COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY

CURRICULUM & SYLLABUS
M.Sc. Forensic Science
(2022 Admission Onwards)

COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY
KOCHI – 682022

Vision

To become a center of excellence in Forensic Science with state of art facilities and world recognition.

Mission

- To produce world class forensic scientists and acquaint them with the current global techniques and trends.
- To research and explore new methods for the examination of forensic evidence which would help police as well as law professionals.
- To provide a globally recognized academic environment through academia collaborations, digital learning, and state of the art skill development.
- To foster into students the universal human values by instilling into them the leadership qualities, teamwork, and ethical code of conduct.

Program specific outcome (PSO)

PSO01 - Apply principles of forensic science in the examination of various evidence often found on the crime scene.

PSO02 - Develop new methods for the examination and interpretation of evidence and help professionals from police department and judiciary to administer justice.

PSO03 - Instill ethical and moral code of conduct into future forensic scientists.

PSO04 - Engage in lifelong learning to keep pace with changing landscapes across the world for better professional achievement.

PSO05 - To develop teamwork, problem solving, and creative thinking in our students.

SUMMARY OF COURSE

Semester	Course Type	Course Mode	No. of Course	Credits/ course	Marks/ Course	Total Credits	Total Marks
FIRST	Core	Theory	4	4	100	16	600
	Core	Practical	2	2	100	4	
SECOND	Core	Theory	4	4	100	16	600
	Core	Practical	2	2	100	4	
THIRD	Core	Theory	3	4	100	12	600
	Core	Practical	1	2	100	2	
	Elect.	Theory	1	4	100	4	
	Elect.	Practical	1	2	100	2	
FOURTH	Core	Project	1	10	200	10	500
	Elect.	Theory	2	4	100	8	
	Elect.	Practical	1	2	100	2	
Grand Total						**80**	**2300**

Total credits: Core course : Theory -44; Practical -10; Total – 54
Elective course : Theory - 12; Practical -04; Total – 16
Project : 10
Grand total : 80

SEMESTER-WISE DETAILS

FIRST SEMESTER

Code No. & Course	Credits	CE Marks	ESE Marks	Total Marks
22-358-0101 – FUNDAMENTALS OF FORENSIC SCIENCE, CRIMINAL LAWS, & PSYCHOLOGY	4	50	50	100
22-358-0102 –LABORATORY QUALITY MANAGEMENT, RESEARCH METHODOLOGY AND STATISTICS	4	50	50	100
22-358-0103 – INSTRUMENTAL TECHNIQUES– I	4	50	50	100
22-358-0104 – FORENSIC CHEMISTRY				
22-358-0105 – PRACTICAL ON FSC 22-358-0101 & FSC 22-358-0102	2	50	50	100
22-358-0106 – PRACTICAL ON FSC 22-358-0103 & 22-358-0104	2	50	50	100
Total for First Semester	**20**	**300**	**300**	**600**

CE- Continuous Evaluation

ESE- End Semester Examination

SECOND SEMESTER

Code No. & Course	Credits	CE Marks	ESE Marks	Total Marks
22-358-0201 – QUESTIONED DOCUMENTS AND FINGERPRINTS	4	50	50	100
22-358-0202 – INSTRUMENTAL TECHNIQUES – II	4	50	50	100
22-358-0203 – FORENSIC BIOLOGY AND SEROLOGY	4	50	50	100
22-358-0204 – TOXICOLOGY AND FORENSIC MEDICINE	4	50	50	100
22-358-0205 – PRACTICAL ON FSC 22-358-0201 & FSC 22-358-0202	2	50	50	100
22-358-0206 – PRACTICAL ON FSC 22-358-0203 & FSC 22-358-0204	2	50	50	100
Total for Second Semester	**20**	**300**	**300**	**600**

THIRD SEMESTER

Code No. & Course	Core/ Elective	Credits	CE Marks	ESE Marks	Total Marks
22-358-0301 – CRIME SCENE INVESTIGATION	Core	4	50	50	100
22-358-0302 – FORENSIC PHYSICS AND BALLISTICS	Core	4	50	50	100
22-358-0303– DIGITAL AND CYBER EVIDENCE	Core	4	50	50	100
22-358-0311– FORENSIC SEROLOGY AND DNA PROFILING	Elective	4	50	50	100
22-358-0312– SAMPLE PREPARATION TECHNIQUES	Elective	4	50	50	100
22-358-0313– FORENSIC BALLISTICS	Elective	4	50	50	100
22-358-0314 – CYBER FORENSICS AND CYBER SECURITY	Elective	4	50	50	100
22-358-0315 – QUESTIONED DOCUMENTS & FORENSIC ACCOUNTING	Elective	4	50	50	100
	Interdepartmental Elective	4	50	50	100
22-358-0304 – PRACTICAL ON FSC 22-358-0301 & 22-358-0302 & 22-358-0303	Core	2	50	50	100
22-358-0316 – PRACTICAL ON 22-358-0311	Elective	2	50	50	100
22-358-0317 – PRACTICAL ON 22-358-0312	Elective	2	50	50	100
22-358-0318– PRACTICAL ON 22-358-0313	Elective	2	50	50	100
22-358-0319 – PRACTICAL ON 22-358-0314	Elective	2	50	50	100
22-358-0320 – PRACTICAL ON 22-358-0315	Elective	2	50	50	100
Total for Third Semester	**20**		**300**	**300**	**600**

Apart from core papers each student has to choose one elective and its corresponding practical, and one interdepartmental elective.

BASIC ELIGIBILITY FOR SELECTING ELECTIVE COURSES:

22-358-0311	Students should have studied Zoology/ Botany/ Chemistry/ Microbiology/Medical Microbiology/ Biochemistry/ Medical Biochemistry/ Biotechnology/ Genetics as core/ complementary course for at least 2 semesters in the graduation level.
22-358-0312	Students should have studied Chemistry/ Biochemistry as core/ complementary course for at least 2 semesters in the graduation level.
22-358-0313	Students should have studied Physics as core/ complementary course for at least 2 semesters in the graduation level.
22-358-0314	Students should have studied Computer Science/ Information Technology as core/ complementary course for at least 2 semesters in the graduation level.
22-358-0315	Students from all streams mentioned in the admission criteria of M.Sc. Forensic Science programme.

Students having B.Sc. Degree in Forensic Science/ B.Voc. Forensic Science/ B.Voc. Applied Microbiology & Forensic Science is eligible to select any of the Elective Courses as mentioned above.

FOURTH SEMESTER

Code No. & Course	Core/ Elective	Credits	CE Marks	ESE Marks	Total Marks
22-358-0401 – PROJECT	Core	10	100	100	200
22-358-0411 – FORENSIC ANTHROPOLOGY, ENTOMOLOGY & ODONTOLOGY	Elective	4	50	50	100
22-358-0412 – FORENSIC BOTANY, WILDLIFE & MICROBIAL FORENSIC	Elective	4	50	50	100
22-358-0413– EXPLOSIVES & EXPLOSION	Elective	4	50	50	100
22-358-0414 – PHARMACOLOGY & FORENSIC ANALYSIS OF DRUGS	Elective	4	50	50	100
22-358-0415 – FORENSIC AUDIO VIDEO ANALYSIS	Elective	4	50	50	100
22-358-0416– ADVANCED FORENSIC BALLISTICS	Elective	4	50	50	100
22-358-0417 – ETHICAL HACKING & RECOVERY FORENSICS	Elective	4	50	50	100
22-358-0418 – DIGITAL IMAGE PROCESSING	Elective	4	50	50	100
22-358-0419 – ADVANCED FINGERPRINT DEVELOPMENT METHODS	Elective	4	50	50	100
22-358-0420– FORGERY & ITS FORENSIC DETECTION	Elective	4	50	50	100
22-358-0421 – SWAYAM NPTEL ONLINE COURSE	MOOC Elective	4	50	50	100
22-358-0422 – PRACTICAL ON 22-358-0411 & 22-358-0412	Elective	2	50	50	100
22-358-0423 – PRACTICAL ON 22-358-0413 & 22-358-0414	Elective	2	50	50	100
22-358-0424– PRACTICAL ON 22-358-0415 & 22-358-0416	Elective	2	50	50	100
22-358-0425 – PRACTICAL ON 22-358-0417 & 22-358-0418	Elective	2	50	50	100
22-358-0426– PRACTICAL ON 22-358-0419 & 22-358-0420	Elective	2	50	50	100
Total for Fourth Semester		**20**	**250**	**250**	**500**

Each student has to take a project and choose a pair of electives and a corresponding practical

Program Outcomes (PO's)

PO1: Basic and discipline specific knowledge - Apply the knowledge of basic and applied sciences such as forensic physics, forensic chemistry, forensic biology, etc. in the examination of various evidence.

PO2: Problem analysis - Identify and analyze forensic problems using standard methods based on scientific approach.

PO3: Instrumental methods - Demonstrate the basic principles of instrumental methods of analysis

PO4: Use of analytical methods - Apply appropriate analytical methods, tools, and techniques in the forensic examination of various evidence.

PO5: Develop research-based solution - Develop novel solutions to challenging forensic problems through research based innovations.

PO6: Ethical learning - Apply the ethical principles and code of conduct in the professional life and to abide by the responsibilities and norms of forensic scientists.

PO7: Future employment - Acquire skills for future employment in academia and forensic labs.

PO8: Forensic practices for society - Understand and enhance the impact of forensic solutions on the society and the justice setup.

PO9: Global standards - Demonstrate knowledge relevant to the regional, national and international development needs.

FIRST SEMESTER

22-358-0101 FUNDAMENTALS OF FORENSIC SCIENCE, CRIMINAL LAWS & PSYCHOLOGY

Course Outcomes

After completion of this course, the students will be able to

COs	Course Outcome Statements After completion of the full course the student must be able to	Cognitive Level
CO1	Describe historical development and significance of forensic science in society.	Understand
CO2	Analyze various facets of the admissibility of different types of evidence.	Analyze
CO3	Analyze the role of major criminal acts	Analyze
CO4	Analyze the role of minor criminal acts.	Analyze
CO5	Apply psychology in forensic science.	Apply

Module I: Introduction to Forensic Science

- Forensic science – Definition, scope, and branches of forensic science; laws and principles of forensic science
- History and development of forensic science in India and world
- Forensic science laboratories – types of FSLs (CFSLs, SFSLs, GEQDs, FPB, RFSLs, Mobile FSLs); services provided, divisions and organizations; administrative issues with Forensic Science Laboratories; Accountability, Access to Laboratory services
- Forensic scientist – duties and responsibilities; education and training; code of conduct of forensic scientists; ethical problems in forensic science; ethical concerns of DNA databases

Module II: Evidences

- Definition, types (testimonial and real evidence) (oral & circumstantial); Transfer, Persistence, & contamination of evidence, Identification and Individualization (class and individual characteristics); sample limitations in forensic science; Known and

questioned items, Relationship and context, comparison of evidence, controls,

- Analysis of evidence: Controls, preliminary considerations. Collection, preservation, packing and forwarding of different types of evidence (Fingerprint, hair, fiber, glass, soil, Questioned documents, Fingerprints, etc.)

- Admissibility of scientific evidence; Frye case and Daubert standard; Acquisition of DNA evidence; Admissibility of deception detection tests (Polygraph, narcoanalysis, and brain fingerprinting).

- Expert testimony – pre-court preparation and court appearance; examination in chief, cross examination and re-examination

Module III: Criminal Major Acts

- Criminal Major Acts – Indian Penal Code, 1860 - Punishments & Types - Offences against Human Body - Culpable Homicide & Murder- Dowry Death and Causing Death by Negligence, Suicide, Causing Miscarriage, Hurt, Criminal Force, Assault, Acid Attack, Sexual offences, Matrimonial Cruelty - Offences against Property - Theft, Extortion, Robbery, Dacoity, Mischief and Misappropriation - Criminal Procedure Code, 1973 – Arrest-Criminal Courts and Officers – Summons– First Information Report - Investigation and Collection of Evidence- especially Biological Evidence – Charge – Fair Trial - Indian Evidence Act, 1872 General principles of admission of evidence– Fact – Evidence – Proved – Dying Declaration - Expert Evidence - Oral and Documentary Evidence – Witness – Examination of Witness –Presumptions

- The Constitution of India - Constitution of India - Preamble, Fundamental Rights - Directive Principles of State Policy – Fundamental Duties.

Module IV: Minor Acts

- Drugs and Cosmetic Act, 1940 – Offences –Narcotic Drugs and Psychotropic Substances Act 1985 –Offences - Arms Act, 1959 – Offences- Explosives Act, 1884 - Offences – Prevention of Food Adulteration Act 1954 – Offences - Information Technology Act, 2000 – Compensation and Offences under IT Act.

- Dowry prohibition Act 1961, Immoral Traffic (Prevention) Act–1956, Prevention of Domestic Violence Act, 2005. The Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal), 2013. Legislations relating to the welfare of children- The Protection of Children from Sexual Offences Act (POCSO Act) 2012,

Juvenile Justice (Care and Protection of Children) Act, 2015–Socio-economic Legislations-Prevention of Corruption Act- Narcotic Drugs and Psychotropic Substances Act, 1986, The Food Safety and Standards Act, 2006.

Module V: Psychology

- Introduction – scope and importance, principles of development, attention and perception, process of learning, memory and forgetting, motivation, attitudes, value of emotions, behavioral problems, conflict and use of defense mechanism, various types of mental disorders, psychology of criminal behavior, forensic psychology, and psychiatry, narcoanalysis, polygraph, and brain fingerprinting

Recommended Reading:

1. Houck, M.M & Siegel, J.A; Fundamentals of Forensic Science, Acadamic Press, London, 2006.
2. Sharma, B.R; Forensic Science in Criminal Investigation & Trials, Universal Publishing Co., New Delhi, 2003
3. Nanda B.B and Tewari, R.K; Forensic Science in India- A vision for the Twenty First Century, Select Publisher, New Delhi, 2001.
4. James, S.H and Nordby, J.J; Forensic Science- An Introduction to Scientific and Investigative Techniques, CRC Press, USA, 2003.
5. Saferstein; Criminalistics- An Introduction of Forensic Science, Prentice Hall Inc, USA,2007.
6. Barry, A.J. Fisher; Techniques of Crime Scene Investigation, 7th Ed, CRC Press, NewYork, 2003.
7. H.L. Blitzer and J.Jacobia; Forensic Digital Imaging and Photography, Academic Press, London, 2002
8. Mordby, J. & Reckoning, D; The Art of Forensic Detection, CRC Press NewYork, 2003.
9. Robertson and Vignaux; Interpreting Evidence, John Wiley, New York, 1995.
10. Swansan, C.R, Terrbles, L & Taylor,R.W; Police Administration, Prentice Hall, USA, 1998.
11. Gross.H; Criminal Investigation- A Practical Textbook for Magistrates, Police Officers, and Lawyers; Universal Law Publishing Co., New Delhi, 2000.
12. Lyman, M.D; Criminal Investigation – The Art & the Science, Prentice Hall, New Jersey, 2002.
13. O‟Hara CE & Osterburg, JW; An Introduction to Criminalistics., Indiana University.

Press, London, 1972.

14. Swansson,C.R, Chamelin, N.C, & Territ, L; Criminal Investigator, McGrawhill, New York, 2000.
15. The Indian Evidence Act,(1872), Amendment Act (2002); Universal Law Publishing Co., 2003.
16. The Code of Criminal Procedure (1973) Amendment Act, (2001); Universal Law Publishing Co., 2002.
17. Rattan Lal & Dhiraj Lal; The Indian Penal Code, 28th Ed. Wadhwa & Co. Nagpur, 2002.
18. D.A. Bronstein, Law for the Expert Witness, CRC Press, Boca Raton (1999).
19. Vipa P. Sarthi, Law of Evidence, 6th Edition, Eastern Book Co., Lucknow (2006).
20. A.S. Pillia, Criminal Law, 6th Edition, N.M. Tripathi Pvt Ltd., Mumbai (1983).
21. R.C. Nigam, Law of Crimes in India, Volume I, Asia Publishing House, New Delhi (1965).
22. (Chief Justice) M. Monir, Law of Evidence, 6th Edition, Universal Law Publishing Co. Pvt. Ltd., New Delhi (2002).

22-358-0102 LABORATORY QUALITY MANAGEMENT, RESEARCH METHODOLOGY AND STATISTICS

Course Outcomes

After completion of this course, the students will be able to

COs	Course Outcome Statements	Cognitive Level
CO1	Describe significance and types of standards in analytical chemistry	Understand
CO2	Explain quality management and lab accreditation	Understand
CO3	Apply different measures for laboratory management and safety	Apply
CO4	Analyze statistically the significance of various evidence	Analyze
CO5	Employ various research tools for forensic science applications	Apply

Module I: Standards for analysis

Basic standards – Need of standards in analytical sciences – Basic chemical standards – Analytical standards – Reference materials – high purity substances – Certified reference materials – working or secondary standards – matrix effect in standards – Biological standards – Biochemical standards – Microbial cell lines and standards.

Module II: Quality Management and Laboratory Accreditation

Introduction – Quality - Quality system – Quality plan – Inspection and testing – Test records – Control of inspection Handling, storage, packaging, preservation and delivery of the material – Control of quality records – Internal quality audits – Quality assurance– Training. Laboratory Accreditation – ISO 9000 and ISO 14000 and 17000 series of standards – Accreditation Boards – NABL guidelines for accreditation in India. Proficiency testing system – Internal quality control– Inter and intra laboratory testing programmes – Designing and running the proficiency testing programmes – Confidentiality. Advantages of accreditation.

Module III: Laboratory Management and Safety

Administration of Laboratories – Types of laboratories – Connection between filed work and laboratory – Educational requirements of laboratory personnel – Routine laboratory

work – Research and development – Internal organization of a laboratory. Architectural requirements – Laboratory design – Floor area furniture design – Auxiliary services – Receipt of reports and remnants – Record management – Requirement of equipment, glassware, chemicals and other material – Purchase procedure – Disposal of wastes – Security of the premises. Laboratory Information Management system (LIMS) classification of LIMS functions – Sub-division by functional area – Definition of LIMS – Strategic design of LIMS – System development life cycle – Review of the laboratory – Project proposal – Definition of system requirements – specifications– commercial or Bespoke LIMS – Evaluation – Purchase and installation – Demonstration – Validation – user training and implementation. Laboratory safety – planning – written safety plan– Safety policies – Safety resources – operations Hazards of chemicals, solvents, poisons and explosives – storage facilities – Biological hazards - Pressure vessels and then handling – Electrical safety – Fume cup boards- Exhausts system – Protective equipment- Emergency care and medical facilities.

Module IV: Research Methodology

Identification and criteria of selecting a research problem (Hypothesis), Formulation of objectives, research plan, and its components. literature search/review, Sampling- Principles, methods, types of sampling, rationale for using a particular sampling method. Population and sample size, sampling procedures (random and non random), sampling statistics, sampling and physical state, homogenization of samples, sample size and hazards in sampling. Methods of Research; MFS-Survey, experimental, Ex-post facto, case study methods, and content analysis, etc. Tools of Data Collection - Observation, interview schedule, questionnaire, semantic differential. Impact factors of journals, Intellectual property rights (IPR)

Module V: Statistics

Introduction, Descriptive Statistics: Frequency distribution, class intervals, graphical presentation: bar diagram, histogram, pie chart; Measures of Central Tendency; measures of dispersion, Mean and standard deviation: Distribution of random errors, reliability of results, tests of significance, confidence interval, Paired t-test, Correlation and linear regression, the number of replicate determination, analysis of variance, the value of statistics in forensic science. Correlation, Methods of correlation, skewness and Kurtosis variance, Types of correlation (Pearson r & Rho) (+/-); Tests of significance. Parametric and nonparametric statistics; level of significance (Chi-square, t test, F test, Z test), the

various nonparametric tests with one sample, two samples and k-samples, Kruskall-Wallis ANOVA. Regression Analysis, Multi-factorial Analysis, etc. Introduction to probability theory and distributions.

