pressure, Heat problems, Vibration & jump, Measurement of

strength of firearm, projectile velocity determination, theory of recoil, methods for measurement of recoil.

- **Core concepts of External Ballistics:** principal of external ballistics: vacuum trajectory, Trajectory Formation & its computation, effect of air resistance on trajectory, Angle of Fall, Influence of Earth on Trajectory, base drag, yaw, shape of projectile and stability, ballistics

  coefficient and limiting velocity, Ballistics tables, measurements of trajectory parameters, Escape velocity & Ricochet.

UNIT-III

- **Core concepts of Terminal 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
- **Wound Ballistics:** Threshold velocity for penetration of skin/flesh/bones, preparation of gel block, penetrative in gel block and other targets, nature of wounds of entry, exit, initial with various ranges and velocities with various types of projectiles, explosive wounds, evaluation of injuries caused due to shot-gun, rifle, handguns and country made firearms, methods of measurements of wound ballistics parameters, post-mortem and anti-mortem firearm injuries. Determination of range of fire- burning, scorching, blackening, tattooing and metal fouling shots dispersion and GSR distribution, time offering different method employed, and their limitations, Bullet recovery, time of firing.
- **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-IV

- **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 various standard for ballistic and material testing.

- **Principles and practice of identification of origin**: ammunition and their components, different types of marks produced during firing process on cartridge-firing pin marks, breech face marks, chamber marks, extractor and ejector marks band on bullet- number/ direction of lands and grooves, striation marks on lands and grooves, identification of various parts of firearms, techniques for obtaining test material from various types of weapons and their linkage with fired ammunition, class and individual characteristics.

UNIT-V

- **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.
- 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- data base creation and significance in forensic ballistic investigations
- Management and reconstruction of cases involving firearm; Report writing and court findings.

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.

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, P A
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, P A
9. Gary J. Ordog, Management Of Gunshot Wounds, Elsevier, New York
10. Working Procedures Manual: Ballistics, BPR&D Pub.
11. S.K.Sharma, cyber laws and crime.
12. Fry & Nystron,security monitoring, O. reilly
13. Tipton Krause, Information security management, Aner Bach
14. Schneiner, hacking the code, Syngrers.

CUTM2534 - Audio Recognition & Video Analysis

Course Objective: Understanding the anatomy of Voice production, Audio and video Analysis
Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Identify and Examine Voice samples using Gold wave Software, Automatic Speaker recognition.
CO-2	To perform Audio and Video analysis using AMphed Five.
CO-3	Gain skills in handling audio-video evidences

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, Scope of voice analysis, collection of standards for comparison

UNIT-II

Handling of audio recording evidences & its physical examination, marking of speakers, Procedure for preparation of working copies.
Speech signal processing, Components of speaker recognition- feature extraction, pattern matching and comparison, normalization techniques, speaker profiling, enhancement of speech signal/audio recordings, establishing the authenticity and integrity of audio recordings

UNIT-III

Approaches to speaker recognition- Segregation of Speech samples, auditory analysis/listener's approach, spectrographic approach or voiceprint analysis, automatic speaker recognition technique, phonetic Transcription, linguistic & phonetic analysis, acoustic parameters for examining speech samples, Temporal measurement, Fourier analysis, frequency & time domain representation of speech signal, analogue to digital conversion.

UNIT-IV

CSL & Linear predictive coding technique, Gold wave analysis, Multi speech analysis, SIS software, Voice Net, CEDAR, Video Focus, Discrete Fourier transformation, Fast Fourier transformation, Examination using SPID.

Vocal behaviors-alcohol speech relationships- importance in forensic investigations, Report writing, Limitations, Precautions, Related Case Studies and its admissibility in court proceedings.

UNIT-V

Forensic Video analysis, establishing the authenticity of video recordings, Processing of video media, Capturing, Enhancement techniques, Specific frame analysis, Resolution, Image analysis,

Biometric Analysis for Identification of Individual, Scope & its forensic application in the field of security, Related Case Studies and its admissibility in court proceedings.

