File Ref.No.86241/GA - IV - J1/2016/Admn

UNIVERSITY OF CALICUT

Abstract

General & Academic - CBCSS PG Regulations 2019 - Scheme and Syllabus of M.Sc Forensic Science Programme w.e.f 2020 Admission - I, II & III semester -Rectified in the weightage of marks- Implemented subject to ratification by the Academic Council - Orders Issued.

G & A - IV - J

U.O.No. 11890/2022/Admn Dated, Calicut University.P.O, 16.06.2022

Read:-1) U.O No. 5207/2021/Admn dated 11.05.2021
2) U.O.No. 6985/2021/Admn Dated,14.07.2021
3) U.O.No. 6133/2022/Admn Dated, 05.03.2022
4) U.O Note No.56/EX-I-ASST-3/2021/PB, dated: 22.04.2022
5) Remarks from Chairman, Board of Studies in Forensic Science (Single Board) dated 17.05.2022
6) Remarks from Dean, Faculty of Science dated 08.06.2022
6) Orders of the Vice Chancellor in the file of even no, Dated 15.06.2022

ORDER

1. Scheme and syllabus of I, II & III semester Forensic Science Programme, in tune with the new CBCSS PG Regulations 2019, with effect from 2020 Admission has been implemented, vide paper read (1), (2) & (3) above.
2. Pareeksha Bhavan, vide paper read (3) above, has requested to clarify, the anomaly in the weightage mentioned in the model question paper and Syllabus of M.Sc Forensic Science w.e.f 2020 admissions.
3. Chairman, Board of Studies in Forensic Science (Single Board), vide paper read (4) above, has forwarded the syllabus of I, II & III semester M.Sc Forensic Science Programme (CBCSS PG) after rectifying in the weightage mentioned in the syllabus of M.Sc Forensic Science Programme w.e.f 2020 Admissions.
4. The Dean, Faculty of Science, vide paper read (5) above and the Vice Chancellor, subject to ratification by the Academic council, vide paper read (5) above, approved rectified syllabus of M.Sc Forensic Programme Science, in tune with the new CBCSS PG Regulations 2019, w.e.f 2020 Admissions.
5. The rectified scheme and syllabus of I, II & III semester M.Sc Forensic Science Programme in tune with the new CBCSS PG Regulations 2019, w.e.f 2020 Admissions.
6. Orders are issued accordingly. (Syllabus appended)

Abdussamad M

Assistant Registrar

To

The Principals of all affiliated colleges
Copy to: PS to VC/PA to PVC/ PA to Registrar/PA to CE/JCE I/JCE V/EX and EG Sections/SF/DF/FC

Forwarded / By Order

Section Officer

UNIVERSITY OF CALICUT

SYLLABUS

for

M.Sc. Forensic Science

(CBCSS PG 2019)

Under Choice Based Credit Semester System

(w.e.f. 2020 Admission)

Courses offered for M.Sc. Forensic science programme under CBCSS pattern in affiliated colleges (2020 onwards)

1st Semester M.Sc. Forensic Science course

First semester- Theory and practical courses

Course code No.	Title of the course	Credits	External weightage	Internal weightage
FSC1C01	FUNDAMENTALS OF FORENSIC SCIENCE & CRIMINAL LAWS	4	30	5
FSC1C02	CRIMINOLOGY & FORENSIC PSYCHOLOGY	4	30	5
FSC1C03	INSTRUMENTAL TECHNIQUES	4	30	5
FSC1C04	LABORATORY QUALITY MANAGEMENT, RESEARCH METHODOLOGY & STATISTICS	4	30	5
FSC1L05	PRACTICAL ON FSC1C01 & FSC1C02	2	24	5
FSC1L06	PRACTICAL ON FSC1C03 & FSC1C04	2	24	5

FSC- Forensic Science; C- Core course theory; E- Elective course theory; L- Practical; 1- I semester.

1. Theory exam's model question paper and weightage is appended.
2. Practical examination shall be conducted at the end of each semester.
3. Weightage for the external practical examination can be distributed as follows:

Major question (1 number)	8
Minor question (2 numbers)	2x5=10
Spotters (2 numbers)	2x1=2
Record & viva-voce	2
Total	**24**

4. A minimum of two test papers for each course has to be conducted and the average shall be counted for internal evaluation in each semester.
5. Minimum one seminar for each course is compulsory.