Recommended Reading:

1. Woodget, B. W. and Cooper, D.: Sample and Standards, ACOL Series, Wiley 1987.
2. Dux, J. P., Hand Book of Quality Assurance for Analytical Chemistry Laboratory, Van Nostrand, 1986.
3. Duncan, W. L.: Total Quality: Key Terms and Concepts, 1995.
4. Shah, D. H.: QA Manual, Business Horizons, 2000.
5. Kumar, K.: Quality Management, ABD Pub., 2000.
6. Ross, J.: Total Quality Management, Vanity Book, Intl., 1995.
7. Seiler, J. P., Good Laboratory practice, Springer, 2000.
8. Diwan, P.,: Quality in Totality, Manager‟s Guide to TQM and ISO 9000, Deepti & Deepti Pub., 2000.
9. Gyani, G. J.,:Training Manual on ISO 9000; 2000 and TQM, Raj Pub., 1999
10. Olson, M. H. and Davis, G. B.: Management Information Systems, McGraw Hill, 1998.
11. Specific Guidelines for Accreditation of Forensic Science Laboratories, DST, 1998.
12. Guide for Safety in The Chemical Laboratory: Manufacturing Chemist‟s Association, 1972.
13. Steere N. V.(Ed.): Hand Book of Laboratory Safety, CRC, 1967.
14. Tilstone, W. J. and Lothridge, K.: Crime Laboratory Management, Taylor and Francis,2004.
15. Clair, J. S: Crime Laboratory Management, Academic Press, 2003.
16. Miller, J. C. and Miller, J. N.: Statistics for Analytical Chemistry, Ellis Horwood, 1988.Fisher, R. A.: Statistical Methods for Research Workers, John Wiley, 1954.
17. Sokal, R. R. and Rolf, F. J.: Biometry – Principles and Practices of Statistics in Biological Research, Freeman, 1981.
18. Bhaskar Rao T.: Methods of Biostatistics, Paras, 2001.

19. Rama Krishnan P., Biostatistics, Saras, 1995.

20. Rao,V.K., Biostatistics– A Manual of Statistical methods for use in Health, Nutrition and Anthropology, Jaypee Medical Pub., 1996.

21. Woodget, B. W. and Cooper, D.: Sample and Standards, ACOL Series, Wiley, 1987.

22. Dux, J. P., Hand Book of Quality Assurance for Analytical Chemistry Laboratory, Van Nostrand, 1986.

22-358-0103 INSTRUMENTAL TECHNIQUES -I

Course Outcomes

After completion of this course, the students will be able to

COs	Course Outcome Statements	Cognitive Level
CO1	Discuss instrumentation and spectroscopic methods	Understand
CO2	Apply molecular and atomic spectroscopy (Infrared) for forensic applications	Apply
CO3	Apply chromatography (separation and detection techniques) for forensic applications	Understand
CO4	Explain mass spectrometric and X-ray based methods used in forensics	Understand
CO5	Analyze forensic samples using various instrumental techniques	Analyze
CO6	Analysis of data for interpretation	Analyze

Module 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
- Absorption and emission spectra, electronic and molecular spectra
- Ultraviolet and visible spectroscopy: Instrumentation and Applications.

Module II: Molecular and Atomic Spectroscopy:

- Infrared Spectroscopy: Molecular vibration, Theory of IR absorption, IR Sources and Instrumentation, Fourier Transform Infrared (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.
- Theory, instrumentation, and application of NMR spectroscopy

Module III: Separation and Detection Techniques

- Introduction to Chromatography: Partition, Adsorption, Ion exchange, Size Exclusion Chromatography, their principle and types of chromatography. Forensic applications of Chromatography.
- Thin Layer Chromatography (TLC): Principle, instrumentation and applications, High Performance Thin Layer Chromatography (HPTLC)
- Liquid Chromatography, High Performance Liquid Chromatography: Principle, instrumentation and applications, LC – MS, LC – MS – MS (Tandem).
- 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.

Module IV: Mass spectrometric and X-ray based methods

- Mass Spectroscopy: Theory, Instrumentation and Applications,
- Hyphenated techniques - Inductively coupled plasma-Mass Spectroscopy (ICP-MS): Theory, Instrumentation and Applications. IR-Mass Spectrometry (IR-MS)
- Theory, instrumentation, and application of X-ray diffraction, X-ray fluorescence spectroscopy, Energy dispersive X-ray spectroscopy

Module V: Analysis and Interpretation

- Standards and samples, calibration methods, signal, noise, signal to noise ratio, interferences, contamination, and loss of analyte, limit of detection, limit of quantification, and sensitivity, sampling, managing laboratory information, laboratory automation, Method development and method validation.

Recommend Reading:

1. Kalri P.S. (2001). Spectroscopy of Organic Compounds. India, New Age International Pub.
2. Khanna D.R. &Gulati H.R. (2002). Fundamentals of Optics Geometrical Physical & Quantum. India, R. Chand & Co.
3. Khandpur R.S. (2004). Handbook of Analytical Instruments. USA, Tata McGraw Hill Pub. Co.
4. Patania V.B. (2004). Spectroscopy. India, Campus Books International.
5. Robinson J.W. (1996). Atomic Spectroscopy, Revised & Expanded. NY, Marcel Dekkar, Inc.
6. Sharma B.K., (2000). Instrumental Methods of Chemical Analysis. India, Krishna

Prakashan Media.

7. Silverstein R.M. & Webster F.X., (1997). Spectrometric Identification of Organic Compounds. USA, John Wiley & Sons, Inc.
8. Skoog D.A., Holler F.J. & Stanley R.C. (2017). Principles of Instrumental Analysis, USA, Cengage Learning.
9. Subrahamanyam N. & Brij Lal (2004). A Text Book of Optics. India, S. Chand & Co.
10. Thompson K.C. & Renolds R.J. (1978). Atomic Absorption Fluorescence & Flame Emission Spectroscopy: Practical Approach. London, Charles Griffin & Co.
11. Willard H. & Lynne L.M. (1986). Instrumental Methods of Analysis. USA, CBS Publishers & Distributors.
12. Willard H.H., Merrett L. L. Frank J.A.D. & Settle A. (1986). Instrumental Methods of Analysis. USA, CBS Pub. & Distributors.
13. Jarris K.E., Gray A.L. & Hock R.S. (1992). EDS; handbook of Inductively Coupled Plasma Mass Spectrometry; Glasgow, Blockie Pub.
14. Lindsay, S. (1992). High Performance Liquid Chromatography. New York: Wiley Pub.
15. Maclaffrty F.W. & Turecek F. (1993). Interpretation of Mass spectra. US, Mill Valley, C A Univ. Science Books.
16. Robards K. Jackson P.E. & Haddad P.A. (2012). Principles and Practice of Modern Chromatographic Methods. Germany, Elsevier pub.
17. Saferstein R. (2001). Forensic Science Handbook Vol. I. London, Prentice Hall.
18. Shrivastava & Shrivastava (1991). Introduction to Chromatography. India, S. Chand & Co.
19. Smith and Bogusz M. (2007). Handbook of Analytical Separation. Germany, Elsevier Pub.
20. Srivastava M. (2010). High-Performance Thin-Layer Chromatography (HPTLC). Germany, Springer Science & Business Media.
21. Stahl E. (2013). Thin Layer Chromatography. Germany, Springer Science & Business Media.

22-358-0104 FORENSIC CHEMISTRY

Course Outcomes

COs	Course Outcome Statements After completion of this course, the students will be able to	Cognitive Level
CO1	Apply techniques of fire/arson crime scene and petroleum product analysis	Apply
CO2	Analyze evidence from explosion crime scene	Analyze
CO3	Explain forensic aspects of food adulteration.	Understand
CO4	Employ forensic examination of cement.	Apply
CO5	Identify the tagging dyes in trap cases	Analyze

Module I: Arson and petroleum products

- Fire, chemistry and physics of fire behaviour, elements of life cycle of fire, types of fire, Room fire sequence, direction of fire, incendiary devices, fire extinguishers, Analysis of fire/arson crime scene, establishing the origin of fire, patterns and surface effects of char, Accidental fire causes, crime scene investigation & management of evidences on a fire/arson crime scene.
- Petroleum Products, Adulterants, Detection of adulterants of gasoline, diesel and engine oils. Analysis of residues in forensic exhibits, Analysis of recycled engine oils, Analysis of dyes of petrol and kerosene, engine oils, Gas chromatography analysis of petrol, kerosene, diesel and other solvents for detection of adulteration by Flash point, boiling point, ignition method and distillation method.

Module II: Explosives

- Nature, Classification, Composition and characteristics of Explosive, pyrotechnics, IEDs, commonly used Explosive devices, Explosion process and effects, types of hazard, effect of blast wave on structures, human etc. Crime scene management in explosive cases, post-blast residue collection, Reconstruction of sequence of events, Evaluation and assessment of scene of explosion, systematic examination of explosives and explosion residues in the laboratory using chemical and instrumental techniques in the laboratory and interpretation of results, Explosives

Act.

Module III: Food adulteration, fertilizers, and pesticides

- Adulterants in food and food products, cement, petroleum products, pharmaceutical products, medicines, beverages.
- Alcoholic and non-alcoholic beverages
- Introduction to fertilizer, different type of fertilizers and classification, substandard and sub-standard adulterated fertilizers, common adulterants. Chemical and instrumental methods of analysis of fertilizers. Quantitative and qualitative forensic analysis of organic and inorganic Industrial products, chemical fertilizers, pesticides, insecticides.

Module IV: Cement

- Cement: Types of cement and their composition, sampling of cement evidence material, determination of adulterants in cement, bromoform test, fineness test, loss on ignition test of cement.

- Physical and instrumental methods of cement analysis: determination of compressive strength, setting times, initial and final setting time, standard consistency, chemical methods of cement analysis, x-ray powder diffraction- identification of adulterated cement and adulterants. Cement mortar and Cement concrete: Sampling and methods of analysis.

Module V: Miscellaneous

- Forensic analysis of oils and fats for adulteration
- Analysis of gold and other metals in cheating cases
- Examination of chemicals used in trap cases – phenolphthalein

Recommended Reading:

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.

22-358-0105 Practical on 22-358-0101 & 22-358-0102

COs	Course Outcome Statements After the completion of course the student must be able to	Cognitive Level
CO1	Describe the trends in crime in India in past years	Understand
CO2	Analyze cases and court judgements based on IPC, CrPC, and IEA	Apply
CO3	Analyze the fingerprint ridge data using ANOVA	Analyze
CO4	Utilize correlation and regression analysis for analysis of data	Analyze
CO5	Employ various data presentation methods	Apply

1. To study the annual reports of the National Crime Records Bureau and depict the data on different type of crime cases by way of smart art/templates.
2. To write a report on the state of forensic science laboratories in India – their types, roles, and organizational structure.
3. To study a crime case in which an accused was punished on charge of murder under Section 302.
4. To study a crime case in which an accused was punished on charge of rape under Section 375.
5. To cite an example of a case in which the opinion of an expert was called for under Section 45 of the Indian Evidence Act.
6. Visit to the Police Station/ Correctional Institution.
7. Computation of measures of central tendency and dispersion in anthropometric data of a given type of population.
8. Designing of an experiment for the comparison of efficacy of a fingerprint ridge density in males and females of a given population by the method of ANOVA.
9. Regression analysis and correlation analysis of a data of heights and weights of a group of a given population.
10. Data Analysis by SPSS.

11. Construct frequency curve, frequency polygon, bar diagram, histogram and pie diagram using suitable data.
12. Formulate a hypothesis of any scientific problem.
13. Conduct review of literature on problem identified in practical 12.

22-358-0106 Practical on 22-358-0103 & 22-358-0104

Course Outcomes

COs	Course Outcome Statements After the completion of course the student must be able to	Cognitive Level
CO1	Employ UV-Vis spectroscopy for analysis of dyes	Analyze
CO2	Identify pesticides using spot tests and TLC	Analyze
CO3	Identify adulteration in cement samples	Analyze
CO4	Analysis of volatile compounds in alcoholic beverages	Analyze
CO5	Analysis of phenophthalein in trap cases	Analyze

1. To conduct a demo of spectroscopic techniques – UV-Vis spectroscopy, FTIR spectroscopy, ATR – FTIR spectroscopy.
2. Experiments on UV absorption of drug/dyes/Chemicals.
3. Experiments on IR spectroscopy of Paints / Drugs / Organic compounds.
4. Comparison of polythene films by IR spectrophotometry.
5. Identification of drugs / solvents by Gas Chromatography and Gas Chromatography – Mass Spectrometry (GC-MS).
6. Detection of low explosives by chemical/ color test and TLC.
7. Examinations of petroleum products as per BIS specifications.
8. Detection of pesticides by color/spot tests and TLC
9. To perform color tests for detection of adulteration of cement samples
10. To study various types of arson patterns for determination of point of origin.

11. Analysis of ethanol, methanol, chloral hydrate, and acetone
12. Analysis of Phenolphthalein in trap cases using thin layer chromatography (TLC) and UV-Vis spectroscopy
13. Analysis of different metals in cheating cases.

SECOND SEMESTER

22-358-0201 QUESTIONED DOCUMENTS, FINGERPRINTS, AND IMPRESSION EVIDENCE

Course Outcomes

After completion of this course, the students will be able to

Cos	Course Outcome Statements	Cognitive Level
CO1	Explain questioned document examination	Understand
CO2	Examine handwriting and signatures	Analyze
CO3	Describe fingerprint science & classification	Understand
CO4	Compare fingerprints for forensic examination	Analyze
CO5	Examine impression evidence	Analyze

Module I: Introduction to questioned documents

- Forensic Document Examination and its scope & importance; Classification of documents; Care, handling, preservation of documents; Observation tests and their application in handwriting examination; Preliminary examination of documents; examination of paper & inks, Process of comparison of handwriting; Principle of handwriting examination; Importance of natural variations and disguise in handwriting examination; Latest technological developments in the field of document examination with reference to office automation; Quality Assurance in document Examination; Document Expert in trial courts.

Module II: Examination of handwriting and signatures

- Writing forms and qualities, handwriting features, writing variation, class and individual characteristics; holographic wills, factors affecting handwriting, disguise, handwriting classification system, identification of hand printing and numerals
- Preparation and collection of signatures and handwriting standards

Module III: Introduction to fingerprint science & classification

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

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

Module IV: Fingerprint development

- Development, Identification and Presentation of Fingerprint.
- Known prints and rolled impressions, Direct or Inked prints.
- Development of Latent Prints and Lifting techniques.
- Physical and chemical Methods: Powder techniques & various chemical techniques,
- Processing of Post developed prints.
- Fingerprint comparison and Identification.
- Introduction to AFIS.

Module V: Impression evidence

- Types of Impression Evidence, Significance of Impression Evidence, Footwear Impressions (General Characteristic), Footwear Impressions at the Crime Scene, Casting three Dimensional Footwear impressions, Lifting imprints, Comparison of footwear impressions, Tire Impressions Evidence, skid mark, Serial numbers restoration.

- Lip Prints, Ear Prints, Bite marks-Nature, Location, Types, Classification, Development, Lifting, Evaluation, Analysis, Minutiae Identification and comparison with reference/control sample(s), Forensic Significance.

Recommended Reading:

1. Wood Ordway Hilton; Scientific Examination of Questioned Documents. Revised Edition, 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 Thumb – Print Identification,

profusely illustrated, Law Book, Allahabad (1988).

7. Morris Ron N; Forensic Handwriting Identification, Acad Press, London (2001).
8. Kurtz Sheila; Graphotypes a new Plant on Handwriting Analysis, Crown Pub. Inc., USA (1983).
9. Lerinson Jay; Questioned Documents, Acad Press, London (2001) Vacca John R;
10. Computer Forensics- Computer crime scene Investigation, Firewall Medial, An imprint of Laxmi Pub(2002).
11. Casey Eoghan; Handbook of computer crime Investigation, Forensic Tools & Technology- Academic Press (2002).
12. Ellen Davin; Questioned Documents – Scientific Examination, Taylor & Francis, Washington (1997).
13. Roy A Huber, AM Headrick, Handwriting Identification-Facts & Fundamental, CRC Press (1999).
14. Andrea Mc Nichol, Jeffrey A Nelson; Handwriting Analysis Putting it to work for you, Jaico Books, Delhi (1994).
15. Morris (2000); Forensic Handwriting Identification (fundamental concepts & Principals).
16. Madinger J & Zalopany AR; (1999) -Money Laundering- CRC Press.
17. Manning CA;(1999) -Financial Investigation & Forensic Accounting- CRC Press.
18. Brewster F.; Contested Documents and Forgeries," The Eastern Law House, Kolkata.
19. Quirke AJ; Forged Anonymous & Suspect Documents- 1930, Reorge Rontledge & Sons Ltd, London.
20. Katherine M Kappenhaver, CDE-Forensic Document Examination-Humana Press.
21. Jan Seaman Kelly & Brian S Lindblom-Scientific Examination of Questioned Documents-Taylor Francis Group London and New York.

22-358-0202 INSTRUMENTAL TECHNIQUES - II

Course Outcomes

COs	Course Outcome Statements After completion of this course, the students will be able to	Cognitive level
CO1	Use various microscopic techniques	Analyze
CO2	Employ biological / biochemical analysis including centrifugation, biosensors and its types	Analyze
CO3	Employ instrumentation of electrophoretic techniques in protein and DNA analysis.	Apply
CO4	Explain the concepts of antigen antibody interactions and immunoassays techniques	Understand
CO5	Discuss concepts and techniques involved in molecular biology	Understand

Module I: Microscopy

- Introduction - Resolving powers of different microscopes, Visualization of cells and subcellular components by light microscopy, Microscopy and detection of molecules in living cells, Phase contrast, Immunofluorescence and Confocal microscopy,
- Theory, instrumentation, and application of Compound microscope, Polarization microscope, Comparison microscope, Stereomicroscope, and Fluorescence microscope
- Theory, instrumentation, and application of electron microscopy: Scanning and Transmission Electron Microscope (SEM and TEM), Freeze-etch and freeze-fracture methods for Electron Microscope, Cytophotometry, Micrometry, Different fixation and staining techniques, Cryotechniques.

Module II: General Principles of Biological / Biochemical Analysis

- 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**.**

- **Biosensors –** principle, types, instrumentation and forensic application.

Module III: **Electrophoretic techniques**

- General principle, factors affecting electrophoresis, low voltage thin sheet electrophoresis, High voltage electrophoresis, pulsed field gel electrophoresis (PFGE), Agarose gel electrophoresis, detection of proteins and nucleic acids after electrophoresis, DNA probes, electrophoretic heating, joule heating, electroosmotic flow, separation efficiency and resolution. Sodium Dodecyl Sulphate polyacrylamide gel electrophoresis (SDS- PAGE), Isoelectric focusing (IEF), Preparative electrophoresis Horizontal and Vertical Electrophoresis. Capillary Electrophoresis.

Module IV: Immunoassays

- Immuno-chemical Technique, General principles, Production of antibodies, Precipitin reaction, Gel immune-diffusion, Immunoelectrophoresis, complement fixation, Radio Immuno Assay (RIA), Enzyme-linked Immuno Sorbent Assay (ELISA), Fluorescence immune assay.

Module V: Molecular biology techniques

- Blotting and Hybridization techniques- Southern, Northern and Western blotting techniques, Dot and Slot blots, Molecular probes and hybridization.
- Polymerase Chain Reaction (PCR)- Basic PCR and its modifications: Inverse PCR, Anchored PCR, PCR for mutagenesis, Asymmetric PCR, Real time PCR and its applications, RACE, Applications of PCR in forensic science.
- Cloning in bacteria and eukaryotes- Construction and screening of genomic and cDNA libraries. Gene silencing techniques, Transgenic animals and Gene knockouts. Knockout vectors, Knockout mouse.
- Animal Tissue Culture, Hybridoma and Monoclonal antibodies- Organ Culture, Cell cultures, Culture media, Initiation of cell cultures, Evolution of cell lines, large scale culture of cell lines: Monolayer and suspension cultures, Hybridoma technology and the production of monoclonal antibodies, Antibody engineering using genetic manipulations, Alternatives to hybridoma technology, Production of human and humanized antibodies, Uses of monoclonal antibodies.

Suggested Reading:

1. Walker J.M. & Rapley R. (2009). Molecular Biology and Biotechnology. UK, Royal Society of Chemistry.
2. Willard, Merrit and Dean. (1974). Instrumental Methods of Analysis. USA, Van Nostrand.
3. (1978). Biology Methods manual. London: Metropolitan Police Forensic Science

Laboratory.