Practicals

1. Recording, editing, processing, and conversion of audio files using Goldwave v 5.63 software.
2. Speech acquisition and analysis of speech samples using CSL-4500 and Multispeech software.
3. Detection of tampering in audio files, audio restoration and speech enhancement using CEDAR Cambridge ™.
4. Working procedure of SIS.
5. Working procedure of Voice net software.
6. Video analysis and detection of tampered video files using Videofocus.

Reference books:

1. Forensic Speaker Identification by Phil Rose & James R Robertson
2. Forensic Voice Identification by Harry Hollien
3. The Acoustic Analysis of Speech by Ray D Kent & Charles Read
4. Speech Language & Hearing Disorders by Franklin H Silverman
5. Voice Recognition by Richard L Klevans & Robert D Rodman

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Specialization In Fingerprints & Questioned Document

CUTM2535 -Modern Trends in Fingerprint Science

Course Objective: Understanding of morphology and anatomy of fingerprints and their method for fingerprints detection.

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

CO	Statements
CO-1	Demonstrate the fundamental principle of fingerprint formation and their detection methods.
CO-2	Detect and develop fingerprints from various surfaces using physical and chemical development methods.
CO-3	Examine the fingerprint with microscopic techniques and comparison of male and female fingerprint with specific reference and with AFIS method.

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

UNIT-II

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-III

Latent print enhancement by Laser and other alternate light sources:

- Using photo luminescent nano particles
- Basics of time gated fingerprint detection
- Basics of phase resolved imaging
- Fingerprint treatments :lanthanide based procedures
- Photo luminescent fluorescence and phosphorescence
- Use of Nano particles :cadmium , Zinc, Silver salts

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

UNIT-IV

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

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.

Application of edgeoscopy- personal identification using fingerprints

UNIT-V

Automated fingerprint Identification and imaging systems:

- Introduction , emerging application
- System architecture, sensing, finger print representation
- Minutiae feature extraction , orientation, estimation, segmentation Segmentation, ridge detection
- Ridge detection, finger print matching enhancement
- Challenges , system issues system evaluation

- Other biometric methods of identification iris scan, retinal scan.
- Cheiloscopy, palato prints, ear prints etc. in forensic and other sciences.
- Importance of poroscopy , ridgeology/ edgeoscopy
- An introduction to UID aadhaar and its significance
- Scope of research on DNA from fingerprint residues

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 finger prints using Ninhydrin.
4. Development of latent finger prints using iodine fuming
5. Development of latent finger prints using Nanoparticles
6. Understanding AFIS method of fingerprints analysis
7. Palatoprints
8. Cheiloscopy
9. Importance of molecular fingerpints with special refernce to fingerprint residues using instuemtnal 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 Finger Prints, N.M. Tripathi Pub. Bombay (1980)
5. Moenssens; Finger Prints Techniques, Chitton Book Co. Philadelphia, NY (1975)
6. Chatterjee S.K.; Speculation in Finger Print 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 Finger Prints, 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 Inverstigation, Practical fingerprinting, Thumb Impressions, Hand writing 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)

CUTM2536 - Questioned Documents & Forensic Accounting

Course Objective: Concepts of documents and their examination. Understanding of forgery and their detection. Identification of fraud and writings and examination of financial documents.
Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Understand difference between writing forgery and documents forgery. Examine questioned documents and writings.
CO-2	Gain skills to understand frauds, money laundering and financial reports.
CO-3	Gain skill to examine ink, paper age, currency notes and detect of forgery of the documents.
CO-4	Examine counterfeiting of passports, stamp paper, visa, stamps impression.

UNIT-I

Basics of handwriting identification & individuality of handwriting, natural variations, process of comparison, types of documents-genuine and forged documents, holographic documents, Care and Handling of Document Exhibits, Forgeries & its types, detection of forgeries in handwriting, signatures and related case studies, basic tools needed for forensic documents examination and their significance.