AUDIT COURSE

Each student will undergo an audit course viz. Ability enhancement course (AEC) in Semester I. The student should undergo any one course listed under each category AEC. Each student will be under the supervision of a faculty who will be responsible for monitoring the course and evaluation. The allotment of the faculty will be decided by the Department Council.

Ability enhancement course (AEC) – (In semester I) - Not coming in the normal workload, Credit 4 (Not added for SGPA/ CGPA).

a) Minimum five case studies, critical evaluation and presentation.
b) Review article/articles on research topics that are presented in a national level seminar/conference and published in the proceedings.
c) Publication of research article/ articles in the national/international journal.
d) Presentation of research papers/ papers in national level seminar/conference, which should be published in the seminar/ conference proceedings.
e) Attending workshops related to forensic science for a minimum of 3 days.
f) Internships in FSL/ RFSLs/ CFSLs/ CEL/ RCELs for a minimum of 40 hours.
g) Seminar presentation on a frontier area of forensic science research. The topic should be from outside the syllabus.

After conducting the AEC, the evaluation/examination should be done either common for all students in a batch or individually depending upon the AEC conducted. The evaluation/ examination must be conducted jointly by the teacher in charge of the AEC and the head of the department. The result of the AEC, duly signed and sealed by both teacher in charge and the Head of the department, should be uploaded to the University during the stipulated period in the third semester of the programme. Evaluation/examination must be conducted by 30 weightage pattern, as in the theory courses and the GPA and overall grade of the AEC should be uploaded to the University. Evaluation/examination on AEC must contain the following components: MCQ type written examination, Report on AEC, Presentation of AEC, Viva-voce on AEC. Distribution of 30 weightage may be done by the teacher in charge in concurrence with the Head of the department.

FSC1C01 FUNDAMENTALS OF FORENSIC SCIENCE & CRIMINAL LAWS

(4 credit, 54 hrs)

Module I: Introduction to Forensic Science (12 hrs)

- Forensic science- Definition and Scope of Forensic Science, History and development of Forensic science, Need and Principles of Forensic Science.
- Police and, Forensic science laboratories/ institutions in India, Organizational Structure of a Forensic Science Laboratory/Institution, Services provided by other institutions.
- Functions, responsibility and code of conduct of a Forensic Scientist.

Module II: Evidences (12 hrs)

- Definition, types (testimonial and real evidence) (oral & circumstantial), Transfer & Persistence, contamination, Identity, class and Individualisation.
- Known and questioned items, comparison of evidence, controls, Analysis of evidence: Controls, analysis of evidence. Collection, preservation, packing and forwarding of different types of evidences (Fingerprint, hair, fibre, glass, soil, questioned documents, impression evidences, etc.) to the FSL.
- Admissibility of scientific evidence, Frye case &Daubert standard.

Module III: Criminal Major Acts and Indian Constitution (12 hrs)

- Sections of Indian Evidence Act: 32, 45, 46, 47, 57, 58, 60, 73, 135, 136, 137, 159.
- Sections of Criminal Procedure code:53, 53A, 54, 154-173, 291, 292, 293, 311A.
- Sections of Indian Penal Code: Offences against person: 299, 300, 302, 304B, 306, 319, 320, 326, 339, 340, 351, 359, 362, 375, 377. Offences against property: section 378, 383, 390, 405, 415, 441, 463, 471, 499, 503, and 511. Offences relating to coin and Government stamps: sections 232-246; sections 489 A to E.
- Indian constitution: Preamble, Fundamental Rights, Directive Principles of State Policy, Articles- 14, 15, 20, 21, 22, 51A.

Module IV: Minor Acts (10 hrs)

- NDPS Act.
- Prevention of Food Adulteration Act.
- Drugs and Cosmetic Act.
- Arms Act, Explosives Act (Sections: 4, 17).
- Information Technology Act 2000 (Sections: 2 (1) (r), 2 (1) (t), 3, 4, 7, 13, 79).

Module V: Social legislations, Local and Special Laws (7 hrs)

- The Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 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.

Recommended reading:

1. Houck, M.M & Siegel, J.A; Fundamentals of Forensic Science, Academic 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&DhirajLal; 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. M. Monir, Law of Evidence, 6th Edition, Universal Law Publishing Co. Pvt. Ltd., New Delhi (2002).