4. Albert S., Bray B., Lewis D, Roberts K. & Watson J.D., (1989). Molecular Biology of Cell. New York, Garland Pub.
5. Clifford B.J. (1971). The examination and typing of Bloodstains in the Crime Laboratory. USA, US Court Printing Press.
6. Edwin & Caney H. M. (1993). Human Genetics: The Molecular Revolution. London, Jones & Bartlett Pub.
7. Epplen J. T. & Lubjumhin T. (1995). DNA Profiling and DNA Fingerprinting. Basel, Birkha user Verlag.
8. Gardner E.J., Simmons M. I. & Snustad D.P. (1991). Principles of Genetics. New York, John Wiley.
9. Chapmen J.R. (1993). Practical Organic Mass spectrometry, A Guide for Chemical and Biochemical Analysis. New York, Wiley Pub.
10. Chatwal and Anand. (2016). Instrumental Methods of Chemical Analysis. India, Himalaya Publishing House Pvt. Ltd.
11. Harris H., Gaensslen R. & Lee H. (2007). An Introduction to Forensic Science. USA, Mc Graw-Hill Education
12. Triggs C. M. Buckleton J.S. & Walsh S.J. (2004). Forensic DNA Evidence Interpretation. USA, CRC Press
13. Glover D.M. & Hames B.D. (1995). DNA Cloning, vol. 1 to 4. England, Oxford University press, Oxford Pub.
14. Joshi A. R. (2002). A Textbook of Practical Biochemistry. India, B. Jain Publishers.
15. Triggs C. M., Buckleton J. S. & Walsh S. J. (2004). Forensic DNA Evidence Interpretation. NY, CRC Press.
16. Walker J. M. & Rapley R. (2009). Molecular Biology and Biotechnology. UK, Royal Society of Chemistry.
17. Li R. (2008). Forensic Biology: Identification and DNA Analysis of Biological Evidence. USA, Taylor & Francis.
18. McClintock J. T. (2014). Forensic Analysis of Biological Evidence, A Laboratory Guide for Serological and DNA Typing. NY, CRC Press.
19. Oates D.W., Brown C.W. & Weigel D.L. (1974). Blood and Tissue Identification of Selected Birds and Mammals. JPR study Projects Lincoln NE Nebraska Gome

and Perks Commission. Philadelphia, Staff Research Publications.

22-358-0203 FORENSIC BIOLOGY AND SEROLOGY

Course Outcomes

After completion of this course, the students will be able to

COs	Course Outcome Statements	Cognitive level
CO1	Examine blood, semen and saliva for forensic analysis	Analyze
CO2	Examine hair and fiber for determination of origin, race, sex, site from hair.	Apply
CO3	Methods of identification and comparison of botanical evidence like pollen, leaves, paper, pulp and diatoms recovered from crime scenes	Apply
CO4	• Understand the methods of forensic anthropology and odontology • Sex, age, race, and stature estimation from long bones, mandible and sternum • Facial Reconstruction	Understand Apply Analyze
CO5	Understand the basic concepts and techniques involved in analysis of DNA evidence	Understand

Module I: Body fluids – 1 (Blood, semen, and saliva)

- Composition, formation and function of body fluids. Collection and preservation of biological fluids. Types and distribution of body fluids (semen, synovial fluid, gastrointestinal secretions, tear, milk, faeces, saliva, aqueous humour, Vaginal fluid, epithelial cells, etc.) Blood and its variants: Blood composition, Blood group antigens the classification of blood cell antigens, Forensic significance of ABO blood group, Hb blood group, Rh blood group, Kell blood group, Duffy blood group, Kidd blood group, Diego blood group, MNS blood group, etc. origin, grouping, etc.

- Blood and blood stains– Physical examination, presumptive test (TMB, Kastle-Meyer Test, Luminol) Confirmatory Tests (Takayama, Teichmann, spectrophotometric).. Identification of other body fluids and their stains. Semen and seminal stains- Physical Examination, Presumtive

test (Acid Phosphatase Test), Confirmatory test (microscopic examination) Gram staining, cross-over electrophoresis.

- Blood groups – history, biochemistry and genetics of ABO, Rh, Mn and other systems. Methods of ABO blood grouping (absorption-inhibition, mixed agglutination and absorption elution) from blood stains and other body fluids/stains viz. menstrual blood, semen, saliva, sweat, tear, pus, vomit, hair, bone, nail etc., blood group specific ABH substances. Secretors and non- secretors. Blood groups that make racial distinctions. Lewis antigen, Bombay Blood groups. HLA antigens and HLA typing.
- Lectins - their forensic significance. Buffers and serological reagents, methods of sterilization employed for serological work.

Module II: Hair and Fiber

- Forensic hair examinations, introduction: Growth of hairs, Microanatomy, human v/s non human hairs, body area determination, ancestral estimation, damage, disease and treatments, comparison of human hairs, DNA and hairs, case studies. Morphology and biochemistry of human and animal hair, Comparison between human and non- human hair. Structure of hair and hair follicle, hair cycle- anagen, catagen, telogen. Collection and preservation of hair samples. Morphological and microscopic examination of human and animal hair. Macroscopic and microscopic features of hair. Microscopic features- diameter, pigment, cortex, cuticle, cross section. ABO grouping and isozyme typing from hair roots. Determination of origin race, sex, site from hair.
- Types of fiber – forensic aspect of fibre examination- fluorescent, optical properties, refractive index, birefringence, dye analysis etc. Identification and comparison of man-made and natural fibre.

Module III: Forensic botany

- Leaves, seeds, pollens, Paper and Paper Pulp identification, Microscopic and biochemical examination of pulp material etc. Diatoms: Isolation of diatoms from various body organs, long bones and their forensic significance in drowning cases.
- Methods of identification and comparison, various types of planktons and diatoms and their forensic importance; Limnology, Diatoms types and morphology, methods of isolation from different tissues. Study and identification of pollen grains

Module IV: Anthropology and Odontology

- Anthropology and Odontology, Introduction: The human skeleton, Collecting Human remains, analysis of skeleton materials, facial reproductions, Interpretations, case studies

- Sex, age, race, and stature estimation from long bones, mandible and sternum
- Facial Reconstruction 2-D, 3-D, etc
- Definition and Scope of Forensic Odontology, Types of dentition, Basic structure of human teeth, types of teeth & their morphology, and determination of age from teeth using various methods, dental anomalies and their role in Personal Identification.
- Bite marks: Types & forensic importance. Collection and preservation of samples, analysis of Bite marks, presentation of bite mark evidences in court of law. Role of Forensic Odontology in mass disaster victim identification. Dental Charting. Comparison of Ante-mortem and post-mortem dental records.

Module V: DNA as evidence

- Sources of DNA, extraction/ isolation of DNA from stains, tissues, hair, nails, buccal swabs, blood, semen and other samples. FTA cards for isolation of DNA. DNA typing systems – length polymorphisms, short tandem repeats and single nucleotide polymorphisms. Introduction to DNA profiling.

Recommended Reading:

1. Mclay, W.D.S; Clinical forensic medicine, Cambridge University Press, London, 1990.
2. Shepherd, R; Simpson‟s forensic medicine, Oxford University press, London, 2003.
3. Mant, A.K; Taylor‟s priniciples & practice of medical jurisprudence, Wingking Tong company ltd., Hong Kong, 2003
4. Maio, D.J. & Maio V.J; Forensic pathology, CRC press, Costa Rica, 1993.
5. Wecht, C.H; Legal medicine annual, Academic Press Publisher, Massachussets, 1970.
6. Polson C.H; Essentials of forensic medicine, Pergamon press, London, 1973.
7. Lahiri, S.K; Elements of medical jurisprudence, Prabasi press, Calcutta, 1973.
8. Flzinga, R.J; Fundamentals of Entomology, Prentice Hall of India pvt ltd, New Delhi, 1978.
9. Smith, D.G.V; A manual of Forensic Entomology, Ithaca New York Camstock Univ. Press, New York, 1986.
10. Byrd, J.H. & Castner, J.L; Forensic Entomology, The utility of Anthropods in legal Investigation, CRC Press, New York, 2000.

11. Harvey, Warren; Dental identification and forensic, Henry Kimption Publishers, (1976).

12. Singh, Inderbir; Human Osteology, Jayee Brothers, (2004).

13. Joseph, J; Human Osteology, Jaypee Brothers, (1996).

14. Marion, Krogman Wilton; Human skeleton in forensic medicine, Charles C Thomas, (1986).

15. Singh, Inderbir; Textbook of human osteology, Jaypee Brothers, (2002).

16. P.L. Williams & R. Warwick; Gray‟ Anatomy, Churchill Livingston, London,(1980).

17. Krogman, W.M.. The Human Skeleton in Forensic Medicine, Chalres C Thomas, Springfield, (1973).

18. K.J. Reich; Forensic Osteology: Advances in the identification of Human remains, Charles C Thomas, (1998).

19. William M. Bass;Human Osteology: A Laboratory and Field Manual, Missouri Archaeological Society (1995).

20. Reddy,V.R; Dental Anthropology, Inter-India Publication, New Delhi, 1985.

21. Kroeber; Anthropology, Oxford & IBH Publishing Company, New Delhi, 1972.

22. Pickering, R. & Bachman D; The use of Forensic Anthropology, CRC Press, Costa Rica, 2009.

23. Bose, N K; Anthropology, Narayana Press, Denmark, 1972.

24. James, R; Forensic examination of hair, Taylor & Francis, 2ND Ed. London, 1999.

25. Shubhra, G; Introduction to forensic examination, Selective Scientific Books, New Delhi, 2008.

26. Michael, W. Haney, H.A. & Freas, L.E; The Forensic Anthropology Laboratory, CRC Press, 2008.

27. Brown, T; Gene cloning and DNA analysis: An Introduction , 5th ed. Blackwell publishing, London, 2006 .

28. Butler, J; Advanced Topics in Forensic DNA Typing: Methodology, 1st Ed., Academic Press, London, 2009.

29. Easteal, S. McLeod, N. & Reed, K; DNA Profiling: Principles, Pitfalls and Potential, Harwood Academic Publishers, New Jersey, 1991.

30. Primorac, D.& Schanfield, M; Forensic DNA Applications: An Interdisciplinary Perspective, CRC Press, New York, 2014.

31. Rudin, N. & Inman, K; An Introduction to Forensic DNA Analysis, Second Ed.,CRC press, New York, 2001.

32. Spencer, C; Genetic testimony: a guide to forensic DNA profiling, Pearson, New Delhi, 2004.

33. Eveleth, P.B. & Tanner, J.M; Worldwide Variation in Human Growth, Cambridge University Press, London, 1976.

22-358-0204 TOXICOLOGY AND FORENSIC MEDICINE

COs	Course Outcome Statements	Cognitive Level
CO1	Understand the medicolegal aspects of death	Apply
CO2	Understand the medicolegal aspects of injuries	Apply
CO3	Understand the basics of poisons	Understand
CO4	Study the concepts of poisoning due to metallic and non-metallic poisoning and its application in investigation of death due to poisoning	Apply
CO5	Understand the concepts of poisoning involving plant and animal poisons	Understand

Module I: Thanatology and Forensic Pathology

- Signs of death and changes after death. Somatic death, molecular death, early changes after death-Algor mortis, rigor mortis, cadaveric spasm, heat stiffening, cold stiffening, changes in blood, chemical changes in cerebrospinal fluid, changes in vitreous humour, post mortem lividity, fluidity of blood.
- Late changes- putrefaction- external and internal changes. Adipocere, mummification, gastric content and bladder content and time of death from growth of hair and nails.
- Destruction of body and tissues by maggots and other insects, rodents, fish and crabs, moulds. Sudden death, post-mortem demonstration of myocardial infarction.
- Medico legal aspects of death- Asphyxia, syncope, coma, death by starvation, drowning, hanging and strangulation. Asphyxial Deaths (Hanging, Strangulation, Throttling, Suffocation, Drowning, Bansdola). Sexual Offences (Perversions, Natural, Unnatural). Abortion, Infanticide. Traffic Accident Death (Vehicular, Railway, Aircraft)., Impotence and Sterility, Artificial insemination, test-tube baby, surrogate motherhood, Virginity, Criminal Abortion Medico-legal aspects of female feticide, legitimacy, medico- legal aspect of sterilization,
- Causes and mechanism of traumatic death, manner of death. Classification of traumatic deaths. Identification & Examination of Decomposed/Mutilated Bodies & Fragmentary Remains. Identification of possible causes of death.

Module II: Mechanical Injuries

- Abrasions, Bruises, Lacerations, Incised wounds, Stab wounds, Firearm injuries, Defence injuries, fabricated injuries.
- Traffic accident injuries: vehicular injuries, railway injuries and aircraft injuries.
- Thermal injuries: Burn and scalds, Lightning, Electricity, Explosions. Chemical trauma.
- Injuries- Accidental, self-inflicted, or inflicted by others. Ante -mortem and post-mortem, artificial injuries and aging of injuries.
- Fractures, Dislocations Secondary causes of death Regional injuries- wound of the scalp- incised, contusions, lacerations, firearm injuries. Fractures of the skull from direct & indirect impact, injuries of the brain, face, eyes, nose, ears, lip, teeth and alveoli, neck, spine and spinal cord, chest, rib, sternum, ribs, lungs, heart, blood vessels, diaphragm, oesophagus, abdomen, stomach, liver, intestine, pancreas, spleen, kidneys, adrenals urinary bladder, rectum external genitalia, muscles, bones and joints.

Module III: Poisons

- Definition, dosage, administration of poisons, Classification of poisons, action of poisons & factors modifying its action. collection and preservation of toxicological exhibits in fatal and survival cases, signs and symptoms of poisoning, mode of action and its effect on vital functions, medico-legal and post mortem examination report/finding studies, specific analysis plan/ approach to toxicological examination of poisoning samples. The role of drug recognition expert, Drugs of Abuse, Signs and symptoms of addiction, Interpreting drug findings, Functions and roles of toxicologists in a forensic science lab. Significance of toxicological findings.
- Classification and Types of Poisons: Metallic, Inorganic, Organic, Volatile, Animal, Plant, Insecticides, Pesticides, etc.
- Volatile Poisons:- Nature, use, administrations, symptoms, post-mortem findings, fatal dose, fatal period, isolation, detection, qualitative and quantitative estimation of: Acetone, Methyl alcohol, ethyl alcohol. Analysis by colour tests, chromatographic techniques (TLC, FTIR, NMR, GC, GC-MS, etc.).
- Non-Volatile Organic Poisons: Classification and types (alkaloids, sedatives, stimulants, hallucinogens, sominiferous, spinal, cardiac etc.): Nature, extraction from viscera, blood, vomit etc. Fatal dose, fatal period, signs and symptoms, post mortem findings.

Module IV: Metallic, Non-metallic and Food Poisons

- Metallic poisons: Nature, use, administrations, symptoms, post-mortem findings, fatal dose, fatal period, isolation, detection, qualitative and quantitative estimation of metallic poisons including: Lead, Mercury, Arsenic.

- Non-metallic poisons including: chlroine, bromine, iodine, phosphorus. Nature, use, administrations, symptoms, post-mortem findings, fatal dose, fatal period, isolation, detection, qualitative and quantitative estimation. Analysis by colour tests, AAS, FTIR etc.

Module V: Plant poisons

- Plant Poisons: Classification and types (Dhatura, Abrus precatorious, Nerium oleander, Calotropis gigantia, Gloriosa superba, Ergot, Mushroom etc.) of Plant Poisons: Nature, extraction from viscera, blood, vomit etc. Fatal dose, fatal period, signs and symptoms, post mortem findings, detection (preliminary and confirmatory tests) and medico legal significance. Animal Poisons: Classification and types (neurotoxin, myotoxin, cantharides, vasculotoxin, spider, snakes, scorpion, etc.) of Animal Poisons: Nature, extraction from viscera, blood, vomit etc. Fatal dose, fatal period, signs and symptoms, post mortem findings, detection (preliminary and confirmatory tests) and medico legal significance.

Suggested Readings:

1. Curry: Analytical Methods in Human Toxicology, Part II, 1986.
2. Curtis Klaassen, Casarett & Doll Toxicology: The Basic Science of poisons, 8th Edtion, Mc Graw Hill,2013
3. 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 Press,2004.
4. Holfmann, F.G.: Handbook of Drug and Alcohol Abuse.
5. Reject Paul. M.P, Forensic Toxicology, SSBT, New Delhi, 2009 6. Sunshine, I: Guidelines for Analytical Toxicology Programme, Vol-I, CRC press, 1950.
6. Sunshine, I: Handbook of Analytical Toxicology, press, 1969. 8. Mule, S. J. et al.: Immunoassays for Drugs subjects to ab, CRC Press, 1974.
7. Connors, K.: A text book of Pharmaceuticals analysis, Interscience, New York, 1975.
8. Niesink, RJM; Toxicology- Principles and Applications, CRC Press, 1996.
9. Jaisingh P Modi, A Textbook of Medical Jurisprudence and Toxicology ,Edited by Justice K Kannan,26th Edition,2019,LexisNexis .
10. Morrison R.T and Boyd R. N; Organic Chemistry 6th Ed Prentice Hall, 2003.
11. Laboratory procedure Manual, Forensic Toxicology: Directorate of Forensic Science, MHA, Govt. of India, 2005.

12. B.V.Subrahmanyam; Modi‟s Medical jurisprudence, Lexis Nexis butterworth, (1988).

13. WDS. Mclay; Clinical forensic medicine, Greenwich medical media, (1990)

14. Nandy; Principals of forensic medicine, New central book agency, (1995)

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18. C.H.Wecht; Legal medicine annual , ACC Press, (1970)

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20. R. Mortiz & R.C. Morris; Handbook of legal medicine, C.V. Mosby company, (1975).

21. S.K. Lahiri; Elements of medical jurisprudence , Prabasi press, (1973)

22-358-0205 Practical on 22-358-0201 & 22-358-0202

COs	Course Outcome Statements	Cognitive Level
CO1	Identify the class and individual characteristics of handwriting	Apply
CO2	Decipher alterations, foregeries in the document	Apply
CO3	Develop and classify latent fingerprints	Analyze
CO4	Develop footprints and footwear evidence	Apply
CO5	Understand the workings of DNA extraction and DNA fingerprints	Understand

1. Forensic identification of class and individual characteristics of handwriting
2. To detect and decipher alterations in a document
3. Reconstruction of torn sheets of paper.
4. Examination of creases and folds and determination of sequence of strokes.
5. Identification of normal/ disguised writings.
6. Examination of rubber stamp impressions and other mechanical impressions.
7. To obtain class characteristics of fingerprints
8. To obtain individual characteristics of fingerprints
9. Study of pores on friction ridges
10. Sweat Analysis of palmer and plantar surfaces.
11. To perform ridge tracing and ridge counting.
12. Fingerprint classification using Henry system
13. To measure the Gait of Individuals under various circumstances
14. To study various wear and tear characteristics on footwear
15. To examine anatomical difference in footprints of individuals under various circumstances.
16. To learn the principle and working of compound microscope and stereomicroscope.
17. Microscopic examination of various biological samples using compound microscope.
18. Demo of DNA extraction from bacterial culture.

19. Demo of visualization of DNA using gel electrophoresis.

20. To learn sample preparation for various types of microscopic techniques.

21. To prepare slides and permanent mounting of slides for preservation.

22. Demo of PCR.

23. To determine the pH of various biological fluids using pH paper and pH meter.

22-358-0206 Practical on 22-358-0203 & 22-358-0204

COs	Course Outcome Statements	Cognitive Level
CO1	Confirm the presence of blood, semen, saliva, vomit, etc.	Analyze
CO2	Determination of species of origin from blood	Analyze
CO3	Examine human and non-human hair samples	Analyze
CO4	Examine the pollen samples	Analyze
CO5	Identify sex, stature, and race from bones	Apply

1. Confirmatory tests of blood, semen, saliva, vomit etc.
2. Identification of species (precipitin test)
3. Blood grouping.
4. ABO grouping from hair root
5. Rh grouping of bloodstains
6. Microscopic examination of hair samples of human and non-human origin
7. Microscopic examination of different fibers
8. Microscopic examination of pollens.
9. Extraction and microscopic examination of freshwater and marine origin
10. Stature estimation from long bones
11. Sex determination from skull, pelvis, and mandible.
12. Study of various dental anomalies.
13. Personal identification using dental x-rays.
14. Preparation of dental casts using dental stone and their analysis.
15. Reinsch test for As, Hg, and Pb
16. Colour tests for plant poisons
17. Microscopic examination of cannabis

THIRD SEMESTER

22-358-0301 CRIME SCENE INVESTIGATION

Course outcomes (Cos)

COs	Course Outcome Statements	Cognitive Level
CO1	Understand the different types of crime scenes	Understand
CO2	Collect, preserve, and store of evidence from crime scene	Apply
CO3	Documentation of crime scene	Apply
CO4	Blood spatter analysis	Analyze
CO5	Methods of crime scene reconstruction and courtroom presentation	Apply

Module I: Crime Scene Investigation (CSI)

- Types of Crime Scenes (Indoor, Outdoor, Mobile, Water), Various Crime Scenes (Homicide, Suicide, Murder, Accidental, HBT, Hit and Run, Hanging, Drowning, Shooting etc.).
- Various types of Evidences (Physical, Biological, Chemical). Various Crime Scene Search methods. Locating, Prioritize Collection of Evidence ,
- Collect, Preserve, Inventory, Package, Transport, and Submit Evidence.
- Crime Scene Documentation (Sketching, Photography, Videography and Notes- taking). Safety,
- Sources & Forms of dangerous materials: Inhalation, skin contact, Ingestion, Injection. Universal precautions, personal protective equipment, transporting hazardous materials.