UNIT-II

Disguised writing and anonymous letters- Identification of writer
Examination of alterations- erased writing, overwritings, additions, substitutions and obliterations Examination, preservation and 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

UNIT-III

Examination of Photostat (Xerox) copies, carbon copies, fax message, typewritings, printed matter: letterpress printing, intaglio printing, offset printing, screen printing & its related concepts, types of printing of security documents, examination of counterfeit currency notes, passports, visa, credit cards, debit cards, pan card, license, stamp papers, legal deeds, postal stamps, etc, Related Case Studies.

UNIT-IV

Determination of age of document and writings
Types of computer printers and their working: dot-matrix, daisywheel, line printers, ink-jet, thermal jet and laser printers, 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-V

Introduction to Forensic accounting, Money laundering, Fraud deterrence, Types of money laundering, understanding business information & financial reporting system accounting & auditing standards & procedures, evidence gathering & investigative techniques, litigation processes, Examination of financial documents.

Practicals

1. Examination of ink by TLC
2. Examination of ink by GCMS
3. Examination of ink by LCMS
4. Examination of ageing of paper
5. Examination of currency notes
6. Examination of Passport
7. Examination of Stamp
8. Examination of Rubber Stamp Impressions
9. Related case studies

Suggested Readings

1. Ordway Hilton; Scientific Examination of Questioned Documents, Rev ED, Elsevier, NY (1982)
2. Albert S. Osborn; Questioned Documents, 2nd Ed., Universal Law Pub., Delhi (1998)
3. Albert S Osborn; The Problem of Proof, 2nd Ed., Universal Law Pub. Delhi (1998)
4. Charles C. Thomas; I.S.Q.D. Identification System for Questioned Documents, Billy Prior Bates Springfield, Illinois, USA (1971)
5. Wilson R. Harrison; Suspect Documents Their Scientific Examination, Universal Law Pub. Delhi Indian Reprint (2001)
6. Hard less H.R; Disputed Documents, Handwriting and Thumbs – Print Identification, profusely illustrated, Law Book, Allahabad (1988)
7. Morris Ron N; Forensic Handwriting Identification, Acad Press, London (2001)
8. Kurtz Sheila; Grapholypes a new Plant on Handwriting Analysis, Crown Pub. Inc., USA (1983)
9. Lerinson Jay; Questioned Documents, Acad Press, London (2001)
10. Mcmenamin, Gerald R; Forensic Linguistics- Advances in Forensic Stylistics, CRC Press, Washington, D.C. (2002)
11. Ellen David; Questioned Documents- Scientific Examination, Taylor & Francis, Washington (1997)
12. Roy A Huber, A.M. Headrick; Handwriting Identification- Facts and Fundamental, CRC Press (1999)

CUTM2537 - Forensic Photography & Biometric Traits

Course Objective: To learn about the importance of photography, filters used during photography and different biometric techniques.
Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Gain skills in crime scene photography using different camera attachments. Development of photographic prints
CO-2	Demonstrate the application different light sources and filters for doing evidence photography and viodeography.
CO-3	Gain skill in analysing the different biometric traits and also their application for security purposes.

UNIT-I

Introduction to Photography, photographic instruments: light sources, types of camera and lenses, optical filters**,** fundamentals of light and vision, Basic principles and techniques of Black & White and color photography, Spectral sensitivity of photographic materials, Concepts of colored photography, Camera exposure determination.

UNIT-II

Linkage of cameras and film negatives, Modern developments in photography: digital photography, Image sensors, photo shop-development- digital images processing and manipulation- forensic application,

UNIT-III

Crime scene photography, photomicrography, macro photography, photography of fingerprints and documents, IR and UV photography, photogrammetry, crime scene videography / high speed videography, and laboratory photography, Court representation and admissibility in judicial system.

UNIT-IV

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

UNIT-V

Gait Pattern, Keystroke Analysis, Signature Analysis, Voice pattern Analysis, Heartbeat Analysis, Recent Advances in Biometrics for Security Prospects.