FSC1C02 CRIMINOLOGY & FORENSIC PSYCHOLOGY

(4 credit, 54 hrs)

Module I: Crime and criminology (12 hrs)

- Crime: Definition, types of crimes, causes of crime, theories of crime (Differential Association theory, Labelling theory, Multiple factor theory, etc.), characteristics of criminals, criminal profiling, identification of persons (with special emphasis on Portrait Parle), crime pattern, crime statistics.
- Child Abuse- Physical Abuse, Emotional Abuse, Sexual Abuse, Child Neglect; Crime against Women, Crime against Elderly, Youth and Crime.

Module II: Penology and Victimology (10 hrs)

- Theories of punishment, Probation & Parole, Correctional Institutions.
- Victimology- Role of victim in crime, victim-offender relationship, Types of Victims, Effects on the victim post-crime (the feeling of insecurity, mental harassment, feeling victimized throughout life, quest for justice), secondary victimization, victim compensation.
- Justice system to the aid of the victim, relief and compensatory aids, therapies, etc.

Module III: Criminal Justice System in India (12 hrs)

- Structure of Police, Police and Forensic Scientist relationship with reference to Crime Investigation, Modus Operandi and its role in Crime Record, maintenance of crime records.
- Prosecution and Judicial Organizations. Courts in India, Jurisdiction of courts in criminal cases.
- Bailable and Non-bailable offenses, Dying Declaration, dying deposition, Summons, Warrant, Subpoena, perjury, Cognizable and non-cognizable offenses, FIR, Complaint, Inquest, Inquiry, Search and Seizure, Types of Witnesses (eye witness, hear-say witness, Hostile witness, etc.), medical certificate, medico legal report.
- Custodial Death, Police and Human Rights.

Module IV: Report writing, evidence evaluation and court testimony (8 hrs)

- Components of reports and report format in respect of crime scene and laboratory findings.
- Admissibility of expert testimony, pre-court preparation and court appearance, examination in chief, cross examination and re-examination.
- Ethics in forensic science.

Module V: Forensic psychology and investigative techniques (12 hrs)

- Assessment and evaluation in forensic psychology, forensic behavioural analysis, Forensic Psychologists as an Expert, Psychopathology.

- Interrogation Techniques- Polygraph (Lie-detection), Narcoanalysis, Brain mapping; NHRC guidelines; P.E.A.C.E model of interviewing, Brain Electrical Oscillation Signature Profiling (BEOS), Voice-Stress Analysis.
- Forensic psychiatry-Introduction to different mental illnesses- neurosis, depression, mood disorder, insanity, psychosis, delusion, delirium, schizophrenia, impulsive control stress disorder, anti-social personality disorder, psychopathy, post-traumatic stress disorder and post-partum stress disorder. Substance abuse, Association between mental disorder and crime, M'Naghten rule- section 84 IPC, relationship between human behaviour and legal proceeding in both civil and criminal cases.

Recommended reading:

1. Ram Ahuja: Criminology, Rewal Publ. Jabalpur
2. 'Criminology' by Larry Siegel
3. R Deb's Criminology, Criminal Law & Investigation, 44t edition 2018, S C Sarkar& Sons, Kolkatta.
4. 'Introduction to Forensic Psychology' by Bruce Arrigo
5. 'Forensic & Criminal Psychology' by Dennis Howitt.
6. 'Abnormal Psychology' by Halgin&Whitbourne.
7. 'Abnormal Psychology', by Robert C. Carson, James N. Butcher, Susan Mineka, Jill M. Hooley thirteenth Edition, Thirteenth Edition.
8. 'Encyclopedia of Forensic Science' by Jay A. Siegel, PekkaJ. Saukko, Geoffey C. Knupfer, Volume-1 to Volume-5.
9. 'Mental Disorders and Treatment' by Katherine Marsland.
10. 'Handbook of Forensic Psychology' by Prof. Dr.VimalaVeeraraghavan.
11. 'Handbook of Polygraph Testing' by Murray Kleine.
12. 'Brain Mapping-The Methods' by Arthur W. Toga & John C. Mazziotta, Second Edition.
13. 'Criminal Profiling and Introduction to Behavioural Evidence Analysis' by Brent Turve, Second Edition.
14. Krishnamurthy, R., Introduction to Forensic Science in Crime Investigation, 2011, Selective & Scientific Books, New Delhi.
15. 'Forensic Psychology' by Graham Towel& David Crighton
16. Serial Crime, Theoretical & Practical issues in Behavioural Profiling, Petherick, Woodworth Publication.
17. 'Introduction to Forensic Psychology', by Bruce Arrigo.
18. Diagnostic & Statistical Manual-IV, American Psychological Association