Module II: Photography

- Introduction, Photographic instruments, fundamentals of light and vision, light source, geometry and photometry of image formation, types of camera, features, camera movement, and Optical filters.
- History and Development of Photography. Photography in indoor and outdoor scene of crime; aerial photography, Significance of Photography in Forensic Science. Use of photography in reconstructing the scene of crime and its presentation in the court of law. Image magnification, U.V. and I. R. illumination, Art factual evidences (Bloodstain,

fingerprint, imprints, and micro evidences).

- Digital watermarking and digital imaging, photogrammetric, Videography/ highspeed Videography, crime scene and laboratory photography. Photography of objects- Close up, normal, telephoto and processing, aerial photography.
- Digital photography, how digital camera works and basics of digital imaging. 3-D Photography/Videography, videography/high speed videography, High-speed photography, legal aspects of visual evidence, Admissibility in the court.

Module III: Crime Scene Reconstruction (CSR)

- Steps involved (Recognition of evidence, Documentation of evidence, Collection of evidence, Evaluation of evidence, Hypothesis, Testing, Reconstruction), various crime scenes and scenarios (like Hit and Run, Accidents, Hanging, Shooting, Burglary, etc.). Role of Logic in CSR.
- Writing a Reconstruction report.
- Correlation of crime scene analysis with behavioural analysis. Cases of Special Importance pertaining to forensic examination Digital Aids in Reconstruction (3-D Photography/Videography, Computer aided Reconstruction).

Module IV: Blood Spatter Analysis

- Historical perspective, Introduction, terminologies, biological and physical properties of human blood, droplet dynamics- in-flight and on-impact, directionality, point of convergence and point of origin, Spatter Types, Altered bloodstain patterns, Artifactual bloodstain patterns,
- Documentation, Evaluation & importance of Bloodstain evidences,
- Legal aspects of BPA,
- Manual and Computer-assisted reconstruction of BPA.
- Dealing with risks associated with blood- borne pathogens.

Module V: Report Writing & Court Room Presentation

- Report Writing and Evidence Evaluation: Components of reports and Report formats in Crime Scene and Laboratory findings.
- Constitutional validity of Forensic Evidence, Expert Testimony:

- Admissibility in court of law, Pre-Court preparations & Court appearance, Interpretation of Reports, Presentation in the court, Common witness, Expert witness, Expert Testimony: The role of the expert-witness; acceptance of evidence in the court; mental disorder and acceptance of evidence in court; child witness in the court, Examination-in-chief, Direct examination and cross – examination by prosecution and defense.

Recommended Reading:

1. Houck, M.M & Siegel, J.A; Fundamentals of Forensic Science, Acadamic Press, London, 2006.
2. Mordby, J. & Reckoning, D; The Art of Forensic Detection, CRC Press NewYork, 2003.
3. David R.Redsicker; The Practical Methodology of Forensic Photography- 2nd Ed. CRC Press, New York, 2001.
4. R.E.Jacobson, S.F.Ray, G.G.Attridge; The Manual of Photography- Photographic and Digital Imaging , N.R. Oxford.
5. Sharma, B.R; Forensic Science in Criminal Investigation & Trials, Universal Publishing Co., New Delhi, 2003.
6. Barry, A.J. Fisher; Techniques of Crime Scene Investigation, 7th Ed, CRC Press, NewYork, 2003.
7. Nanda B.B and Tewari, R.K; Forensic Science in India- A vision for the Twenty First Century, Select Publisher, New Delhi, 2001.
8. James, S.H and Nordby, J.J; Forensic Science- An Introduction to Scientific and Investigative Techniques, CRC Press, USA, 2003.
9. Saferstein; Criminalistics- An Introduction of Forensic Science, Prentice Hall Inc, USA,2007.

22-358-0302 FORENSIC PHYSICS AND BALLISTICS

COs	Course Outcome Statements	Cognitive Level
CO1	Examine soil and paint evidence	Analyze
CO2	Examine glass evidence and toolmarks	Analyze
CO3	Understand the historical development of firearms	Understand
CO4	Learn the basics of internal, external, and terminal ballistics	Understand
CO5	Examine different types of evidences found in shooting crime scenes	Analyze

Module I: Soil and Paint

- Types and composition of soil, sample preparation, removal of contaminants, colour, molecular particle size distribution, turbidity test, pH measurements, microscopic examination, density gradient analysis, ignition-loss test, elemental analysis, interpretation of soil evidence. Types of paint and their composition, macroscopic and microscopic analysis of paint pigments, pigment distribution, micro-chemical analysis- solubility test, pyrolysis gas chromatography, TLC, colorimetric analysis, IR spectroscopy and X-ray diffraction, elemental analysis, mass spectrometer, interpretation of paint evidence.

Module II: Glass and toolmarks

- Types of glass and their composition-soda-lime, boro-silicate, safety glass, laminated, light-sensitive, tampered/ toughened, wire glass, coloured glass. Matching and comparison. Forensic examinations of glass fractures- rib marks, hackle marks, cone fracture, wavy, backward fragmentation, concentric and radial fractures. Colour, fluorescence, physical measurements, refractive index, density gradient, becke-line, specific gravity examination and elemental analysis of glass evidence.

- Types of tool marks- compression marks, striated marks, combination of compression and striated marks, repeated marks, class characteristics and individual characteristics, tracing and lifting of marks, Photographic examination of tool marks and cut marks on clothes and walls etc. Restoration of erased / obliterated marks- Method of making-cast, punch, engrave; methods of obliteration, method of restoration- etching (etchings for different metals), magnetic, electrolytic etc., recording of restored marks – restoration of marks on wood, leather, polymer etc.

Module III: History of Firearms ant types of ammunitions

- History and background of Firearms, their classification and characteristics, various components of small arms, smooth bore and rifled firearm, different systems and their functions, techniques of dismantling/assembling of firearm.
- Types of ammunitions- 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 bullets and compositional aspects

Module IV: Internal, External, and Terminal 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,
- Basics of external ballistics - principal problems of exterior ballistics, vacuum trajectory, drag, yaw, trajectory in air, air resistance
- Terminal ballistics – penetration of target, factors on which the damage to the target depends
- Wound Ballistics; entry and exit wounds and their different types

Module V: Examination of firearm evidence

- Class and individual characteristics
- Firearms, ammunition and their components identification and examination, different types of marks produced during firing process on cartridge-firing pin marks, breech face marks, chamber marks, extractor and ejector marks and on bullet number/direction of 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, determination of range of fire- burning, scorching, blackening, tattooing and metal fouling, shots dispersion and GSR distribution, stereo & comparison microscopy, automatic bullet and cartridge comparison system.
- GSR analysis: Mechanism of formation of GSR, source and collection, spot test, chemical test, identification of shooter and instrumental methods of GSR Analysis.

Suggested Reading:

1. Caddy, B; Forensic Examination of Glass and Paint Analysis and Interpretation, CRC Press, New York, 2001.
2. Shaw, D; Physics in the Prevention and Detection of Crime, Contem Phys. Vol.17, 1976.

3. Saferstein, R; Forensic Science Handbook. Vol. I, II, (Ed.), Prentice Hall, New Jersey, 1988.
4. Working Procedure Manual; Physics BPR & D Publication, 2000.
5. Sharma, B.R.; Firearms in Criminal Investigation & Trials, 4th Ed, Universal Law Publishing Co Pvt Ltd, New Delhi, 2011.
6. Mathews, J.H; Firearms Identification, Vol I, II and III, Charles C. Thomas, USA, 1977.
7. Hatcher, Jury and Weller; Firearms Investigation, Identification and Evidence, Stackpole Books, Harrisburg, Pennsylvania,1997.
8. Sharma, B.R; Forensic Science in Criminal Investigation and Trials (3rd Ed.), Universal Law Publishing Co., New Delhi, 2001.
9. Hess, K.P; Textile Fibers and their Use, 6th Edn, Oxford and IBH Publishing Co., 1974.
10. Philip Rose; Forensic Speaker Identification; Taylor and Francis Forensic Science Series, London.
11. Bengold & Nelson Moryson- Speech and Audio signal processing; John Wiley & Sons, USA,
12. Raymond C Murray & John C.F Tedrew; Forensic Geology; Prentice Hall, New Jersey.
13. B. Caddy; Forensic Examination of glass and paints analysis and interpretation, ISBN 0784 05749
14. Vincent Di Maio, Gunshot Wounds; CRC Press, Washington, Dc.
15. Brain J. Heard; Hand Book of Firearms And Ballistics; John Willey, England.
16. TA, Warlow; Firearms, The Law And Forensic Ballistics; Taylor And Francis, London.
17. Karl G. Sellier et al.; Wound Ballistics and the Scientific Background; Elsevier, London.
18. M. Johari, Identification of Firearms, Ammunition and Firearms Injuries; BPR&D, New Delhi.
19. L V. Hogg; The Cartridges Guide - A Small Arms Ammunition Identification Manual; The Stackpole Co., Harrisburg, P A.
20. Gary J. Ordog, Management of Gunshot Wounds, Elsevier, New York.
21. Working Procedures Manual: Ballistics, BPR&D Pub.
22. Heard, B.J; Handbook of Firearms and Ballistics, John Wiley, England, 1997.
23. Warlow, T.A.; Firearms, The Law and Forensic Ballistics, Taylor and Francis, London,1996.

22-358-0303 DIGITAL AND CYBER EVIDENCE

COs	Course Outcome Statements	Cognitive level
CO1	Define computer system architecture Identify and interpret the various sources for digital evidence	Understand Analyze
CO2	Analyze the systematic procedure for the cyber investigation process and to get knowledge about various tools for forensics investigation	Understand
CO3	digital communication and computer networks. Students have gained sufficient knowledge to analyze attacks in wireless networks	Understand Analyze
CO4	Examine the web browser architecture and analyze email communications	Apply
CO5	Able to set well-defined objectives and goals for mobile and cloud forensics investigation process	Understand

Module I: Computer System Architecture

- CPU, Multiprocessing, Operating System Components, Memory Types, Virtual Memory, Input and Output Devices. File Systems- Types and components. Computer Booting Process, Computer Memory – Volatile and Non-Volatile Memory. Basic Input and Output System (BIOS), and System Applications. Types of Storage Media – Hard Drive, SSD, Optical Devices.

Module II: Digital Forensics

- Principles of Digital Forensics, Collection of Evidence- Single System, Networked System and Remote System. Digital Forensic Software and Hardware tools – Proprietary and Open Source Tools. Imaging and Analysis of Storage Media – Tools and Techniques. Computer Facilitated Crimes and Reasons of Attacks, Rules of Digital Forensic, Standard Operating Procedure (SOP) of Digital Crime Scene. Incidence Response tools and techniques. Search and Seizure of Volatile and Non-Volatile Data. Imaging and Hashing Digital Evidence, Analyzing and Recovering Deleted files and folders.

Module III: Introduction to Network and Communication Technology

- Overview of OSI Model and TCP/IP Protocol. Network Address and NAT, Monitoring

Network Activities, Searching for Evidence from the Network. Live Packet Capturing and Analysis. Routers and Routing Protocols, Routing Table Poisoning, Denial of Service Attack (DOS), Distributed Denial of Service Attack (DDOS) and Wireless Attacks.

Module IV: Web Browsers and Email

- Web Browsers, Cookies, Favorites or Bookmarks, Cache, Session Data and Plugins. Email: Types of Email and Protocols. Analyzing the Header details and tracking the email, Spoofed Mails.

Module V: Smart Phones

- Types of Smart Phones and the Operating Systems, Collection and Preservation of Mobile Phone and PDA, Analyzing Mobile Phone Evidence, Rooting and Jail Braking. Virtual Machine and Cloud Technology Forensics.

Suggested Reading:

1. Harlan Carvey; Windows Forensic Analysis Toolkit, Syngress, 2012.
2. Anthony Reyes, Jack Wiles; The Best Damm Cybercrime and Digital Forensics Book, Syngress, USA, 2007.
3. Aaron Philipp, David Cowen, Chris Davis; Hacking Exposed Computer Forensics Second Edition, McGrawHill, USA, 2010.
4. Cory Altheide, Harlan Carvey; Digital Forensics with Open Source Tools, Syngress, USA, 2011.
5. Andrew Hoog; Android Forensics Investigation, Analysis and Mobile Security for Google Android, Syngress, USA, 2011.
6. Hakima Chaouchi, Maryline Laurent-Maknavicius; Wireless and Mobile Network Security, Wiley, 2007.
7. Dan Kusnetzky; Virtualization: A Manager‟s Guide, O‟Reilly, 2011.

Specialization

22-358-0311 FORENSIC SEROLOGY AND DNA PROFILING

COs	Course Outcome Statements	Cognitive level
CO1	Understand the concepts of immunology and serology	Understand
CO2	Determine blood group and human and animal origin from blood	Apply
CO3	Employ DNA fingerprinting techniques	Apply
CO4	Discuss the current and advanced techniques in the field of DNA profiling	Understand
CO5	Interpret forensic DNA data	Analyze

Module I: Immunology and Serology

- Immune system, immune response, innate and acquired immunity, antigens, antibodies, haptenes and adjuvants, immunoglobulin- types, physico-chemical properties and function, raising of anti-sera.
- Role of sero-genetic markers in individualization and paternity disputes. Pitfalls in red cell typing. Examination of vaginal fluid & stains of vaginal secretions-Physical examination, SAP/VAP electrophoresis, Lugol‟s stain. Examination of saliva & saliva stains-starMFS-iodine test, salivary haemagglutinin test, radial diffusion test for amylase. Examination of vomit-test for mucus,test for free HCL (Gunzberg‟s test),endothelial cells. Examination of urine stains-Physical stains, odour test ,urea nitrate crystal test, creatinine test. Types and distribution of body fluids, urine formation, composition, properties, abnormal constituents and clinical significance, Beta HCG; CSF, lymph, amniotic fluid, sweat, composition, formation and function; semen, synovial fluid, gastrointestinal secretions composition, formation and function; tears, milk, faeces; saliva, aqueous humour, Vaginal fluid, epithelial cells, etc. their analysis and forensic significance. Forensic examination of menstrual blood and its stain – physical and microscopic examination, identification by fibrin degradation product

Module II: Determination of human and animal origin

- Determination of human and animal origin from bones, hair, flesh, nails, skin, teeth body tissue, fluids/ stains viz. blood, menstrual blood, semen, saliva, sweat, tear, pus, vomit,

etc., through immunodiffusion and immuno - electrophoresis, cross reactivity among closely related species. Individualization of blood stains: Determination of blood groups, sex age and racial origin from dried bloodstains. Red cell enzymes : Genetics , polymorphism and typing of PGM, GLO-I, ESD, EAP, AK, ADA etc. and their forensic significance. Serum proteins: Genetics, polymorphism and typing of- Hb, HP, Tf, Bf, C3 etc. and their forensic significance.

Module III: Forensic DNA Profiling

- VNTRs, STRs, Mini STRs , SNPs. Detection techniques - RFLP, PCR amplifications, Amp- FLP, sequence polymorphism, Y-STR, Mitochondrial DNA. Evaluation of results, frequency estimate calculations and interpretation, Allele frequency determination, Match probability – Database, Quality control, Certification and Accreditation.
- Possible sources for DNA, collection, transportation and preservation of various forensic samples for DNA profiling. DNA extraction techniques for different forensic samples (early techniques, solid phase extraction, differential extraction, chelex extraction, automated techniques, commercial extraction kits), RNA extraction from different forensic samples. Determining quality and Quantity of DNA and RNA, Gel elution technique. DNA Amplification: Types of PCR: Nested PCR, Touchdown PCR, Gradient PCR, Hot-starts PCR, Quantitative PCR, multiplex PCR. DNA quantification by Slot- blot assay, Pico-green micro-titer plate assay, AluQuant human DNA quantification system, endpoint PCR, PCR inhibitors & solutions, Contamination Issues, etc.

Module IV: Advanced techniques in DNA profiling

- Uni-parentally inherited genetic markers in ethnic and geographical origin detection, DNA Profiling Kits (Easy DNA, Pro-filer, etc.) DNA fingerprinting of degraded samples, Slot-blot assay for quantification of DNA, DNA-DNA Hybridization, next generation sequencing,
- Nano-particle technology in PCR, Drug- DNA interactions, SNP microarray for supplementary paternity testing. Genetic analysis of chromosome X (pentaplex/heptaplex PCR assay), multicopy Y-STR analysis, mitochondrial DNA analysis, DNA multi-reverse parental analysis, cytochrome b analysis, cDNA Personal Effects and DNA analysis (sources and problems). DNA Profiling Applications: Case studies in disputed paternity cases, child swapping, missing person's identity, civil immigration, veterinary, wild life and agriculture cases ;Legal perspectives – legal standards for admissibility of DNA profiling – procedural & ethical concerns, status of development of DNA profiling in India & abroad; Limitations of DNA profiling; Population databases of DNA markers –STRs, Mini STRs, SNPs. Uses of STR Typing, New & future technologies: Microarrays technology, Synthetic DNA, analysis of Degraded DNA, Low Copy Number DNA,

MALDI-ToF, Mass Spectrometry.

Module V: Forensic DNA evidence interpretation

- Interpretation of DNA typing results: Complicating Factors (Multiple contributors, degradation, and extraneous substances), System-specific Interpretational Issues (RFLP, PCR systems). Assessing strength of evidence: Determination of Genetic Concordance, Evaluation of Results, Frequency Estimate Calculations, Population Substructure, Likelihood Ratios, and Uniqueness of DNA Profile. Admissibility standards: Frye, Daubert, and the Federal Rules of Evidence, Landmark cases, The State of Debate. Prosecutor‟s fallacy, defendant‟s fallacy. Ethics of DNA analysis and Post conviction DNA analysis.

Recommended Reading:

1. Wiener, Alexander S; Advances in blood grouping II, Grune & Stratton, (1965).
2. Boorman, Kathleen E,Churchill ; Blood group serology Livingstone,1977.
3. Kabat, Elvin A ; Blood group substances, Academic Press, (1956).
4. Race, R R, Blackwell; Blood groups in man, Scientific Publications, (1975).
5. Mourant, A.; Distribution of the human blood groups, E, Oxford University Press, (1976).
6. Sussman, Leon N, Charles C Thomas; Paternity testing by blood grouping, 1968.
7. Prakash, M ; Physicology of Blood, Anmol Publications, (1998).
8. Roitt, Ivan M,Blackwell ;Essential Immunology, Scientific Publications, (1977).
9. Gupta, S.K.; Essentials of Immunology, Arya Publications, (2008).
10. Clark, William R; Experimental foundations of modern immunology,John Wiley & Sons, (1986).
11. Fudenberg, H. Hugh; Basic and clinical immunology, Lange Medical Publications, (1976).
12. Gell, P.G.H.; Clinical aspects of immunology, Blackwell Scientific, (1975).
13. Nossal, G J V;Antigens, lymphoid cells, and the immune response, Academic Press, (1971).
14. T.J. Kindt, R.A. Goldsby, B.A. Osborne; Kuby Immunology, W.H. Freeman & company, (2004).
15. Brown, T; Gene cloning and DNA analysis: An Introduction, 5th ed. Blackwell publishing, London, 2006.
16. Butler, J; Advanced Topics in Forensic DNA Typing: Methodology, 1st Ed., Academic Press, London, 2009.
17. Easteal, S. McLeod, N. & Reed, K; DNA Profiling: Principles, Pitfalls and Potential,

Harwood Academic Publishers, New Jersey, 1991.