Practicals

1. Photography of objects-close up, normal, telephoto and processing.
2. Document and Finger print photography.
3. Crime scene photography-long shot, medium and close up shots
4. Developing of black and white Photographic prints
5. Photomicrography and Macro photography
6. Photography with different filters for developing contrasts.
7. Study on types of Biometric Analysis

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Specialization In Cyber Forensics

CUTM2538 - Cyber Law and IRM

Course Objective : To learn about different cyber laws, IPR, Copyrights and IRM
Course Outcome : On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Demonstrate the significance and application of cyber laws and other regulatory affairs.
CO-2	Demonstrate the importance of copyright and IPR in cyber security.
CO-3	Gain skill in developing IRM team

UNIT-I

Introduction

Basics of Law, Understanding Cyber Space, Defining Cyber Laws, Scope and Jurisprudence, Concept of Jurisdiction, Cyber Jurisdiction, Overview of Indian Legal System, Introduction to IT Act 2000, Amendments in IT Act, Cyber Laws of EU – USA – Australia - Britain, other specific Cyber laws.

UNIT-II

IPR & Copyrights

Copyrights, Jurisdiction Issues and Copyright Infringement, Multimedia and Copyright issues, WIPO, Intellectual Property Rights, Understanding Patents, Understanding Trademarks, Trademarks in Internet, Domain name registration, Software Piracy, Legal Issues in Cyber Contracts, Authorship, Document Forgery.

UNIT-III

Miscellaneous

Cyber Incident Statistics, Computer Security Incident, Information as Business Asset, Data Classification, Information Warfare, Key Concepts of Information Security, Vulnerability, Threat, and Attack, Types of Computer Security Incidents, Examples of Computer Security Incidents, Signs of an Incident, Incident Categories: Low Level, Incident Categories: Middle Level, Incident Categories: High Level

UNIT-IV

Incident Handling

Goals of Incident Response, Incident Response Plan, Incident Identification, Incident Prioritization, Incident Handling, Estimating Cost of an Incident, Incident Reporting, Incident Reporting Organizations, Vulnerability Resources.

UNIT-V

Incident Response Team Development

Security Awareness and Training, Incident Management, Incident Management Team, Incident Response Team, Roles and Responsibilities, Developing Skills in, Dependencies.

Reference Books

1. NIST - Computer Security Incident Handling Guide by Paul Cichonski, Tom Millar, Tim, Grance,Karen Scarfone
2. Good Practice Guide for Incident Management, ENISA
3. Handbook for Computer Security Incident Response Teams (CSIRTs) by Moira J. West-Brown, Don Stikvoort, Klaus-Peter, Kossakowski, Georgia Killcrece, Robin Ruefle, Mark Zajicek
4. Computer Incident Response and Forensics Team Management: Conducting a Successful Incident Response by Leighton Johnson
5. Incident Response & Computer Forensics, Third Edition by Jason T. Luttgens, Matthew Pepe, Kevin Mandia
6. Information Security and Cyber Laws by Saurabh Sharma
7. Cyber frauds, cybercrimes & law in india by pavan duggal
8. The Internet Law of India: Indian Law Series by Shubham Sinha
9. Cyber Laws - Indian and International Perspectives on Key topics including Data Security, E- commerce, Cloud Computing and Cyber Crimes by Aparna VIswanathan

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CUTM2539 - Digital Forensics

Course Objective: To learn about basics of digital forensics, data recovery, registry and logging, and mobile forensics.
Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Demonstrate the basic concepts of digital forensics.
CO-2	Gain skills in imaging and data recovery systems.
CO-3	Gain skills in using softwares like FTK and Encase for solving cyber crimes.

UNIT-I Introduction

Introduction to Digital Forensics, Locard's Principle of Exchange in Digital Forensics, Branches of Digital Forensics, Phases of digital/computer forensics investigation, Identification of digital evidences, necessary documentations such as Chain of Custody, pre-acquisition forms etc., Digital evidence handling at crime scene as per standards, Collection/Acquisition and preservation of digital evidences, Processing & analysis, Compilation of findings & Reporting, Pre-requisite for setting up Digital Forensic lab and global standards

UNIT – II Computer Basics and File Systems

Understanding of Windows , Linux & Macintosh operating systems, Understanding of mobile operating systems such as android, iOS, Windows, Blackberry etc., Introduction to hardware and software, Key terms, Number systems, Boot process, File types and signature, Architecture and Functioning of memory device, Retrieval of information, etc., Windows file systems, UNIX /Linux file systems, MAC file systems, Mobile file systems, Network file system, other types of file systems.