FSC1C03 INSTRUMENTAL TECHNIQUES

(4 credit, 54 hrs)

Module I: Spectroscopic methods (10 hrs)

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

Module II: Molecular and Atomic Spectroscopy (10 hrs)

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

Module III: Emerging and Hyphenate Spectroscopy (10 hrs)

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

Module IV: Separation and Detection Techniques (14 hrs)

- Introduction to Chromatography: Partition, Adsorption, Ion exchange, Size Exclusion Chromatography, their principle and types of chromatography. Forensic applications of Chromatography.
- Gas Chromatography: Principle, instrumentation and applications. Gas-liquid and gas-solid chromatography, GC – MS, GC – MS – MS (Tandem).Gas Chromatography – Head Space: Principle, instrumentation and applications.
- High Performance Liquid Chromatography: Principle, instrumentation and applications, LC – MS, LC – MS – MS (Tandem).
- Electrophoretic technique: General principle, factors affecting electrophoresis, low voltage thin sheet electrophoresis, High voltage electrophoresis, Sodium Dodecyl Sulphate (SDS) polyacrylamide gel electrophoresis, Isoelectric focusing (IEF), Preparative electrophoresis, Horizontal and Vertical Electrophoresis.

Module V: General Principles of Biological / Biochemical Analysis (10 hrs)

- pH and Buffers, Physiological solution.
- Centrifugation Techniques- Basic principle of sedimentation, various types of centrifuges, Density Gradient Centrifugation, Preparative Centrifugation, analysis of sub-cellular fractions, Ultra centrifuge- Refrigerated Centrifuges.
- Microscopy- Basic principles of microscopy, Simple and Compound microscope; Comparison microscope, Phase contrast microscope, Stereoscopic microscope, Polarizing microscope, Fluorescence microscopy, IR microscopy, Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM).

Recommended reading:

1. D.A.Skoog, F.J.Holler and T.A.Neman, Harcoust Principles of Instrumental Analysis, College publishers, Singapore
2. G.D.Christian and J.E.O'Reilly, Instrumental Analysis, Allyn and Bacon, Inc., Boston.
3. F.W.Fifield and D.Kealey, Principles and practice of Analytical Chemistry, International Textbook Company, London.
4. R.P.Bauman, Absorption Spectroscopy, John Wiely, New York.
5. M.Donhrow, Instrumental Methods in Analytical Chemistry; Their Principles and practice Vol.2, optical method, Pitaman, New York.
6. G.G.Guilbanlt, Practical Fluorescence: Theory, Methods and Practice, Marcel Dekker, New York.
7. S.Udenfriend, Fluorescence Assay in Biology and Medicine, Academic Press, New York.
8. W.J.Price, Spectrochemical Analysis by Atomic Absorption, Hyden, London.
9. R.S.Alger, Electron Paramagnetic Resonance: Techniques and Applications, Interscience, New York.
10. Analytical Chemistry by open Learning, John Wiley & Sons, New York.
11. J.C.Giddings, Dynamics of Chromatography, Marcel Dekker, New York.
12. R.C.Grob, Modern Techniques of Gas Chromatography, Marcel Dekker, New York.
13. J.A.Dean, Chemical Separation Methods, BanNostrand Reinhold Co., New York.
14. R.E.Smith, Ion Chromatography Applications, C.R.C. Press, Inc., Boca Raton.
15. R.E.Smith, Supercritical Fluid Technology, C.R.C. Press, Inc., Boca Raton.
16. G.Zweig and J.R.Whitaker, Paper Chromatography and Electrophoresis, Academic Press, New York.
17. Safferstein: Forensic Science Handbook Vol. I, II, III.
18. Lee Honry: An Introduction to Forensic Science
19. Egon Stahl: Thin Layer Chromatography.

FSC1C04 LABORATORY QUALITY MANAGEMENT, RESEARCH METHODOLOGY & STATISTICS

(4 credit, 54 hrs)

Module I: Quality Management and Laboratory Accreditation (10 hrs)

- Standards for analysis- Analytical standards, reference materials, high purity substances, certified reference materials, working standards.
- Introduction to Quality system, internal quality audits.