18. Primorac, D & Schanfield, M; Forensic DNA Applications: An Interdisciplinary Perspective, CRC Press, New York, 2014.

22-358-0312 SAMPLE PREPARATION TECHNIQUES

COs	Course Outcome Statements	Cognitive Level
CO1	Understand the basics of the measurement system.	Understand
CO2	Study of different methods of extraction of semivolatile organic poisons from liquids.	Apply
CO3	Methods of extraction of semivolatile organics from solids.	Apply
CO4	Understand the extraction process for organic compounds.	Understand
CO5	Employ various methods of sample preparation	Analyze

Module I: Introduction

- Measurement process, qualitative and quantitative analysis, errors in measurement, method performance and method validation, sensitivity, detection limit, LOD, LOQ and other parameters, preservation of sample, post extraction procedures, determination of accuracy and precision, statistical control, matrix control, contamination control.

Module II: Extraction of semivolatile organics from liquids

- Principles of extraction – volatilization, hydrophobicity, acid base equilibria, factors affecting extraction procedure
- Liquid liquid extraction – method, procedure, significance, limitation, and recent advances
- Liquid solid extraction - method, procedure, significance, limitation, and recent advances
- Solid phase extraction - method, procedure, significance, limitation, and recent advances
- Solid phase microextraction - method, procedure, significance, limitation, and recent advances
- Stir bar sorptive extraction - method, procedure, significance, limitation, and recent advances

Module III: Extraction of semivolatile organics from solid matrices

- Introduction – extraction mechanism, pre-extraction and post-extraction procedure
- Soxhlet and automated Soxhlet - method, procedure, significance, limitation, and recent

advances

- Ultrasonic extraction - method, procedure, significance, limitation, and recent advances
- Supercritical fluid extraction - method, procedure, significance, limitation, and recent advances
- Microwave assisted extraction - method, procedure, significance, limitation, and recent advances

Module IV: Extraction of volatile organic compounds from solids and liquids

- Static headspace - method, procedure, significance, limitation, and recent advances
- Dynamic headspace (purge and trap) - method, procedure, significance, limitation, and recent advances
- Membrane extraction - method, procedure, significance, limitation, and recent advances

Module V: Preparation of samples for forensic importance

- Extraction of pesticides - Stauss otto and modified stauss otto method - method, procedure, significance, limitation, and recent advances
- Extraction of gaseous and volatile poisons from different matrices
- Wet digestion methods - method, procedure, significance, limitation, and recent advances
- Dry ashing method - method, procedure, significance, limitation, and recent advances
- Extraction of neutral, acidic and basic organic non-volatile poisons
- Extraction of plant poisons

Suggested Reading:

1. Applicable Note Nos.320 & 321 on ASE, Diones, USA.
2. Bough P J, Gas Chromatography – A practical approach, p-174, 1 st edition, Oxford University Press, NY, 1993.
3. Curry, Alan., Poison Detection in Human Organ. 3rd Edn. Charles C. Thomas, Springfield, 19767.
4. Lundquist, Frank., Methods of Forensic Science, Vol.I-IV, Interncience Publishers, N. York, 1962.
5. Clarke, E.G.C., Isolation and Identification of Drugs, 2nd Edn. The Pharmaceutical Press, London, 1986.
6. Bamford, F. Poisons, Their Isolation and Identifications, J/A/, Churchill Ltd., London, 1940.

7. Stewart, C.P. and Solman, A., Toxicology – Mechanism and Analytical Methods, Vol. 2, Academic Press, N. York, 1961.

8. Whelpton, R. in Analytical Methods in Human Toaxicology (Curry, A.S. – ed), Macmillan, London, 1984.

9. Middleditch, B.S., Analytical Artifacts. GC., HPLC, TLC and PC, J. Chromatogr. Libr., Vol.44, Elsevier, Amsterdam, 1989.

10. Maehly, Andreas, Chemical Criminalistics, Springer – Verlag, Berlin, 1981.

11. Stahl, E. Thin Lyer Chromatography, 2nd Edn. Springer – Verlag, Berlin, 1969.

12. Gour, T.H. (Ed.), Guide to Modern Methods of Instrumental Analysis, Wiley. Inter Science, N. York, 1972.

13. Jennings, Walter, Analytical Gas Chromatography, Academic Press, Inco., N. York, 1987.

14. Ewing, Galenwood (Ed), Analytical Instrumentation Hand book, Marcel Dekker, Inc., N. York, 1990.

15. Sethi, P.D., High Performance Thin Layer Chromatography : CBS Publishers and Distributors, India, 1996.

16. Gauglitz, Gunter and VO – Dinn, Tuan (Eds), Handbook of Spectroscopy, Wiley VCH, Germany, 2003.

17. Curry, Alan., Poison Detection in Human Organ. 3rd Edn. Charles C. Thomas, Springfield, 19767.

18. Lundquist, Frank., Methods of Forensic Science, Vol.I-IV, Internclence Publishers, N. York, 1962.

19. Clarke, E.G.C., Isolation and Identification of Drugs, 2nd Edn. The Pharmaceutical Press, London, 1986.

20. Bamford, F. Poisons, Their Isolation and Identifications, J/A/, Churchill Ltd., London, 1940.

21. Modi's textbook of medical jurisprudence and toxicology, 17nth edition, 1969, P-596.

22. Clarke's Isolation & Identification of drugs, IInd edition, The Pharmaceutical press, London, 1986, p-58.

23. J.Hoste, Anal.Chim.Acta. 4(1950)23.

24. F.Feigl and V.Anger, Spot Test in Inorganic Analysis, Elsevier Pub.Co.Amsterdam, London VI Ed.1972, p.203.

22-358-0313 FORENSIC BALLISTICS

Cos	Course Outcome Statements	Cognitive Level
CO1	Understand the history of firearms	Understand
CO2	Identify different types of ammunition	Apply
CO3	Explore the concepts of internal ballistics	Apply
CO4	Determine the range of firing	Apply
CO5	Examine the firearms related evidence	Analyze

Module I: History of Firearms

- History and background of Firearms, their classification and characteristics, various components of small arms, smooth bore and rifled firearm, different systems and their functions, rifling – various class characteristics, types of rifling and methods to produce rifling. Trigger and firing mechanism, cartridge-firing mechanism. Projectile velocity determination, Theory of recoil, methods for measurement of recoil. Techniques of dismantling/assembling of firearm.

Module II: Types of ammunitions

- Types of ammunitions- 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 bullets and compositional aspects, latest trends in their manufacturing and design, smooth bore firearm projectile, identification of origin, improvised ammunition and safety. Identification of origin, improvised/ country-made/ imitative firearms and their constructional features.

Module III: Internal and External 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, principal problems of exterior ballistics, vacuum trajectory, effect of air resistance on trajectory, base drag, yaw, shape of projectile and stability, trajectory computation, ballistics coefficient and limiting velocity, Ballistics tables, measurements of trajectory parameters, introduction to automated system of trajectory computation and automated management of ballistics data.

Module IV: 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, Cavitation – temporary and permanent cavities, Ricochet and its effects, stopping power, Wound Ballistics; Threshold velocity for penetration of skin/flesh/bones, preparation of gel block, penetration of projectiles in gel block and other targets, nature of wounds of entry, exit, initial track 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.

Module V: Examination and identification

- Firearms, ammunition and their components identification and examination, different types of marks produced during firing process on cartridge-firing pin marks, breech face marks, chamber marks, extractor and ejector marks and on bullet number/direction of 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, determination of range of fire- burning, scorching, blackening, tattooing and metal fouling, shots dispersion and GSR distribution, stereo & comparison microscopy, automatic bullet and cartridge comparison system. GSR analysis: Mechanism of formation of GSR, source and collection, spot test, chemical test, identification of shooter and instrumental methods of GSR Analysis.

Recommended Reading:

1. Sharma, B.R.; Firearms in Criminal Investigation & Trials, 4th Ed, Universal Law Publishing Co Pvt Ltd, New Delhi, 2011.
2. Mathews, J.H; Firearms Identification, Vol I, II and III, Charles C. Thomas, USA, 1977.
3. Hatcher, Jury and Weller; Firearms Investigation, Identification and Evidence, Stackpole Books, Harrisburg, Pennsylvania,1997.
4. Heard, B.J; Handbook of Firearms and Ballistics, John Wiley, England, 1997.
5. Warlow, T.A.; Firearms, The Law and Forensic Ballistics, Taylor and Francis, London,1996.
6. Schooeble, A.J. and Exline, L.D; Current methods in Forensic Gunshot Residue Analysis, CRC Press, New York, 2000.
7. Wilber; Ballistic Science for the Law Enforcement Officer, Charles C. Thomas, USA, 1977
8. Carlucci, D.E & Jacobson, S.S; Ballistics, CRC Press, London, 2008.
9. Sellier, K.G; Wound Ballistics and the Scientific Background, Elsevier Pub. Co., London,

1994.

10. Jauhari M; Identification of Firearms, Ammunition, & Firearms Injuries, BPR&D, New Delhi.
11. Ordog, G.J; Management of Gunshot wounds, Elsevier Pub. Co., New York, 1983.
12. Schooeble, A.J. and Exline, L.D; Current methods in Forensic Gunshot Residue Analysis, CRC Press, NewYork, 2000.
13. Beyer, J.C; Wound Ballistics, US. Printing Office, Washington, 1962.
14. Wilber; Ballistic Science for the Law Enforcement Officer, Charles C. Thomas, USA, 1977.
15. Di Maio, JM; Gunshot Wounds, CRC Press, New York, 1999.

22-358-0314 CYBER FORENSICS AND CYBER SECURITY

COs	Course Outcome Statements	Cognitive Level
CO1	Analyze a web page and identify its elements and attributes.	Analyze
CO2	Recognize common web application security vulnerabilities and if they are present in web applications	Apply
CO3	Employ the specific do's and don'ts regarding secure web-application design for securing the web applications.	Analyze
CO4	Know the concept of circuit switching and various networking protocols	Understand
CO5	Apply protocols for network security to protect against the threats in the networks.	Apply

Module I: Internet & Web Technologies

- Role of Networking in IT, Evolution and Impact of Internet, Internet Services, Internet Process- Concept of World Wide Web, History of World Wide Web, Purpose of Web, Functioning & Mechanism of Web, Web Hosting & Development, Website Legal Issues HTML (Elements, Attributes, Headings, Paragraphs, Formatting, Fonts, Styles, Links, Images, Tables, Lists, Forms, Frames, Iframes, Colors, Colornames, Colorvalues, Layout, Doctypes, CSS, Head, Meta ,Scripts, Entities, URLs, URL Encode, Webserver) XML, PHP, Installing PHP on wamp server PHP (Syntax, Variables, String, Operators, If...Else, Switch, Arrays, While Loops, For Loops, Functions, forms, GET, POST, Date, Include, PHP File, File Upload, Cookies, Sessions, E-mail, Secure E-mail, Error, Exception Filter) Cyberspace: - Concept of Cyberspace, Emergence of Cyberspace, Nature & Meaning of Cyberspace, Attributes of Cyberspace, Classification of Cyberspace, Legal Framework for Cyberspace.

Module II: Understanding vulnerabilities in Web Applications

- Understanding vulnerabilities in traditional client server application and web applications, client state manipulation, cookie based attacks, SQL injection, cross domain attack (XSS/XSRF/XSSI) http header injection. Introduction to PHP, MySQL, Apache, Server modules, HTML, CSS, Javascript/ Jquery**:** Browser Security, Authentication and session management, HTTPS goals and pitfalls, web application security, secure web application, web threat models, web attacker, network attacker, malware attacker, secure user interface, secure user communication, cookies, frames and frame busting. http

request, http response, rendering and events, html image tags, image tag security issue, java script on error, Javascript timing, port scanning, remote scripting, running remote code, frame and iframe, browser sandbox, policy goals, same origin policy, library import, domain relaxation, window, post message syntax, legacy browser behaviour, mixed content and network attack, cookies client state, cookie authentication, cookie security policy, secure cookies, http only cookies.

Module III: Secure Website Design

- Architecture and Design Issues for Web Applications, Deployment Considerations Input Validation, Authentication, Authorization, Configuration Management, Sensitive Data, Session Management, Cryptography, Parameter Manipulation, Exception Management, Auditing and Logging, Design Guidelines Summary SQL and command injection: Forms and validity, Technical implementation, Incorrectly filtered escape characters, Incorrect type handling, Blind SQL injection, Conditional responses, Mitigation, Parameterized statements, Enforcement at the coding level, Escaping, Pattern check, Database permissions, Examples, Sql injection Commands. Securing web application XACS.

Module IV: Circuit Switched Networks

- SONET - DWDM -Fiber to the Home - DSL - CATV - ISDN – Broadband ISDN. Wireless Networks: Mobile Communications technologies- wireless channel- Network design-Ad hoc Networks-Bluetooth technology. Recent Trends: Optical Networks - VoIP –Advanced intelligent Networks-Home networking. OSI, TCP/IP, IP, Addressing, CIDR, DHCP, IPV6, TCP, ARP, RARP, ICMP, VPN, VLAN, DNS, RIP, Wireless, IEEE 802.11, IEEE 802.16, Bluetooth, SIP,
- VOIP, CTI, ATM: Addressing Signaling & Routing - Header Structure - ATM Adaptation layer
- Management control. Internetworking with ATM: LAN - IP over ATM - Multiprotocol over ATM - Frame Relay over ATM.

Module V: Network Architecture & Security

- Network Scanning, Eaves dropping techniques and counter measures. Network security including firewalls. Internet and E-commerce security issues. Networks and vulnerabilities, networking software - Client side and server side, secure network infrastructure, security protocol layers, create usage policy, conduct risk analysis, security violation and restoration. Network security zone, encapsulation of network services, allocation of traffic control functions. Internal boundary systems. Hardening a Network - Basic services, extended services, Perimeter defence tools, Cryptographic tools, Systems penetration testing, Studying computer forensics issues associated with computer networks, telecommunications and distributed systems. Wireless Network

Security – Introduction and Standards, Vulnerabilities, Countermeasures, Management Issues of Wireless and Mobile Devices. Network & Anti-Computer Forensics: Ethernet analysis, Network interface card analysis, wireless forensic, attackers footprints, firewall logs, IDS/IPS, web proxies, traffic captures, DHCP log examination, sniffing traffic, analyzing proxy cache, tools like tcpdumps, Snort, ngrep, tcpxtract, and wireshark. Email tracker pro, analyzing index.dat, input debugging, controlled flooding, ICMP traceback, packet marking techniques, honeypots and honeynets, source path isolation engine (SPIE). Anti-Computer Forensic: Definition, Sub-categories, Purpose and goals, Data hiding, Encryption, Steganography, Other forms of data hiding, Artifact wiping, Disk cleaning utilities, File wiping utilities, Disk degaussing/ destruction techniques, Trail obfuscation, Attacks against computer forensics Physical, Effectiveness of anti-forensics.

Recommended Reading:

1. Walrand.J. Varaiya, High Performance Communication Network, Morgan Kauffman - Harcourt Asia Pvt Ltd, 2nd Edition, 2000.
2. William Stallings, ISDN & Broadband ISDN with frame Relay & ATM, PHI 4th Edtion 2000.
3. Uyless Black, Emerging Communications Technologies2/e Prentice Hall 1997.
4. Bates & Donald W.Gregory, Voice & Data Communications Handbook, Mc-Graw Hill, Edition, 3rd edition 2000.
5. Behrouz A Forouzan and Firouz Mosharraf, Computer Network (A Top-Down Approach), TMH.
6. Andrew S. Tanenbaum, Computer Network, 4th Edition, Pearson Prentice Hall.
7. Optical Networking Best Practices Handbook by John R. Vacca.
8. R.C.Gonsales R.E.Woods, “Digital Image Processing”, Second Edition, Pearson Education.
9. Anil K. Jain, “Fundamentals of Image Processing”, PHI William Pratt, “Digital Image Processing”, John Wiley.
10. R.O.Duda, P.E.Hart and D.G.Stork, “Pattern Classification 2nd Edition”, John Wiley, 2007.
11. Milan Sonka,Vaclav Hlavac, Roger Boyle, “Image Processing, Analysis, and Machine Vision” Thomson Learning.
12. B. Chanda, D. Dutta Majumder, “Digital Image Processing and Analysis”, PHI.
13. E. Gose, R. Johansonbargh, “Pattern Recognition and Image Analysis”, PHI.
14. Harvey M. Deitel, “Operating Systems”, Second Edition, Pearson Education Pvt. Ltd, 2002.
15. Andrew S. Tanenbaum, “Modern Operating Systems”, Prentice Hall of India Pvt. Ltd, 2003.
16. William Stallings, “Operating System”, Prentice Hall of India, 4th Edition, 2003.

17. Pramod Chandra P. Bhatt – “An Introduction to Operating Systems, Concepts and Practice”, PHI, 2003.
18. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, “Operating System Concepts”, Sixth Edition, John Wiley & Sons (ASIA) Pvt. Ltd, 2003.
19. Web security and commerce by simson garfinkel.
20. Foundations of security by neil daswani, anita kesavan.
21. Hacking Exposed Web Applications, Second Edition by Joel Scambray, Mike Shema, Caleb Sima Professional Pen Testing for Web Applications by Andres Andreu.
22. Preventing Web Attacks with Apache by Ryan C. Barnett.

22-358-0315 QUESTIONED DOCUMENTS & FORENSIC ACCOUNTING

COs	Course Outcome Statements	Cognitive Level
CO1	Identify forgeries in questioned documents	Apply
CO2	Detect forgery and Identification of writer	Analyze
CO3	Examine ink and paper	Analyze
CO4	Utilize forensic linguistics in speaker identification	Apply
CO5	Explore the concepts of forensic accounting and related crimes	Understand

Module I:

- Basics of handwriting identification and individuality of handwriting.
- Natural variations, process of comparison.
- Types of documents- genuine and forged documents, holographic documents, care and handling of document exhibits.
- Forgeries and its types, detection of forgeries in handwriting, signatures and related case studies.
- Basic tools needed for forensic documents examination and their significance.

Module II:

- Disguised writing and anonymous letters- Identification of writer.
- Examination of alterations- erased writing, overwriting, 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.

Module III:

- Examination of Photostat (Xerox) copies, carbon copies, fax message, typewriting, printed matter: letterpress printing, intaglio printing, offset printing, screen printing and its related concepts.
- Ink and paper examination : History and development of writing inks; types and manufacturing of inks; printing inks; forensic examination of inks – physical examination, chemical examination, TLC, spectrophotometry; dating of inks
- Historical development of papers; types of paper and the manufacturing process; forensic examination of paper – physical characteristics, identification of paper additives, trace elemental analysis, watermark examination

- 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.

Module IV:

- Determination of age of document and writings.
- 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.

Module V:

- Introduction to Forensic accounting, Money laundering, Fraud deterrence.
- Types of money laundering.
- Understanding business information and financial reporting system.
- Accounting and auditing standards and procedures.
- Evidence gathering and investigative techniques, litigation processes, examination of financial documents.

Recommended reading:

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
5. Bates Springfield, Illinois, USA (1971).
6. Wilson R. Harrison; Suspect Documents Their Scientific Examination, Universal Law Pub. Delhi Indian Reprint (2001).
7. Hard less H.R; Disputed Documents, Handwriting and Thumbs – Print Identification, profusely illustrated, Law Book, Allahabad (1988).
8. Morris Ron N; Forensic Handwriting Identification, Academic Press, London (2001).
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).

22-358-0304 Practical on 22-358-0301 & 22-358-0302 & 22-358-0303

COs	Course Outcome Statements	Cognitive Level
CO1	Identify different types of crime scenes	Apply
CO2	Collect, preserve, and store evidence from crime scenes	Apply
CO3	Reconstruct crime scenes using blood spatter analysis	Apply
CO4	Examine different types of physical evidence	Analyze
CO5	Examine evidence from shooting crime scene	Analyze

1. To study different types of simulated crime scenes.
2. To study different types of evidences found on crime scene
3. To study documentation of crime scene (Notes taking, sketching, and photography)
4. To study collection, preservation, and storage of evidence
5. To perform crime scene reconstruction using blood spatter analysis.
6. To study reconstruction report.
7. Application of Forensic Stylistics in personal identification.