UNIT – III Imaging / acquisition & data recovery

Acquisition of stand-alone machine, peripheral device, other storage media, CCTV, systems (both physical & logical), Acquisition or triage collection of live system, Acquisition of mobiles, PDA's, Tablets, Navigation systems etc., Acquisition over the network i.e. remote acquisition, Understanding of various acquisition software/hardware device, details of various file formats of forensic image, Deleted data recovery techniques

UNIT – IV Registry and Logging

Understanding and in-depth analysis of registry in various operating systems, Log analysis with respect to standalone machine and server, which includes event logs, ftp/sftp, application, Web Servers/ Proxy logs.

UNIT – V Computer and Mobile Forensic Analysis

Introduction to DFF, Working with Autopsy, Using FTK to solve a Cyber Crime, Introduction to EnCase, various features of EnCase, Solving a case using EnCase, Understanding of other intermediate tools for data processing, keyword search & analysis etc., Encryption handling techniques, Aquisition and Analysis of Volatile Memory

Practical

1. Practical using Encase.
2. Practical using FTK.
3. Forensics of Apache Web Server Logs.
4. Practical based on Hard Disk Forensics.
5. Practical based on windows registry forensics.

Reference Books

1. The Basics of Digital Forensics: The Primer for Getting Started in Digital Forensics by John Sammons
2. Digital Forensics Workbook: Hands-on Activities in Digital Forensics by Michael K Robinson
3. Computer Forensics and Cyber Crime: An Introductio by Marjie T. Britz
4. Digital Forensics with Open Source Tools by Cory Altheide, Harlan Carvey
5. Forensic Computing - A Practitioner's Guide by Tony Sammes, Brian Jenkinson
6. Guide to Computer Forensics and Investigations by Bill Nelson, Amelia Phillips, Christopher Steuart.
7. Handbook of Digital Forensics and Investigation by Eoghan Casey
8. Digital Forensics Explained by Greg Gogolin
9. Windows Registry Forensics (WRF) with Volatility Framework: Quick Startup Guide for Beginners by Kapil Soni
10. Windows Registry Forensics: Advanced Digital Forensic Analysis of the Windows Registry by Windows Registry by Harlan Carvey
11. File System Forensic Analysis by Brian Carrier
12. EnCase Computer Forensics -- The Official EnCE: EnCase Certified Examiner Study Guide by Steve Bunting
13. Computer Forensics and Digital Investigation with EnCase Forensic v7 by Suzanne Widup
14. Computer Forensics with FTK by Fernando Carbone

15. Digital Forensics with the AccessData Forensic Toolkit (FTK) by John Sammons
16. Logging and Log Management: The Authoritative Guide to Understanding the Concepts Surrounding Logging and Log Management by Anton A. Chuvakin and Kevin J. Schmidt
17. Cyber Crime Investigation manual, DSCI – NASSCOM, Government of India.

CUTM2540 - Vulnerability Assessment and Penetration Testing

Course Objective: To learn about vulnerability assessment using different tools, foot scanning, password attacks and social engineering.
Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Perform vulnerability assessment using tools like Nikto, Nessus, W3af
CO-2	Map a network and perform OS fingerprinting using softwares.
CO-3	Gain skills in Cross site scripting, command execution, manual SQL injection using DVWA. Automated SQL injection using SQL Map on DVWA.

UNIT-I

Vulnerability Assessments

Introduction to Vulnerability Assessment, Life cycle of Vulnerability Assessment, Vulnerability Scanners, Manual Testing, Vulnerability using W3af and Nikto, Nessus, Architecture, Introduction to Unknown Vulnerability Assessment.

UNIT-II

Foot printing 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 5.2.

UNIT-IV

Miscellaneous

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, 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.