Module II: Laboratory Accreditation (10 hrs)

- Laboratory Accreditation – ISO 9000, ISO 14000, ISO 17000 series of standards, ISO/IEC 17025.
- Accreditation Boards – NABL guidelines for accreditation in India, Proficiency testing system, internal quality control, Inter and intra laboratory testing programmes.

Module III: Laboratory management system (10 hrs)

- Laboratory Information Management system (LIMS).
- Chain of custody of samples covered by LAN system.
- Security system.
- Validation and safety equipment.

Module IV: Research Methodology (12 hrs)

- Development of hypothesis, formulation of objectives, Types of research- descriptive vs. analytical, applied vs. fundamental, quantitative vs. qualitative, conceptual vs. empirical.
- Literature search/ review, Impact factors of journals.
- Sampling methods and tools of data collection - Observation, interview schedule, questionnaire, and semantic differential.
- Report and thesis writing, oral and poster presentations.
- Intellectual property rights, copy right, plagiarism in scientific research & communications.

Module V: Biostatistics (12 hrs)

- Types of data, basic concept of frequency distribution.
- Measure of central values- Mean, median and mode.
- Measure of dispersion- standard deviation.
- Probability- theory and definition of probability, Bayes theorem of probability, conditional probability and coincidence probability, probability- normal distribution.
- Regression and correlation analysis.
- Likelihood ratio, Multivariate analysis- PCA, factor analysis; Chi-square test, ANOVA, SPSS, Microsoft Excel, and open source software.
- Types of errors and interpretation of findings.

Recommended Reading:

1. Statistics and the evaluation of evidence for forensic scientists / Colin G.G. Aitken, Franco Taroni. 2nd ed. John Wiley & Sons Ltd., 2004.
2. Woodget, B. W. and Cooper, D.: Sample and Standards, ACOL Series, Wiley 1987.
3. Dux, J. P., Hand Book of Quality Assurance for Analytical Chemistry Laboratory, Van Nostrand, 1986.
4. Duncan, W. L.: Total Quality: Key Terms and Concepts, 1995.
5. Shah, D. H.: QA Manual, Business Horizons, 2000.
6. Kumar, K.: Quality Management, ABD Pub., 2000.
7. Ross, J.: Total Quality Management, Vanity Book, Intl., 1995.
8. Seiler, J. P., Good Laboratory practice, Springer, 2000.
9. Diwan, P.,: Quality in Totality, Manager's Guide to TQM and ISO 9000, Deepti&Deepti Pub., 2000.
10. Gyani, G. J.,:Training Manual on ISO 9000; 2000 and TQM, Raj Pub., 1999
11. Olson, M. H. and Davis, G. B.: Management Information Systems, McGraw Hill, 1998.
12. Specific Guidelines for Accreditation of Forensic Science Laboratories, DST, 1998.
13. Guide for Safety in The Chemical Laboratory: Manufacturing Chemist's Association, 1972.
14. Steere N. V.(Ed.): Hand Book of Laboratory Safety, CRC, 1967.
15. Tilstone, W. J. and Lothridge, K.: Crime Laboratory Management, Taylor and Francis, 2004.
16. Clair, J. S: Crime Laboratory Management, Academic Press, 2003.
17. 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.
18. Sokal, R. R. and Rolf, F. J.: Biometry – Principles and Practices of Statistics in Biological Research, Freeman, 1981.
19. BhaskarRao T.: Methods of Biostatistics, Paras, 2001.
20. Rama Krishnan P., Biostatistics, Saras, 1995.
21. Rao,V.K., Biostatistics– A Manual of Statistical methods for use in Health, Nutrition and Anthropology, Jaypee Medical Pub., 1996.
22. Woodget, B. W. and Cooper, D.: Sample and Standards, ACOL Series, Wiley, 1987.
23. Dux, J. P., Hand Book of Quality Assurance for Analytical Chemistry Laboratory, Van Nostrand, 1986.