Forensic Physics

8. Collection, Packing and Forwarding of Physical evidence/ Trace evidence/ Sources of Digital evidence.
9. Physical matching of Cloth piece and/or rope piece and /or garments.
10. Examination of Soil evidence.
11. Restoration techniques of tool mark impressions.

12. Forensic examination of glass evidence.

13. Restoration of erased identification marks.

14. Physical examination of paint samples by microscopic method

15. Comparison of tool marks.

Forensic Ballistics: (Prototype of the firearms and ammunitions may be used for conducting practical)

16. Characteristics of Firearms- Caliber, Choke, Trigger pull, and Proof marks (Demo only).

17. Examination and comparison of fired bullet with reference to caliber, rifling characteristics, and identification of firearm (Demo only).

18. Examination and comparison of fired cartridge case with reference to caliber, firing pin, breech face, chamber indentations, extraction, and ejector marks by comparison microscope (Demo only).

19. Determination of shot numbers from size and weight of shots.

Digital and Cyber Forensics

20. Identification of storage media and its authentication.

21. Collection of digital evidence using different softwares.

22. Recovering the deleted files and folders.

23. Malware analysis.

24. Imaging the Seized storage media with different imaging format.

25. Analyzing the image file for hidden files and folders including slack space.

26. Collecting Registry, Event logs and Executable files details using Forensic Tools.

27. Capture and Analysis the TCP packet from the LAN.

28. Analysis the browser detail of Internet Explorer and Header details of email.

22-358-0316 Practical on 22-358-0311

COs	Course Outcome Statements	Cognitive Level
CO1	Examine stains for the presence of body fluids	Analyze
CO2	Perform ABO grouping from hair root	Analyze
CO3	Identify the species of origin	Analyze
CO4	Extraction and isolation of DNA from various substrates	Analyze
CO5	Perform PCR from the extracted DNA	Apply

1. Confirmatory tests of blood, semen, saliva, vomit, etc.
2. Identification of species (precipitin test)
3. Blood grouping.
4. ABO grouping from hair root
5. Rh grouping of bloodstains
6. MN grouping of blood stains.
7. Experiments on electrophoresis of red cell isozymes viz. PGM, GLO, EsD, EAP, ADA, AK.
8. Experiments on electrophoresis of serum proteins Hp, Tf, C3, Bf, Gc etc.
9. Experiments on separation of SAP/VAP.
10. DNA – isolation from blood and bloodstains.
11. DNA – Isolation from bones.
12. DNA – Isolation from teeth.
13. DNA – Isolation from organs/tissues.
14. DNA – Isolation from saliva stains.
15. DNA – Isolation from hair root.
16. DNA – Isolation from other seminal stains
17. DNA – Isolation from nails.
18. DNA – Isolation from vegetable material.
19. Quantity and quality assessment of DNA extracted by various methods from different biological samples.
20. PCR – amplifications and STR typing through vertical polyacrylamide gel electrophoresis and silver staining.
21. PCR – amplifications and STR typing with automatic DNA sequencer.

22-358-0317 Practical on 22-358-0312

COs	Course Outcome Statements	Cognitive Level
CO1	Identify metallic and non-metallic poisons in the samples	Analyze
CO2	Employ visual examination, color test and TLC to identify plant poisons	Apply
CO3	Analyze viscera for organic and inorganic poisons	Analyze
CO4	Determine alcohol in blood and urine	Analyze
CO5	Determine volatile poisons	Analyze

1. Determination of Mercury in biological materials by spectrophotometry.
2. Analysis of animal Poisons using TLC.
3. Analysis of Plant poisons using TLC.
4. To study the separation of metal ions by paper chromatography.
5. Determination of alcohol in blood and urine sample.
6. Analysis of food material in case of food poisoning by chemical, microscopic and instrumental techniques.
7. Analysis of viscera in case of food poisoning by chemical, microscopic and instrumental techniques.
8. Comparison of polythene films by IR spectrophotometry.
9. Analysis of viscera for volatile Organic and inorganic poisons.
10. Analysis of non- metallic (anionic) poisons in viscera.
11. Analysis of viscera for organochloro, organophosphoro, carbamates and pyrethroids by colour test TLC/HPTLC and UV-visible spectrometry method.
12. Determination of poisonous metals in biological materials by AAS.
13. Analysis of Na and K contents in soil sample by Flame Photometry.

22-358-0318 Practical on 22-358-0313

COs	Course Outcome Statements	Cognitive Level
CO1	Identify components of firearms	Apply
CO2	Identify the class and individual charateristics of firearms	Apply
CO3	Identify the class and individual characteristics of ammunition	Apply
CO4	Compare and match the questioned and test bullets, cartridge cases, and other components	Analyze
CO5	Reconstruct shooting crime scene	Analyze

1. To separate different components of shotgun cartridges, identify them and record their different measurements.
2. To separate different components of all-metal cartridges, identify them and record their different measurements.
3. To dismantle and assemble various components of firearms.
4. To study the characteristics of firearms-caliber, choke, proof marks etc., to prepare sulphur casts of bore.
5. To study the locks of various firearms, measurement of trigger pull, liability of accidental discharge of firearms.
6. To determine shot number from size and weight of shots
7. Determination of velocity and energy of bullets.
8. To determine whether given ammunition/ components of ammunition are fired or not.
9. TLC/ HPTLC/HPLC/GC of propellants loaded in shotgun, rifle and handgun cartridges.
10. IR spectra of propellants loaded in shotgun, rifle and handgun cartridges
11. FTIR analysis of propellants particles found inside the fired cartridge case, barrel and on the target around the gun-shot hole- comparison of results.
12. Preparation of gel block and study of wound ballistic parameters for bullets fired from handguns and .22-rifle – determination of entry, exit and path of the bullet on fired gel block.

22-358-0319 Practical on 22-358-0314

COs	Course Outcome Statements	Cognitive Level
CO1	Utilize slack space for analysis of hidden files and folders	Analyze
CO2	Examine wireless network attacks and bluetooth attacks	Analyze
CO3	Utilize firewall auditing	Analyze
CO4	Examine trojans, and other types of malware	Apply
CO5	Configure S/MIME for e-mail communication	Apply

1. Encrypting and Decrypting the partition using Bitlocker
2. Analysing the image file for hidden files and folders including slack space.
3. Wireless Network attacks, Bluetooth attacks
4. Drive and partition carving process
5. Malware – Keylogger, Trojans, Keylogger countermeasures
6. Understanding Data Packet Sniffers
7. Understanding the buffer overflow and format string attacks
8. Using NMAP for ports monitoring
9. Working with Trojans, Backdoors and sniffer for monitoring network communication
10. Implementing Web Data Extractor and Web site watcher.
11. Using IP TABLES on Linux and setting the filtering rules
12. Configuring S/MIME for e-mail communication
13. Lan Scanner using look@LAN, wireshark.
14. Advance firewall auditing
15. Auditing with and without network traffic
16. Auditing Authentication, Authorization, accounting and logging configuration
17. Intrusion detection and prevention configuration
18. Implementing Web Data Extractor and Web site watcher.
19. Using IP TABLES on Linux and setting the filtering rules
20. Configuring S/MIME for e-mail communication

22-358-0320 Practical on 22-358-0315

COs	Course Outcome Statements	Cognitive Level
CO1	Utilize stereomicroscope and VSC	Apply
CO2	Examine the alterations in a questioned document	Analyze
CO3	Decipher secret writings	Analyze
CO4	Examine Ink and Paper samples	Analyze
CO5	Study the effect of writing instrument, posture, and emotions on handwriting	Apply

1. Working and handling of Stereo Zoom Microscopes, Video Spectral Comparator,
2. Electrostatic Detection Apparatus (Demo only).
3. Forensic identification of class and individual characteristics of handwriting.
4. To detect and decipher alterations in a document.
5. To decipher secret writings, indentations and charred documents.
6. Determination of relative age of the document.
7. To study the handwriting of ethnic and population groups.
8. Reconstruction of torn sheets of paper.
9. Examination of creases and folds and determination of sequence of strokes.
10. Examination of paper.
11. Analysis of inks by TLC.
12. Identification of normal/ disguised writings.
13. Detection of built-up documents.
14. Examination of anonymous letters.
15. Application of Forensic stylistics in personal identification.
16. Effect of writing instruments, posture and emotions on handwriting.

FOURTH SEMESTER

22-358-0401 COMPULSORY PROJECT/ DISSERTATION

Cos	Course Outcome Statements	Cognitive level
CO1	Use the concepts of research methodology to develop a research proposal	Apply
CO2	To do significant research work towards solving the research problem	Apply
CO3	To submit the thesis of project/dissertation and communicate the research as an article in a reputed SCI approved journals	Apply

- A part of the project/ dissertation shall be done in collaboration (association) with CFSL/FSL/RFSL/FPB/Chemical Examiner's Laboratory/ Kerala Police Academy/ Any other State or Central Institutions of Forensic importance.

22-358-0411 FORENSIC ANTHROPOLOGY, ENTOMOLOGY AND ODONTOLOGY

COs	Course Outcome Statements	Cognitive level
CO1	Study the basic concepts of Anthropology	Understand
CO2	Understand the concepts of bio-archeology	Understand
CO3	Personal identification of living and dead using the concepts of anthropology	Apply
CO4	• Study the methods forensic entomology • Apply the above learned concepts to determine PMI	Understand Apply
CO5	• Introduction into the basics of forensic odontology and also role played in personal identification • Identification of victims in mass disasters or mass graves using forensic odontology.	Understand Apply

Module I: Forensic Anthropology

Theories for Anthropology: The scope of anthropology (Paleoanthropology, skeletal biology and human osteology, Paleopathology and Bio-archeology, Forensic Anthropology), Fossil formation, taphonomy, Relative dating techniques, Chronometric dating techniques;, Bio-cultural and evolutionary approaches to disease, Birth, growth and aging, infectious disease and bio-cultural evolution. Role of anthropology in mass disaster, Physical Anthropology and its forensic aspects.

Module II: Bio-archaeology

Field recovery methods, Laboratory processing, curation and chain of custody, Age at death, sex, ancestry, height and weight, pre-mortem injury and disease, taphonomy, peri-mortem trauma, postmortem trauma, DNA Kinship and identity, Identification and forensic Anthropology: Time since death, ante-mortem records and positive ids, facial reconstruction.

Module III: Personal Identification of Living & Dead

Identification through somatometric and somatoscopic observation, nails, occupation marks, scars, tattoo marks and deformities; handwriting and mannerisms. Genetic traits of forensic significance: ear lobe, brachydactyly, polydachtyly, widow‟s peak, eye and hair-color, face

form, frontal eminences, nasal profile, nasal tip, lips, chin form. Skeletal age (Earlier years)**:** Prenatal ossification. Postnatal appearance and union of centers of ossification, Differences due to race, Skeleton age (Later years): Cranial suture closure, pubic symphysis, Sexing skeletal Remains: General consideration and age factors. Sex differences in skull, Pelvis and long bones. Calculation of stature of long bones: Studies on stature reconstruction in various population groups. Use of fragmentary long bones in stature reconstruction. Racial differences in human skeleton; distinguishing humans from other non- human skeletal remains; Forensic odontology, DNA isolation from bones and teeth. Age estimation. Facial Reconstruction 2-D, 3-D, etc.

Module IV: Forensic Entomology

Taxonomy and Biology of forensically important insects**:** Coleoptera – General characters, taxonomy and biology of Silphidae (carrion beetles), Staphylinidae (rove beetles), Histeridae (clown beetles), Dermestidae (hide & skin beetles), Cleridae (checkered beetles), Carabidae (Ground beetles). Diptera - General characters, taxonomy and biology of Calliphoridae, Sarcophagidae, Phoridae, Muscidae, Fannidae. Insects of forensic importance, collection of entomological evidence during legal investigations; collection of: meteorological data, specimens before body removal, ground-crawling arthropods on and around the body, entomological samples from the body, entomological samples during autopsy, specimens from buried remains, from enclosed structures & aquatic habitats. Laboratory rearing of insects of forensic significance: Larval rearing, rearing containers, monitoring growth, larval dispersal in laboratory, adult emergence, rearing aquatic insects, unique host preference, rearing beetles in the laboratory, factors that influence insect succession on carrion: Attraction to the remains, geographical differences in succession, effects of season, humidity, effects of sunlight exposure, urban versus rural scenarios, bodies found inside buildings, effects of burial, bodies in water, bodies in vehicles, bodies in enclosed spaces, hanged bodies, burnt remains, wrapped remains, Role of aquatic insects in forensic investigations, estimating the postmortem interval, soil environment and forensic entomology, entomo-toxicology, chemo-ecology, molecular methods for forensic entomology.

Module V: Forensic Odontology

Definition and Scope of Forensic Odontology, Types of dentition, Basic structure of human teeth, types of teeth & their morphology, and determination of age from teeth using various methods, dental anomalies and their role in Personal Identification. Bite marks: Types & forensic importance. Collection and preservation of samples, analysis of Bite marks, presentation of bite mark evidences in court of law. Role of Forensic Odontology in mass disaster victim identification. Dental Charting. Comparison of Ante-mortem and post-mortem dental records.

Recommended Reading:

1. Application areas of anthropology, Anil Mahajan & Surinder Nath Reliance Publishing house,
2. Dental Anthropology, V.Rami Reddy Inter-India Publication,
3. A manual of biological Anthropology, Indra P. Singh & M.K. Bhasin Kamla Raj Enterprises,
4. Anthropology, Fred Plog, Clifford J. Jolly & Danial G. Bates Alfred A. KNOPF NewYork,
5. Anthropology, Kroeber Oxford & IBH Publishing Co.,
6. The use of Forensic Anthropology, Robert Pickering & David Bachman CRC Press,
7. Physical Anthropology, B.R.K. Shukla & Sudha Rastogi Palaka Prakashan,
8. The Forensic Anthropology Laboratory, Michael W. Warren, Heather A.Haney& Laurel E. Freas; CRC Press,(2008)
9. Forensic recovery of human remains: Dopras, Schultz, Whirler, Williams
10. Advances in Forensic Taphonomy, Method theory and Archaeological perspective.
11. Forensic Dental evidence, Mike Bowers, Elsevier Publ
12. Practical forensic odontology, DH Clark, Butterworth-Heinemman Publis
13. Forensic odontolgy, G Gustafson, 1st Ed, Elsevier, 1966
14. Forensic Radiology, B.G. Brogdon, 1st Ed, CRP Press, 1998
15. Bite Mark Evidence, Robert BJ Dorian, 1st Ed, CRP Press, 2004
16. Dental Autopsy, William E Silver, Richard R Souviron, 1st Ed, CRP Press, 2009
17. Forensic Dentistry, Senn DR and PG Simson, 2nd Ed, CRP Press, 2010.
18. Forensic Entomology: Jason H Byrd & James L Castner
19. Insect Biology : Hovard Evan
20. Fundamentals of Entomology, Richard J. Flzinga Prentice hall of India pvt ltd, (1978)

22-358-0412 FORENSIC- BOTANY, WILDLIFE AND MICROBIAL FORENSICS

COs	Course Outcome Statements	Cognitive level
CO1	Examine botanical evidence	Analyze
CO2	Analyze the plant and animal-based foods	Apply
CO3	Identify species of flora and fauna from the examination of wildlife evidence	Analyze
CO4	Study the concepts of environmental forensics	Understand
CO5	Examine different microbes of forensic importance	Analyze

Module I: Forensic Botany

Introduction, types, location, collection, evaluation and forensic significance of fungi and plants in forensic science, wood and pollen grains, Identification of starch grains, powder and stains of spices etc.; Paper and Paper Pulp identification, Microscopic and biochemical examination of pulp material. Study of Various types of Poisonous Plants. Identification of wood-physical properties, colour, fluorescence, hardness, weight, odour, lustre, texture, anatomical features, pore/vessel distribution, size and arrangement, pore numbers, pore arrangements, inclusions, colored deposits, etc.

Module II: Other Biological Evidences

Identification of Foodstuffs & their stains: Plants used as food, animals used as food. Examination of plant foods (starch, herbs, spices & flavorings, fruits, vegetables). Examination of animal foods(meat & fish) – microscopic and macroscopic examination, chemical examination, muscles, skin, hairs, scales, bones & cartilage. Histopathological examination of tissues. Examination of faecal matter & faecal stains-Physical appearance, microscopic examination, urobilinogen test. Examination of stomach contents- microscopic examination.

Module III: Wildlife Forensic

Protected and endangered species of animals and plants; Sanctuaries and their importance; Relevant provision of wild life and environmental act; Types of wildlife crimes, different methods of killing and poaching of wildlife animals; Enforcement of wildlife protection policy, Wild animals as pharmacopeias, Wildlife artifacts (Bones, skin, fur, hair, nails, blood, feather, etc.), Trade in wild animals, elephant, Indian rhino, wild cat, poisonous snakes for venom and skin, crocodiles, salamanders, deer, birds (feathers Macau parakeets), whales, sharks, spectacle bear, Himalayan antelopes. Recovering evidence at poaching scenes,

Locating the burial: Anomalies on the surface international trade in reptile skins, Challenges to species identification of reptile skin products, species and products represented in the reptile skin trade, reptile scale morphology basics and current limitations, Identifying features of major reptile groups. Wildlife (Protection) Act-1972).

Module IV: Environmental Forensics

Introduction to Environmental Forensics. Mercury- Natural and anthropogenic sources, detecting mercury in indoor environment and forensic aspects. Asbestos-sources and detection in air, water, fibres etc. Sewage, Lead- sources, compounds, analytical methods and lead forensics. Arsenic-sources, compounds, analytical methods and forensic aspects. Pesticides-Types, analytical testing and forensic techniques. Polycyclic aromatic hydrocarbons (PAHS)-sources, types and analytical techniques. Crude oil and refined products- oil analysis methods, oil spill analysis protocol. Environmental Legislation: central and state boards for the prevention and control of environmental pollution, powers and functions of pollution control boards, penalties and procedure, duties and responsibilities of citizens for environmental protection. The Water (Prevention and Control of Pollution) Act 1974. Prevention and Control of Air Pollution Act 1981, Forest Conservation Act 1981, Environment (protection) Act 1986, Hazardous waste (Management and Handling) Rules, 1989, Bio-Medical Waste (Management and Handling) Rules, 1998. Issues involved in enforcement of environmental legislation, public awareness, and public interest litigations (PILs) and its role in control of environmental pollution in India.

Module V: Microbial Forensics

Defining the microbial forensics program, epidemiology, Microbial forensic tools.

Dynamics of disease transmission, Outbreak Investigation. Deliberate introduction of a biological agent, emerging microbial forensic techniques.

Microbes of Forensic Importance: *Bacillus anthracis, Yersinia pestis, Francisella tularensis, Brucella spp., Burkholderia Pseudomallei, Clostridium botulinum, Listeria monocytogenes* and their morphological & biochemical studies.DNA of microbes in soil for crime detection.

Fungi of forensic importance: Opportunistic mycoses, *Chytridiomycota zygomycota*, *Aspergillus fumigates*, *Microsporidum*, *Pneumocytosis jiroveci*, *Asp.flavus* & *Candida* sp, epidemiology, Antifungal agents.