UNIT-V

Social Engineering

Introduction to social engineering, social engineering cycle, information gathering, user profiling, types of social engineering attacks and techniques, elicitation, social engineering tools and counter measures.

Practical

1. Configuration of DVWA with Apache Server.
2. Vulnerability assessment using w3af and Nikto.
3. Cross site scripting using DVWA.
4. Command execution using DVWA.
5. Manual SQL injection using DVWA.
6. Automated SQL injection using SQL Map on DVWA.

Reference Books

1. Social Engineering: The Art of Human Hacking Kindle Edition by Christopher Hadnagy (Author), Paul Wilson (Foreword)
2. The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws (by Dafydd Stuttard, Marcus Pinto)
3. Metasploit - The Penetration Tester's Guide Paperback – Import, 15 Jul 2011 by David Kennedy (Author), Jim O'gorman (Author), Devon Kearns (Author), Mati Aharoni (Author)

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Elective Subjects

CUTM2519- FORENSIC ENGINEERING

Course Objective: To learn about different structural features of a building, their cause of collapse, fire and explosion and motor vehicle fire investigation.
Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	To gain knowledge about different structural features of a building, causes of collapse and its investigation
CO-2	To enhance their skill about investigation of fire and explosion scenes
CO-3	To enhance skill about investigation of motor vehicle accident

UNIT-I

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

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,
Case studies

UNIT-III

Fire and explosion investigation
Chemistry and behavior of fire
Classification of fires
Origin and cause of fire

UNIT-IV

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

Suggested readings

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

CUTM2520- Scientific Protocols of Fire Investigation

Course Objective: To learn about protocols involved in fire scene investigation.
Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	To gain knowledge about chemistry of fire, chemistry and physics of combustion
CO-2	To enhance their skill in understanding fire dynamics and fire patterns
CO-3	To enhance skill about investigation of fire and arson scenes and analysis of ignition residues

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

UNIT-II

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

UNIT-III

Fire dynamics

Introduction, ignition, spontaneous and chemical ignition Flames and flam abilities, compartmental fire (house fire) Development of fire pattern, fire modeling

UNIT-IV

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-V

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 1) Identification of gasoline 2) 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 1) Joint examination of physical evidence appliances and electrical components 2) Testing of ignition scenario, spontaneous ignition tests, Conclusion

Suggested readings

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

CUTM2521- Explosives Analysis & Post Blast Investigation

Course Objective: To learn about high and low explosives, processing of explosion crime scenes and analysis of post blast residues

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

CO	Statements
CO-1	To examine high and low explosives
CO-2	To gain skills in processing an explosion scene and collection of evidences
CO-3	To gain skills in detection and analysis of post blast residues,

UNIT-I

- Introduction- History and Development of explosives- Oxygen balance-Explosive power and power index-Temperature-Force and pressure of explosion-Kinetics of explosive reactions

UNIT –II

- Classification of explosive materials-High explosives (Commercial and military)-Initiating Devices Safety fuse- Detonators-Pyro- technics-Propellants shattering

UNIT-III

- Initiation techniques-Combustion and deflagration- Detonation-Thermal decomposition- Mechanics of explosions- The generation of shock wave, The effect of fragmentation

UNIT -IV

- Processing of explosion scene of crime - Role of Forensic scientist in Post blast investigation-Documentation of bomb scene and Collection of post blast residues-Evaluation and assessment of explosion site and reconstruction of sequence of events- Famous case studies in explosion and court testimony

UNIT -V

- Clandestine explosive manufacturing.
- Analysis of Post blast residues by chemical methods, microscopic method and various instrumental techniques including chromatographic, spectroscopic and electrophoresis methods.

Reference books

1. Verma, R. M: Analytical Chemistry – Theory and Practice, CBS Pub., 1994
2. Svehla, G. Ed.: Vogel's Qualitative Inorganic Analysis, Longman, 1998.
3. Bassett: Vogel's Text Book of Quantitative Inorganic Analysis, Longman, 1978
4. Vogel, A. I: Text Book of Practical Organic Chemistry including Qualitative Organic Analysis, ELBS, 1971.
5. Skoog, D. A., West, D. M. and Holler, F. J: Analytical Chemistry: An Introduction, Saunders College, 1994.
6. Siegel, J. A, Saukko, P. J. and Knupfer, G. C: Encyclopedia of Forensic Sciences, Academic Press, 2000.
7. Townsends, A. (Ed): Encyclopedia of Analytical Science, Academic Press, 2005.
8. Beveridge, A: Forensic Investigation of Explosives, Taylor & Francis, 2000.
9. Yallop, H. J: Explosion Investigation, Forensic Science Society & Scottish Academic Press, 1980.
10. Narayanan, T. V: Modern Techniques of Bomb Detection and Disposal, R. A. Security System, 1995.
11. Yinon, J. and Zitrin, S: The Analysis of Explosives, Oxford: Pergamon, 1981
12. Yinon Jitrin; Modern Methods & Application In Analysis Of Explosives, John Wiley & Sons, England
13. Working Procedure Manual – Explosives
14. C.A. Watson; Official And Standardized Methods Of Analysis, Royal Society Of Chemistry, UK
15. Feigl; Spot Test In Inorganic Analysis, Elsevier Pub. New Delhi
16. Feigl; Spot Test In Organic Analysis, Elsevier Pub. New Delhi
17. Silverman; Organic Chemistry Of Drug Design & Drug Action, Elserier Pub. New Delhi

CUTM2522 - Nano Biotechnology

Course Objective: To learn about basic concepts of nano-technology, instrumental techniques involved and molecular imaging

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

CO	Statements
CO-1	To demonstrate basic concepts of nanotechnology and its application in forensic as well
CO-2	To gain skills in characterizing nanomaterials
CO-3	Understand the application of nanoparticles as molecular imaging probes,

UNIT-I

- Introduction, history and development in nanotechnology
- Physical synthesis of nanoparticles.
- Biological production of nanoparticles: fungi, bacteria, yeast and actinomycetes

UNIT –II

- Properties and characteristic of nanomaterials.
- Tool for the characterization of nanomaterial: Optical microscopy, Electron microscopy (TEM and SEM), scanning probe microscopy, atomic force microscopy, fluorescence microscopy.

UNIT-III

- DNA based nanostructure, DNA-protein nanostructure
- Carbon nanotubes, nanorods and fullerens

UNIT -IV

- Application of nanoparticles as molecular imaging probes (Quantum dots)
- Application of nanoparticles as therapeutic drug carriers, gene delivery and diagnostics.

UNIT -V

- Application of nonmaterials in forensic and life science.
- Nanoparticles as a tool for cleaning environment: Remediation of heavy metal
- Nanoparticles as sensors.

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 Ryan M. Richards, John Wiley and Sons Inc., ISBN: 978-0470222706

CUTM2523 - Forensic Voice, Multimedia Comparison And Evidence Evaluation

Course Objective: To learn about basic concepts of phonetics, audio and video examination and analysis

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

CO	Statements
CO-1	To gain knowledge about basics key concepts of forensic phonetics
CO-2	To gain skills in evidence handling and signal processing
CO-3	Enhance skills for analysis of audio and video evidences

UNIT - I

Forensic Phonetics
Introduction, History, Forensic Linguistics, Literature and Plagiarism, Larynx Anatomy and Physiology, Anatomy and Physiology of ear

UNIT - II

Evidence
Handling, Legal Aspects of digital multimedia evidence, recovery of audio and video files, copyright infringement

UNIT - III

Signal Processing
Audio and Video Examination and Recovery, DFT, Fourier Transform for Periodic Signals, Properties of DFT-Signal Sampling, Analog to Digital Conversions, Frequency and Time Domain functions, LPC and FFT, Speech and Video Enhancement.

UNIT - IV

Video
Video Analysis, Video Technology, Forensic Video Analysis, Types of Video Signals, Analog and Digital Video Formats, Models of Image Formation and Sequencing, Tools for Analysis.