Biological agents in warfare: Collection, transportation and preservation of microbial forensic samples, Categories of biological weapons, recent studies

Biosafety and biosecurity, Bio surveillance, documentation, and case studies,

Recommended Reading:

1. Concept in wildlife Management, Hosetti, B.B Daya publishing 103House
2. Forensic science in wild life investigation, Linarce, Adrian CRC Press, Taylor & Francis
3. The wild life (protection) act, Baalu, T.R.1972, Nataraj Publication.
4. Wild life (Protection act, 1972), Universal Publication
5. Wildlife protection act, 1972; Natraj Publishers
6. Timber Identification, N. Clifford; Leonard Hill ltd.,
7. A manual of wood identification, Herbert L. Edlin Viking Press,
8. Man-made fibres, R.W. Moncrieff Newness butter worth
9. Identification of vegetable fibres,. Dorothy catling & John Grayson Chapman & hall ltd
10. Pollen morphology & Plant taxonomy: angiosperms (an introduction to palynology), Erdtman, G Hafner Publishing Co.,
11. Forensic botany, Coyle, Heather Miller CRC Press,
12. College botany, Gangulee, Hirendra Chandra New Central Book Agency,
13. Plant anatomy, Esau, Katherine Wiley Eastern Ltd,
14. Plant anatomy, Chandurkar, P J Oxford & IBH Publishing Co,
15. Systematic botany for degree students, Singh, Jagjit S Chand & Co.,
16. The poisonous plants, H.C. Long Asiatic Publishing House,
17. Plant Anatomy, B.P. Pandey S. Chand& Co., New Delhi, (1998)
18. Environmental Law- The Law & policy relating to protection of environment, Ball Simon Universal Law Pub Co, Delhi,
19. Environmental Forensic Principles and Applications, Morrison Robert D, CRC Press,
20. Microbial Forensics : Roger G Breeze, Bruce Budowle, Steven E Schutzer
21. Microbial Forensics : Bruce Budowle, Steven E Schutzer, Roger G Breeze, Paul S Keim, Stephen A Morse
22. Chemical and Physical Signatures for Microbial Forensics: Cliff, J.B, Kreuzer, H.W, Ehrhardt C.J, Wunschel,D.S.

22-358-0413 EXPLOSIVES AND EXPLOSION

COs	Course Outcome Statements	Cognitive Level
CO1	Identify different types of explosives	Apply
CO2	Recreate the effects of blast wave on various structures	Apply
CO3	To study the synthesis of different types of explosives.	Understand
CO4	Investigate the blast crime scene	Analyze
CO5	Examine fire debris to identify ignitable liquids	Analyze

Module I: Introduction to Explosives

Chemistry of explosives, Temperature of chemical explosion, Force and pressure of explosion, Kinetics of explosive reactions. Types of explosives (primary & secondary explosives) Differentiation between High and Low Explosives. General methods of manufacture of explosives.

Module II: Type of Explosions

Types of Explosions: Atomic explosion, Physical explosion, Chemical explosion, Explosion and effects, Type of hazards, Effect of blast wave on structures and human etc.

Module III: Development of explosives

Black powder, Nitro Cellulose, Nitroglycerin, Dynamite, Ammonium nitrate, Commercial explosives (permitted explosives, ANFO and slurry explosives), Military explosives (picric acid, tetry TNT, Nitro guanidine, PETN, RDX, HMX and polymer bonded explosives), IEDs.

Module IV: Post Blast Investigation

Bombs, Crude bombs, Home-made bombs, Improvised Explosive Devices (IEDs), Molotov Cocktail, Disposal of bombs, Explosions effects, Role of Forensic Scientist in Post blast investigation, Collection of samples, Colour tests, Methods for extraction of explosive from post blast material/ debris, Qualitative analysis of explosives and explosion residue by colour test, TLC/HPTLC and High Performance Liquid Chromatography and FTIR, GC-mass. X ray diffraction, ICP for metallic component analysis, equipment used for Detection of explosives and explosive devices. Technical report framework, Evaluation and assessment of explosion site and reconstruction of sequence of events.

Recommended Reading:

1. Akhavan Jacqueline : Chemistry of Explosive, The Royal Society of Chemistry (2004)

2. Saferstein R : Criminalistics : An Introduction to forensic Science
3. Asthana N.C and Nirmal Anjali; The Ultimate Book Of Explosives, Bombs and I E Ds , Pointer Publishers (2008). 4. Suceska, T; Test Methods for Explosives, Springer (1995).
4. Working Procedure Manual on Explosives, Directorate of Forensic Science MHA Govt. of India (2005)
5. Cooper PW and Kurowski S R; Introduction to the Technology of Explosive VCH publisher
6. Cooper P. W; Explosive Engineering, VCH publisher (1997).
7. Urbanski T; Chemistry and Technology of Explosives, Pergamon Press (1985).
8. Lurie Iras & Witwer J D ; High Performance Liquid Chromatography in Forensic Chemistry, Marcel Dekker (1983)
9. Feigl F; Spot Test in Inorganic Analysis, Elsevier Publ. New Delhi (2005)
10. Feigl, F; Spot Test in Organic Analysis, Elsevier Publ. New Delhi (2005)
11. Yallop H J; Explosion Investigation, Forensic Science Society Academy press (1980)

22-358-0414 PHARMACOLOGY AND FORENSIC ANALYSIS OF DRUGS

COs	Course Outcome Statements	Cognitive Level
CO1	Determine the fate of drugs in human body	Apply
CO2	Examine narcotic drugs and psychotropic substances under NDPS Act.	Analyze
CO3	Examine the presence and absence of adulterants.	Analyze
CO4	Interpret the results of examination of drugs	Analyze
CO5	Write reports and testify in court of law	Apply

Module I: Drugs, Other Chemicals

Introduction, Pharma drugs (barbiturates, benzodiazepine & other pharma drugs), Substance abuse, Drug abuse in sports & Date rape drugs: Introduction, common prohibited substances, analytical approach, Forensic Pharmacological studies, Ingestion of drugs, absorption, distribution, metabolism, pathways of drug metabolism, drug metabolism and drug toxicity, excretion of drugs, detection of drugs on the basis of their Metabolic studies. Solvent Abuse (chlorinated hydrocarbons, Aromatic hydrocarbons, alcohols, glycols, fuel and fuel additives): absorption, distribution, and metabolism, psychological & clinical effects. Analysis: collection of sample, distillation & extraction, Analysis by GC, HPLC. Legal Aspect:- Case Studies and Relevant Provisions of – The Drugs Control Act, 1940. The Drugs and Cosmetics Act, 1940. etc.

Module II: Drugs commonly encountered for analysis

Narcotic drugs, depressants, stimulants, hallucinogens, designer drugs, club drugs, drugs of sports and precursors. Field test, colour test, micro crystal test, thin layer chromatography. Performance Enhancing Drugs in sports.

Module III: Analysis of Narcotic & Psychotropic drugs

Opium (alkaloids, morphine, heroin and opioids), Cannabis and its derivatives (Bhang, ganja, hashish (Charas) and Cocaine, Depressants: Barbiturates, methaqulone, benzodiazepines Stimulants: Methaquinolines, amphetamines and related derivatives, Hallucinogens: LSD, Mushroom and Cactile, etc.

Module IV: Adulterants and other chemicals

Detection of common adulterants and determination of percentage purity in seized samples, detection identification, quantization of drugs in pharmaceutical products. Analysis of illicit drugs and search of clandestine laboratory, precursors and their analysis. Estimation of

morphine in opium and heroin in smack. Analysis of drugs in biological samples and their importance: Hair, urine, blood, viscera, methods of extraction of drugs/consultation of drugs. Limitation of chemical analysis of drugs. Report writing and interpretation of drugs. Court testimony in NDPS Act cases. Case studies and ground for acquittal and grant of bail.

Suggested Reading:

1. Turner : Drugs & Poisons.
2. Samford : Poisons Their Isolation Identification.
3. Dubois and Celling: Textbook of Toxicology.
4. R. C. Froede: The Laboratory Management of the Medico-Legal, Specimen Analytical Chemical Laboratory Sciences.
5. Gurudip R. Chatwal, Sham K. Anand: Instrumental Methods of Chemical Analysis, First Edition Reprint 2010, Himalaya Publication.
6. Skoog, Holler, Crouch: Instrumental Analysis, India Edition, 2009.
7. Willard, Merritt, Dean, Settle: Instrumental Method of Analysis, Seventh Edition.
8. M. N. Gleason and et. Al.: Clinical Toxicology of Commercial products.
9. D. K. Molina: Handbook of Forensic Toxicology for Medical Examiners, CRC Press, 2009.
10. T. Altug: Introduction of Toxicology and Food, CRC Press, 2012.
11. Clarke‟s Analytical Forensic Toxocology by A. Negrusz and G. Cooper, 2nd Ed., Pharmaceutical Press, 2013.
12. Spot test in Organic Chemistry by Feigl.
13. M D Cole: The Analysis Of Drugs Of Abuse: An Instruct ion Manual
14. Curry A.S: Analytical Methods in Human Toxicology, Part II, CRC Press Ohio (1986).
15. E. Stahl: Thin Layer Chromatography: A Laboratory Handbook.
16. Clerk‟s Analysis of Drugs & Poisons VOL.-I & II by Clerke

22-358-0415 FORENSIC AUDIO VIDEO ANALYSIS

COs	Course Outcome Statements	Cognitive Level
CO1	Understanding the concepts and mechanism of speech production	
CO2	Identify the speaker using various	
CO3	Examine audio evidences	Analyze
CO4	Examine video evidences	Analyze
CO5	Explore biometric systems	Apply

Module I: Mechanism of speech Production

Speech Anatomy, Mechanism of speech Production, Acoustic Properties of Vocal Tract, Uniqueness in person‟s voice, interspeaker and intraspeaker variation. Articulation- Manner & Place of Articulation, Phonemes, Vowel, Consonant and Glides, Phonetics in Speaker Identification, IPA (The International Phonetic Alphabets), Forensic Phonetics, Effect of context, Supra segmental (Prosodic features). Audio-enhancement, Sound Recording/Playback Devices: Analog Tape recorders, Digital recorder, Microphone types, Digital audio formats. Apex Court Judgments on Speaker Identification. Court presentation of report based on speaker Identification.

Module II: Digital Signal Processing

Digital Signal Processing, A to D Conversion- Sampling, Quantization, Digital Audio Formats, Pulse Code Modulation, Coding and Decoding, Computer Representation of Speech Speaker Recognition: Principles of speaker recognition/identification, Methods on Speaker Recognition. Various approaches in Forensic Speaker Identification, Interpretation of result, Statistical interpretation of probability scale, Objective/Subjective methods, discriminating tests, closed test, open test, likelihood ratio calculation, Concept of test and error in Speaker Identification. Introduction to Pattern Recognition, Pattern Recognition application in Automatic Speaker Identification and Verification System, Different algorithm of automatic speaker identification.

Module III: Audio Evidence Examination

Audio Evidence Examination: Handling of audio recording evidences, Procedure for preparation of working copies, Phonetic transcription, Analysis of linguistic & phonetic characteristics, Temporal measurement, Text-dependent and text-independent speaker recognition. Instrumental Analysis of speech sample: Verbatim, Clue words, IPA marking, CSL & Linear predictive coding technique, Fourier transformation, Examination using SPID, Vocal behaviours-alcohol speech relationships. Authentication of recorded audio: Type of alterations, Auditory Examination by Critical Listening. Waveform analysis, Speech Spectrographic

analysis, Magnetic developing, Optical Method.

Module IV: Introduction to video technology

Video standards, Recording formats- Analog and Digital, Introduction to video devices, Linear and Non-linear editing, Concept of video film production, Graphics and animation technique. Image perception, Colour space & representation, Storage, Image processing application. Introduction to image enhancement, Image restoration, Concept of digital water marking, Image compression, Retrieval of video files, Integrity of images, Facial image recognition. Forensic analysis of audio/video in video recording: Authentication of video recording, Visual examination technique on video frame sequence, Video image analysis- object, costumes, Facial image recognition from video frame image, Video signal analysis.

Module V: Biometrics

Biometric evidences such as finger impressions, retina, iris pattern, voice, gait pattern, face recognition, 3D face recognition, Geometric Morphometrics, automatic forensic dental identification, hand vascular pattern technology, Multibiometric systems, Recent developments, biometric databases.

Recommended Reading:

1. Arthur R Weeks Jr; Fundamentals of Electronic Image. SPIE Press, (2003)
2. Bengold & Nelson Moryson; Speech and Audio signal processing, John Wiley & Sons, USA (1999)
3. D.B. Fry; The Physics of Speech, Cambridge University Press. (2004)
4. David Cheshire; The Complete Book of Video Techniques Subjects Equipment, Dorling Kindersley, London (1992)
5. Des Lyver & Graham Swainson; Basics of Video Production, 2nd Ed. Focal Press (1999)
6. Dwight Bolinger et. al.; Aspects of Language, Third Edition, Harcourt Brace Jovanovich College Publishers, USA. (1981)
7. Gloria J. Borden et. al. Speech Science Primer (Physiology, Acoustics and perception of Speech), 6th Ed, a Wolters Kluwer Company, USA. (2011)
8. Harry Hollien; Forensic Voice Identification, Academic Press, London. (2001)
9. Harry Hollien; The Acoustics of Crime- The New Science of Forensic Phonetics, Plenum Press, New York and London (1990)
10. Husrev Taha Sencar, Nasir Memon; Digital Image Forensics: There is More to a Picture

than Meets the Eye. Springer (2013)

11. John C. Russ; Forensic Uses of Digital Imaging CRC Press, (2001)

12. Martin Uren; BKSTS Illustrated Dictionary of Moving Image Technology, 4th Ed, CRC Press, (2013)

13. Oscar Tosi; Voice Identification-Theory of Legal Applications, University Park Press, Baltimore (1979)

14. O'Shaughnessy, Douglas; Speech Communication, Hyderabad Universities Press (India) Pvt. Ltd. (2001)

15. Patricia Ashby; Speech Sounds, 2nd Ed. Routledge, London and New York (2005)

16. Philip Rose; Forensic Speaker Identification, Taylor and Francis, Forensic Science Series, London (2002)

17. Randy Crane; A Simplified Approach to Image Processing, Prentice Hall. (1996).

18. Simon J. Godsill; Digital Audio Restoration, Springer, (1998)

19. Gary H. Anderson; Video Editing and Post-Production- A Professional Guide, 4th Ed, Focal Press, (1998).

20. Iannavelli, A.V; Ear Identification, Forensic Identification Series, Paramount, (1989).

21. Jain, A.K., Flynn, P & Ross A.A., Handbook of Biometrics, Springer, New York (2008).

22. Fred L. Bookstein. Morphometric tools for landmark data: Geometry and biology. Cambridge University Press, (1991).

22-358-0416 ADVANCED FORENSIC BALLISTICS

COs	Course Outcome Statements	Cognitive Level
CO1	Examine and identify the fired firearm	Analyze
CO2	Determine time since firing	Apply
CO3	Examine entry and exit wounds	Apply
CO4	Restoration of erased identification numbers	Apply
CO5	Reconstruction of shooting crime scene	Apply

Module I: Identification of fired firearm

Testing of barrel wash, chemical tests for testing of lead/ copper around gun-shot holes in clothes, skin and other objects, use of instrumentation techniques in identification of gun-shot holes. Determination of time elapsed since firing, usefulness, different methods employed and their limitations, attempts based on analysis of residue inside the barrel left after the firing of cartridges loaded with black/smokeless powders, attempts based on analysis of CO, CO2, nitrogen oxides, etc., reasons for not being able to estimate time elapsed since firing. Use of instrumentation techniques for analysis of propellant particles found on hands of shooter, fired cartridge case, barrel and target.

Module II: Restoration of erased numbers

Restoration of erased numbers, methods of marking-cast, punch and engraved, methods used for removal of serial numbers, theory behind number restoration, restorations of marks on cast iron, aluminum, brass, wood, leather etc., chemical methods of restoration (etching), reagents used for various metals, electrolytic methods of restoration-reagents used, ultrasonic cavitation for restoration, magnetic particle method for restoration, other methods of restoration, laser etched serial numbers and bar codes and their restoration, recording of restored marks. Gun- handling tests-Introduction, Ferrozine test. Ballistics Data Measurement System.

Module III: Shooting reconstruction

Reconstruction of sequence of events involved in a shooting case, theory and practice of shooting reconstruction, scientific method of shooting reconstruction, suicide, murder, accident, self-defence, encounter cases. All considerations during direct investigation of shooting incident or without the benefit of original crime scene investigation- the scene of occurrence, photography of crime scene, sketching of crime scene, medico-legal report, basic ballistic facts, laboratory examination reports, firearms and ammunition, clothes of victim etc. On scene evidence-evaluation and documentation, off –scene evaluation and investigation,

limitations of shooting reconstruction, simple mathematics involved in shooting reconstruction. Documentation & evaluation of bullet holes, ricochet marks, pellet patterns, estimation of angle of impact, bullet holes in tires and other plastic materials determination of bullet path-use of lasers, cartridge case ejection pattern. Plotting of gun-shot injuries on body-diagrams, evaluation of gun-shot injuries, to determine wounds of entry/ exit, direction of firing, number of rounds fired etc., reconciliation of bullet holes in clothes with underlying wounds, use of blood spatter in reconstruction. Determination of number of participants/firearms involved, their location, position, orientation at the moment of firing, discussion of some important and complicated cases.

Recommended Reading:

1. Sharma, B.R.; Firearms in Criminal Investigation & Trials, Universal Law Publishing Co Pvt Ltd, New Delhi, 4th Edn,(2011).
2. Mathews, J.H; Firearms Identification, Vol I, II and III, Charles C. Thomas, USA, (1977)
3. Hatcher, Jury and Weller; Firearms Investigation, Identification and Evidence, Stackpole Books, Harrisburg, Pa,(1997)
4. Heard, B.J; Handbook of Firearms and Ballistics, John Wiley, England, (1997)
5. Warlow, T.A.; Firearms, The Law and Forensic Ballistics, Taylor and Francis, London,(1996)
6. Jauhari M; Identification of Firearms, Ammunition, & Firearms Injuries, BPR&D, New Delhi.
7. Burrard; The Identification of Firearms and Forensic Ballistics, Herbert Jenkins, London, (1956)
8. Gunther and Gunther; The Identification of Firearms, New York, (1935)
9. Wilber; Ballistic Science for the Law Enforcement Officer, Charles C. Thomas, USA, (1977)
10. Lucas ; Forensic Chemistry and Scientific Criminal Investigation, London, (1945) 11. Williams, Practical Handgun Ballistics, Charles C. Thomas, USA, (1980)
12. Nonte, Jr, Firearms Encyclopedia, Wolfe Publishing Limited, London, (1973)
13. Davis, J.E, An Introduction to Toolmarks, Firearms & the Striagraph, Charles C. Thomas, USA, (1958)
14. Hueske, Practical Analysis and Reconstruction of Shooting Incidence, CRC Press, NY,(2006)
15. Saferstein, Criminalistics, Prantice Hall, NJ, (1995)

22-358-0417 ETHICAL HACKING AND RECOVERY FORENSIC

COs	Course Outcome Statements	Cognitive Level
CO1	Apply the methods of ethical hacking	Apply
CO2	Understand the methods and prevention of system hacking and prevention surveillance techniques	Understand
CO3	Recover evidence from digital media	Apply
CO4	Utilize methods like Winhex for examination of digital evidence	Apply
CO5	Utilize various methods for preveting hacking	Apply

Module I: Ethical Hacking

Computer Image Verification and Authentication, understanding Malicious and hostile code including viruses, Trojan horses, worms, backdoors, trapdoors honeytrap forensics and spyware. Identification, Authentication and Authorization including passwords, smartcards and biometrics. Physical, environmental and organizational considerations for deploying forensic computing initiatives. Computer security and analyze security breaching attacks, Risk analysis, risk assessment and contingency planning for information security.Risk management. Impact and probability of threat.

Module II: System Hacking and prevention

DoS Attacks and prevention, Session Hijacking and prevention, Hacking Web server and prevention, Hacking Web Application and prevention, SQL Injection and prevention, Social Engineering and prevention, Recognize the range of surveillance techniques and countermeasures. Investigate a range of security issues relating to operating systems, PC systems, threats vulnerabilities and security mechanisms.

Module III: Recovery Forensic

Understanding the storage mechanism of devices like CD, DVD, USB, flash card, Hard disk, floppy disk etc, Data deletion concept, Breadth of Recovery software, limitations of recovery software, partition recovery (NTFS, FAT), recover data from CD, DVD, recover lost partition, Gpart recover data when sector 0 is damaged, data recovery form corrupted/formatted/repartitioned/ deleted hard drive, backup of master boot record, restoration of firmware, Carving, recovering data from damaged storage devices.

Module IV: Winhex

Recovering digital evidence using winhex, creation and study of event logs in winhex, analysis

of physical view and logical view, Disk cloning, disk imaging, RAM editor, Analyzing files, Analyzing files, wiping unused space, editing data structure, splitting files, viewing and manipulating files, hiding data and discovering hidden data, API, Cyber forensic application of Winhex.