UNIT - V

Audio and Voice
Audio Analysis Methodology, Speech and Noise Characteristics, Audio Clarification Principles, Voice Identification, Speaker Identification, Voice Spectrograph, Tools for Analysis

Reference books:

1. Forensic Speaker Identification by Phil Rose & James R Robertson
2. Forensic Voice Identification by Harry Hollien
3. The Acoustic Analysis of Speech by Ray D Kent & Charles Read
4. Speech Language & Hearing Disorders by Franklin H Silverman
5. Voice Recognition by Richard L Klevans & Robert D Rodman

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CUTM2524 - Modern Cryptography and Steganography

Course Objective: To learn about basic terminologies cryptography, cryptographic algorithms and steganography

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

CO	Statements
CO-1	To gain knowledge about basics key elements of cryptography and cryptographic algorithms
CO-2	To gain skills in understanding steganography
CO-3	Enhance skills for analysis of cryptography and steganography

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 Geneartors. 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.

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

Introduction and History, Need of Data Hiding, Cryptography V/S Steganography, Steganography Techniques, Network Steganography, Steganography Tools, Steganography in Smart Phones, Various Steganography Algorithms.

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.

Reference Books

1. Applied Cryptography by Bruce Schneier
2. Cryptology Unlocked by Reinhard Wobst
3. Break the Code: Cryptography for Beginners by Bud Johnson
4. Modern Cryptography: Applied Mathematics for Encryption and Information Security by Chuck Easttom
5. Cryptography Engineering: Design Principles and Practical Applications by Niels Ferguson, Bruce Schneier and Tadayoshi Kohno
6. Introduction to Modern Cryptography by Jonathan Katz and Yehuda Lindell
7. Modern Cryptography: Theory and Practice by Wenbo Mao
8. Steganography in Digital Media: Principles, Algorithms, and Applications by Jessica Fridrich
9. Investigator's Guide to Steganography by Gregory Kipper
10. Hiding in Plain Sight: Steganography and the Art of Covert Communication by Eric Cole
11. Data Hiding: Exposing Concealed Data in Multimedia, Operating Systems, Mobile Devices and Network Protocols by Michael T. Raggo and Chet Hosmer
12. Noiseless Steganography: The Key to Covert Communications by Abdelrahman Desoky
13. Digital Watermarking and Steganography by Ingemar Cox, Matthew Miller, Jeffrey Bloom, Jessica Fridrich and Ton Kalker
14. 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 Zuzana Kominkova Oplatkova
15. Security to Images - Steganalysis Algorithms by Yogesh Daga

CUTM2524 -RESEARCH METHODOLOGY

Course Objective: To learn about research structure, data evaluation and thesis writing
Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	To gain knowledge about various components of technical writing
CO-2	To gain skills about developing a research plan
CO-3	Enhance skills in writing a thesis report and basic regulatory affairs involved with it.

UNIT-I

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.

UNIT-II

Research design and methods, developing a research plan - Exploration, Description, Diagnosis, and Experimentation. Determining experimental and sample designs.

UNIT-III

Data Collection, analysis and Interpretation of Findings: 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, Chi-square test, ANOVA, and Interpretation of Findings

UNIT-IV

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-V

Basics of Ethical issues, Intellectual property rights, Copy right, Reproduction of published material: Plagiarism in scientific research and communications.

Reference Books:

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International.
3. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Publications. 2 volumes.
4. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.
5. Wadehra, B.L. 2000. Law relating to patents, trade marks, copyright designs and geographical indications. Universal Law Publishing.
6. Anthony, M., Graziano, A.M. and Raulin, M.L., 2009. Research Methods: A Process of Inquiry, Allyn and Bacon.
7. Carlos, C.M., 2000. Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options. Zed Books, New York.
8. Leedy, P.D. and Ormrod, J.E., 2004 Practical Research: Planning and Design, Prentice Hall. 12. Satarkar, S.V., 2000. Intellectual property rights and Copy right. EssEss Publications.

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Semester- IV

CUTM 2541 - Lab Work/ Dissertation/Major Project

Course Objective: To help in training of students with hands on experience of instruments while working on any research topic.

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

CO	Statements
CO-1	Have understanding of research methodology and lab work/field work.