Recommended Reading:

1. Preventing Web Attacks with Apache by Ryan C. Barnett.
2. Innocent Code : A Security Wake-Up Call for Web Programmers by Sverre H. Huseby
3. HackNotes(tm) Web Security Pocket Suggesive readingsby Mike Shema
4. Testing Web Security: Assessing the Security of Web Sites and Applications by Steven Splaine
5. Improving Web Application Security: Threats and Countermeasures by Microsoft Corporation
6. Hacking the Code: ASP.NET Web Application Security by Mark Burnett
7. How to Break Software Security by James A. Whittaker and Herbert H. Thompson
8. Exploiting Software : How to Break Code by Greg Hoglund and Gary McGraw
9. Advances in digital forensic VI by kam pui chow, sujeet shenoi
10. Malware forensic by Cameron malin
11. Windows registry forensic by Harlan carvey,
12. Digital forensic for network internet and cloud computing clint garrison
13. Wireless crime and forensic investigation by Gregory kipper
14. Digital image forensic by husrev taha, nasir memon
15. Computer forensic investigating data and image files by Ec-council
16. Network forensic tracking hackers by sherri Davidoff
17. Mastering windows network forensic by steven anson
18. Anti computer forensic by Gred numitor
19. Computer forensic Nathan Clarke
20. The secret of hacking
21. The art of human hacking , Kevin mitnik
22. Gray hat hacking, the ethical hackers handbook-Allen Harper,Shon Harris,Jonthan
23. Hardware hacking by Kelvin D. Mitnick

22-358-0418 DIGITAL IMAGE PROCESSING

COs	Course Outcome Statements	Cognitive Level
CO1	Understand image manipulations	Understand
CO2	Identify manipulations in digital images	Analyze
CO3	Use pattern recognition methods	Apply
CO4	Apply steganalysis for image analysis	Apply
CO5	Examine watermarks	Analyze

Module I: Digital Image Processing

Fundamental Steps in Image Processing, Elements of Digital Image Processing, Digital Image Fundamentals, Image Enhancement in the Spatial Domain, Image Enhancement in the Frequency Domain, Image Restoration. Image Compression: Fundamentals, Redundancies, Image compression models, Error free compression, Lossy compression, Image compression standards. Morphological Image Processing, Image Segmentation: Introduction to Dilation, Erosion, Opening, Closing, Hit-or-Miss transformation, Morphological algorithm operations on binary images, Morphological algorithm operations on gray-scale images. Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding, Region-Oriented Segmentation.

Module II: Pattern Recognition

Introduction to Pattern Recognition, Bayesian decision theory: Classifiers, Discriminant functions, Decision surfaces, Normal density and Discriminant functions, discrete features, Principal Component Analysis (PCA), Expectation Maximization (EM), Hidden Markov models for sequential pattern classification, Nonparametric: Density estimation, Parzen window method, Probabilistic Neural Networks (PNNs), K-Nearest Neighbour, Estimation and rules, Nearest Neighbour and Fuzzy Classification. Linear Discriminant function based classifiers: Perceptron, Support Vector Machines (SVM).

Module III: Steganography & Steganalysis

Information Hiding, Steganography, and Watermarking, History of Watermarking, History of Steganography, Importance of Digital Watermarking, Importance of Steganography Applications and Properties. Steganography: Information-Theoretic Foundations of Steganography, Steganographic Methods: Statistics Preserving Steganography, Model-Based Steganography, Masking Embedding as Natural Processing, Minimizing the Embedding Impact. Steganalysis: Steganalysis Scenarios, Some Significant Steganalysis Algorithms.

Module IV: Models of Watermarking

Communication-Based Models of Watermarking, Geometric Models of Watermarking, Modeling Watermark Detection by Correlation, Robust Watermarking Approaches. Watermark Security: Security Requirements, Watermark Security and Cryptography, Some Significant Known Attacks, Content Authentication.

Recommended Reading:

1. Ingemar Cox, Matthew Miller, Jeffrey Bloom, and Jessica Fridrich . Digital Watermarking and Steganography, 2nd Ed, (The Morgan Kaufmann Series in Multimedia Information and Systems). (Hardcover - Nov 16, 2007).
2. Frank Y. Shih. Digital Watermarking and Steganography: Fundamentals and Techniques, CRC Press.
3. Stefan Katzenbeisser, Fabien, and A.P. Petitcolas. Information Hiding Techniques for Steganography and Digital Watermarking, Artech House.
4. Neil F. Johnson; Zoran Duric; Sushil Jajodia. Information Hiding: Steganography and Watermarking - Attacks and Countermeasures, Springer.
5. Gregory Kipper. Investigator's Guide to Steganography, Auerbach

22-358-0419 ADVANCED FINGERPRINT DEVELOPMENT METHODS

COs	Course Outcome Statements	Cognitive Level
CO1	Develop latent fingerprints using powder method	Analyze
CO2	Develop latent fingerprints using advanced instrumental methods	Analyze
CO3	Develop fingerprints using chemical methods	Analyze
CO4	Develop latent fingerprints using metal deposition methods	Analyze
CO5	Employ automated fingerprint identification system	Apply

Module I: Powder Method

- Traditional powder, Magnetic Powder, Luminescent powder, Thermoplastic Powder, Nanotechnology Powder, Anti stroke Powder. Powder suspension technique:-Small particle reagent, Black powder suspension, White powder suspension, fluorescent suspension, Operational usages and sequencing, etc

Module II: Advanced Methods

- Radioactive technique, Biological technique, reflected ultraviolet Imaging system, X-ray fluorescence, Chemical imaging. Challenging surface: Thermal Surface- Solvent treatment, amino acid/Protein reagent, Fuming method. Metallic reagent- Gun bleaching method, Oxidation reduction method, Electrochemical/corrosion method, Fuming method. Glows- Deposition and development latent print on glows. Adhesive tape-Tape separation method, processing the adhesive and non adhesive side of tape. Skin- Iodine silver plate transfer, Electronography, Powder method, Cyno-acrylate fuming, Iodine-Napthoflavone, Direct lifting method.

Module III: Chemistry & Reaction Mechanisms

- Amino acid reagent, Ninhydrin-Chemistry and reaction Mechanism, Forensic application. Metal salt enhancement, Ninhydrin analogous, first analogous, aryl, alkyl and alkoxy analogous, 1,8- Diazafluoren-9-One and 1,2-Indanedione, miscellaneous amino acid reagent-p- Dimethylaminocinamaldehyde, NBD chloride, Dansyal chloride, o-Phthalaldehyde, Fluorescamine, Genipin**.** Cyanoacrylate fuming, health and safety precaution, Cyanoacrylate pretreatment, atmospheric and vacuum CA fuming,

Chemistry of CA dye stains- Ardrox, basic yellow 40, MBD, Rhodamine 6G, MRM 10, RAY, thenoyl europium chelate, gentian violet, sudan black. Iodine fuming, Iodine fixation, Operational uses- vapor method, dusting method, Solution method, miscellaneous fuming method-Osmium/ruthenium Tetroxide, soot method, Disulfur dinitrite, etc.

Module IV: Metal Deposition Methods

- Silver nitrate, Physical developer- Chemistry and mechanism, Sequencing, regent reliability test, bleach toning, potassium iodide toning, other toning process. Single Metal Deposition, Multi- metal deposition- I, II, III, IV, fluorescent and vacuum metal deposition-reaction mechanism, conventional gold zinc process, sequencing. Lipid Reagent: Sudan black, chemistry and mechanism of Oil red O, nile red, Europian chelate, etc. Nanoparticles in Fingerprinting.

Module V: Automated Fingerprint Identification System

- Fingerprints and AFIS, History of automated identification system: Early print, single database, growth and development of AFIS system, Transmission standard, ANSI standard, compression standard. NCIC classification system, Henry and American classification system, working of AFIS- Database, processing ten print, latent print processing, latent search. Types of AFIS searches: Ten print to Ten print search, Latent to ten print search, Latent to latent search. AFIS report: Ten print report and latent print report.

Recommended Reading:

1. Moenssens: Finger Prints Techniques, 1975, Chitton Book Co., Philadelphia, New York.
2. Mehta, M. K.: Identification of Thumb Impression & Cross Examination of Finger Prints, 1980 N. M. Tripathi (P) Ltd. Bombay.
3. Bridges: Practical Finger Printing, 1942, Funk and Washalls Co. New York.
4. H.C. Lee, R.E. Gaensslen “Advances in Fingerprint Technology”, 2nd ed. NY: CRC Press, 2001.
5. S.A. Cole, Suspect Identities: A History of Fingerprint and Criminal Identification. Harvard Univ. Press, May 2001.
6. Cherril, F.R: The Finger Prints. System at Scotland Yard, 1954; Her Majestuy‟s office, London.
7. C. Champod and P.A. Margot, ªComputer Assisted Analysis of Minutiae Occurrences on Fingerprints, Proc. Int'l Symp. Finger-print Detection and Identification, J. Almog and E.

Spinger.

8. E. Roland Menzel; Fingerprint Detection with Loseres; Second edition; Marcel Dekker, Inc. 1999.

22-358-0420 FORGERY AND ITS FORENSIC DETECTION

COs	Course Outcome Statements	Cognitive Level
CO1	Understanding what is forgery and types of forgery.	Understand
CO2	Examine forged signatures	Apply
CO3	Understand the methodologies behind forensic accounting and auditing	Understand
CO4	Examine digital documents	Analyze
CO5	Examine holographic and facsimile documents	Analyze

Module I: Types of forgery

- Types of forgery, attributes of assisted hand signatures, disguise, discriminators of device, flag of forgery and characters of genuineness, indicators of illiteracy, sign of senility, symbol of sinistrality, gender discrimination. Scope of questioned document examination. Anachronistic features and their importance, detection and decipherment of alterations and erasures including additions, over writings, obliterations, examination of carbon copies and carbonless copies.

Module II: Examination of signatures

- Examination of signatures – characteristics of genuine & forged signatures, examination of built-up documents, identification of writers of forged writings/signatures. Importance of tremor in identification of writings and signatures, difference between tremors of fraud and genuine tremors in writings and signatures, hesitations, factors responsible for variations (under threat, while traveling, illness, old age, mental state, etc.).

Module III: Forensic accounting and auditing

- Corporate frauds, forensic accounting and auditing, Use of computers in document examination, automated Signature verification system, determination of age of documents- relative and absolute age of documents, case studies. Examination of security documents including currency notes, Revenue stamps, travel documents - passports, visas, air - tickets, identity cards, lottery tickets, driving license, Bills, educational and financial documents, etc. different types of security features and their examination including watermarks, wire marks, security fibre/threads, Ghost/imitated marks/ security printing, optical variable inks, holograms and all other security features.

Module IV: Forensic examination of digital and other documents

- Types and working of Photostat machine, fax machine, printers, scanners. Identification &

linkage of Photocopies and photocopier, typewriter, fax machine, scanner, Desktop printing including image processing device, their role in counterfeit currency and certificate etc. Holographic mark and their examination, Examination of credit, debit and other plastic cards, examination of photocopies, scanned documents, Fax copies etc., and case studies. Numismatic forgery-Introduction, tool, equipments and other resource, method of forgery-alteration, tooling, embossing, application and plating, Casting: Rubber mold model, wax model from mold, Burn out wax, treatment of casting, Creating dye- Cutting by hand, plating, casting and hubbing. Explosive impact copying preparation of detail report with reasons and illustrative charts, uses of standard terminology.

Recommended Reading:

1. Ordway Hilton; Scientific Examination of Questioned Documents. Revised Edition, 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 Thumb – Print Identification, profusely illustrated, Law Book, Allahabad (1988).
7. Morris Ron N; Forensic Handwriting Identification, Acad Press, London (2001).
8. Kurtz Sheila; Graphotypes a new Plant on Handwriting Analysis, Crown Pub. Inc., USA (1983).
9. Lerinson Jay; Questioned Documents, Acad Press, London (2001)
10. Vacca John R; Computer Forensics- Computer crime scene Investigation, Firewall Medial, An imprint of Laxmi Pub(2002).
11. Casey Eoghan; Handbook of computer crime Investigation, Forensic Tools & Technology- Academic Press (2002).
12. Ellen Davin; Questioned Documents – Scientific Examination, Taylor & Francis, Washington (1997).

13. Roy A Huber, AM Headrick, Handwriting Identification-Facts & Fundamental, CRC Press (1999).

14. Andrea Mc Nichol, Jeffrey A Nelson; Handwriting Analysis Putting it to work for you, Jaico Books, Delhi (1994).

15. Morris (2000); Forensic Handwriting Identification (fundamental concepts & Principals).

16. Madinger J & Zalopany AR; (1999) -Money Laundering- CRC Press.

17. Manning CA;(1999) -Financial Investigation & Forensic Accounting- CRC Press.

18. Brewster F.; Contested Documents and Forgeries," The Eastern Law House, Kolkata.

19. Quirke AJ; Forged Anonymous & Suspect Documents- 1930, Reorge Rontledge & Sons Ltd, London.

20. Katherine M Kappenhaver, CDE-Forensic Document Examination-Humana Press.Jan Seaman Kelly & Brian S Lindblom-Scientific Examination of Questioned Documents-Taylor Francis Group London and New York.

22-358-0421 – SWAYAM NPTEL ONLINE COURSE

Students can opt for anyone course out of the following courses -

a) Fundamentals of biotechnology
b) Industrial biotechnology
c) Analytical techniques in microscopy
d) Nanobiotechnology
e) Organic chemistry in biology and drug development
f) Analytical chemistry
g) Electrochemistry
h) Descriptive statistics with R software
i) Digital voice & picture communication
j) Academic writing
k) Any other course approved by faculty council available on SWAYAM platform and related to the specialization of the student

a)

22-358-0422 – PRACTICAL ON 22-358-0411 & 22-358-0412

COs	Course Outcome Statements	Cognitive Level
CO1	Determine the age of dead from bones	Analyze
CO2	Determine stature of the dead from bones	Analyze
CO3	Examine wood, pulp, and paper	Analyze
CO4	Examine occupational marks	Apply
CO5	Demonstrate 16s and 18s rRNA amplification	Analyze

1. Age determination from bones.
2. Side and site determination from long bones.
3. Stature estimation from bones.
4. Sex determination from various bones.
5. Age estimation from teeth.
6. Examination of nails, occupation, scars, tattoo marks, and other deformities.
7. Examination of plant and animal foods.
8. Separation of bacterial cells from culture media by differential centrifugation.
9. Microscopic and biochemical examination of wood, pulp, paper.
10. Examination of plant and animal foods.
11. Amplification of 16 s rDNA by using PCR
12. Amplification of 18 s r DNA by using PCR
13. Preparation and transformation of competent *E. coli* using calcium chloride.

22-358-0423 – PRACTICAL ON 22-358-0413 & 22-358-0414

COs	Course Outcome Statements	Cognitive Level
CO1	Identify explosives from the residue using TLC	Analyze
CO2	Identify explosives from the residue using FTIR	Analyze
CO3	Identify explosives from the residue using GC-MS	Analyze
CO4	Examination of Narcotic Drugs	Analyze
CO5	Interpretation of toxicological data	Analyze

1. TLC analysis of explosive residues.
2. HPTLC analysis of explosive residues
3. HPLC analysis of explosive residues.
4. Identification and comparison of explosives by FTIR.
5. GC-MS analysis of explosive residues.
6. Extraction, Systematic identification of Narcotic Drugs and Psychotropic substances (opiates, cannabis and barbiturates, benzodiazepines and amphetamines) by spot colour tests.
7. UV-Vis Spectrophotometric, GC and GC-MS analysis of barbiturates.
8. Gas chromatography analysis of Ganja and Charas.
9. Interpretation of given spectral data of various compounds.

22-358-0424 – PRACTICAL ON 22-358-0415 & 22-358-0416

COs	Course Outcome Statements	Cognitive Level
CO1	Record and collect audio samples	Apply
CO2	Compare linguistic and phonetic features of audio samples	Analyze
CO3	Analyze voice samples using voice spectrograph	Analyze
CO4	Restore erased serial marks	Analyze
CO5	Identify GSR	Analyze

1. Recording of speech samples using tape recorder & digital recorders and measures for keeping it in the safe custody.
2. Speaker wise segregation of speech sample of recorded conversation spoken between two speakers.
3. Transfer of audio file from a digital media to other media using standard software and authentication of recorded speech.
4. Comparison of linguistic and phonetic features of audio recording voice samples of two speakers.
5. Spectrographic analysis of voice samples of two speakers using voice spectrograph and comparison of their spectrographic features.
6. Video analysis and detection of tampered video files using Video analyzing tool.
7. Facial, ear landmark measurements and comparison using Geometric Morphometrics.
8. Restoration of erased serial number on firearms.
9. To perform chemical tests for powder residues around gun-shot holes in hard targets.
10. To perform spot test around holes suspected to have been caused by passage of jacketed /non-jacketed projectiles.
11. To perform chemical tests of firearms for detection of firearm discharge residues – to find out whether a given firearm has been fired or not.
12. Reconstruction of sequence of events in shooting incidents.
13. To study glass fractures, determination of direction of firing and sequence of shots.
14. Measurement of spread of pellets fired from shot-guns and determination of range of firing.
15. Given evidence pattern of tattooing, suspected firearms and ammunition recovered -to conduct test firings and estimate range of firing.
16. To determine/ measure rifling details on fired bullets, determination of make/model of suspected firearm firing the bullet.

17. Examination of air guns / rifles/ handguns as per Arms Act.
18. Examination of air guns / rifles as per Arms Act 1959.
19. Identification of shooter: gun-shot residue analysis by AAS.
20. Identification of suspected gun-shot holes in garments, walls, furniture etc. by AAS.

22-358-0425 – PRACTICAL ON 22-358-0417 & 22-358-0418

COs	Course Outcome Statements	Cognitive Level
CO1	Identify firewall intrusions	Understand
CO2	Examine malwares, password guessing, and password cracking	Apply
CO3	Identify operating system hacking	Analyze
CO4	Analyze email headers and URLs	Analyze
CO5	Scan for the vulnerabilities using cyber tools	Analyze

1. Firewalls Intrusion Detection and Honeypots
2. Malware – Keylogger, Trojans, Keylogger countermeasures
3. Password guessing and Password Cracking.
4. Windows Hacking – NT LAN Manager, Secure 1 password recovery
5. Penetration Testing and justification of penetration testing through risk analysis
6. Windows Hacking – NT LAN Manager, Secure 1 password recovery
7. Denial of Service and Session Hijacking using Tear Drop, DDOS attack.
8. Understanding DoS Attack Tools- Jolt2, Bubonic, Land and LaTierra, Targa, Nemesy Blast, Panther2, Crazy Pinger, Sometrouble, UDP Flood, FSMax.
9. Email header and URL analysis
10. Scanning for vulnerabilities using (Angry IP, HPing2, IPScanner, Global Network Inventory Scanner, Net Tools Suite Pack.)
11. NetBIOS Enumeration Using NetView Tool, Nbtstat Enumeration Tool (Open Source).
12. How to Detect Trojans by using – Netstat, fPort, TCPView, CurrPorts Tool, Process Viewer.
13. Understanding SQL Injection
14. Steganography using tools: Tool: Merge Streams, Image Hide, Stealth Files, Blindside, STools, Steghide, Steganos, Pretty Good Envelop,

22-358-0426 – PRACTICAL ON 22-358-0419 & 22-358-0420

COs	Course Outcome Statements	Cognitive Level
CO1	Develop latent fingerprints on different surfaces	Analyze
CO2	Identify simultaed forgeries	Analyze
CO3	Examine typescripts and printed materials	Analyze
CO4	Examine photocopies and scanned documents	Analyze
CO5	Examine security documents and plastic cards	Analyze

1. To develop latent finger Prints with Powder methods.
2. To develop latent finger Prints with Fuming methods.
3. To develop latent finger Prints with Chemical methods.
4. Development of fingerprint on pen drive.
5. Development of fingerprint on CD/ DVD.
6. Development of fingerprint on hard disk.
7. Development of fingerprint on glass.
8. Detection of Forgeries including freehand and traced forgery.
9. Detection of simulated forgery.
10. Examination of alterations, additions, obliterations, overwritings and erasures.
11. Examination of typescripts and printed matters.
12. Examination of computer printouts.
13. Examination of photocopies and scanned documents.
14. Examination of fax copies.
15. Examination of Security Documents – Indian Bank Notes under VSC.
16. Examination of Travel Documents – Indian Passports and Visas under VSC.
17. Examination of Plastic Cards.
18. Examination of Stamp Papers and Lottery Tickets.