FSC1L05 PRACTICAL ON FSC1C01 & FSC1C02

Minimum no. of practical that shall be done: 10
(Five practical each, based on the theory paper)

1. Descriptive study of organizational structure of a forensic science laboratory (FSL & CFSL).
2. Report of the visit to Police station/ Correctional institution.
3. Format of Medico legal report.
4. Format of FIR in a crime case.
5. Portrait Parle.
6. Anti-social Personality Disorder test.
7. Demonstration/ working of Polygraph: Testing of individuals.
8. Narcoanalysis- Demo/ working/ principle/ framing questionnaire.
9. Brain mapping- Demo/ working/ principle/ interpretation of results.
10. Computation of measures of central tendency and dispersion in anthropometric data of school children.
11. Regression analysis and correlation analysis of a data of heights and weights of a group of students.
12. Construct frequency curve, frequency polygon, bar diagram, histogram and pie diagram using suitable data.
13. Designing of an experiment for the comparison of efficacy of a few diets on different types of animals by the method of ANOVA.
14. Regression analysis and correlation analysis of a data of heights and weights of a group of students.
15. Data analysis by SPSS.
16. Formulate a hypothesis of any scientific observation done by the student.

FSC1L06 PRACTICAL ON FSC1C03 & FSC1C04

Minimum no. of practical that shall be done: 10
(Five practical each, based on the theory paper)

1. Working principle of Simple, Compound and Comparison Microscope.
2. Determination of pH of biological fluids using pH meter.
3. Separation of DNA by electrophoresis.
4. Preliminary forensic examination of body fluids.
5. Microscopic and spectrophotometric examination of textile fabrics.
6. Microscopic examination of different body hairs.
7. Determination of refractive indices of glass and liquids.
8. Physical matching of cloth piece and/ or rope piece and/ or garments.
9. Experiments on UV absorption of drug/ dyes/ chemicals.
10. Experiments on IR spectroscopy of paints/ drugs/ organic compounds.
11. Comparison of polythene films by IR spectrophotometry.
12. Identification of drugs/ solvents by Gas Chromatography and Gas Chromatography – Mass Spectrometry (GC-MS).
13. Identification and Estimation of Volatile Substances by chemical and Gas Chromatography – Head Space technique (GC-HS).

MODEL QUESTION PAPER

I/II/III/IVSEMESTER M.Sc. DEGREE EXAMINATION (CBCSS), Month & Year

Forensic Science

Course Code: Course Name

Time: 3hrs Maximum Weightage: 30

I. Answer any 4 of the following (Short Answer type questions) (Weightage-2)

1.

2.

3.

4.

5.

6.

7.

4 x 2 = 8

II. Answer any 4 of the following (Short essay type questions) (Weightage-3)

8.

9.

10.

11.

12.

13.

14.

4 x 3 = 12

III. Answer any 2 of the following (Long essay type questions) (Weightage-5)

15.

16.

17.

18.

2 x 5 = 10

Courses offered for M.Sc. Forensic science programme under CBCSS pattern in affiliated colleges (2020 onwards)

2nd Semester M.Sc. Forensic Science course

Second semester- Theory and practical courses

Course code No.	Title of the course	Credits	External weightage	Internal weightage
FSC2C07	FINGERPRINTS & QUESTIONED DOCUMENTS	4	30	5
FSC2C08	FORENSIC PHYSICS & BALLISTICS	4	30	5
FSC2C09	FORENSIC CHEMISTRY & TOXICOLOGY	4	30	5
FSC2C10	FORENSIC BIOLOGY, SEROLOGY & DNA PROFILING	4	30	5
FSC2L11	PRACTICAL ON FSC2C06 & FSC2C07	2	24	5
FSC2L12	PRACTICAL ON FSC2C08 & FSC2C09	2	24	5

FSC- Forensic Science; C- Core course theory; E- Elective course theory; L- Practical; 2- II semester.

Professional Competency Course (PCC):

PCC is a 4 credit course and should be conducted during the second semester of the programme. The credit of the PC course will not be considered while calculating the SGPA/CGPA. But the student has to obtain minimum pass requirements in this course, which is compulsory for an overall pass in the programme.

One particular PCC may be selected for all the students in a batch in the department or each student in a batch may choose one PCC, among the pool of courses suggested below. The exact title of the course may be decided by the department, but the area of study should be from the pool of courses suggested below. Either a single faculty from the department may be in charge of this course for a batch or each student may be assigned to a particular faculty in the department, in charge of this PCC, which will be decided by the Department council/ HoD.

a) Development of skills on using 'SPSS' software.
b) Development of skills on using 'R' software.
c) Development of skills on using 'Java' software.
d) Development of skills on using 'Python' software, Artificial intelligence and Machine learning.

After conducting the PCC, the evaluation/examination should be done either common for all students in a batch or individually depending upon the PCC conducted. The evaluation/ examination must be conducted jointly by the teacher in charge of the PCC and the Head of the department. The result of the PCC, duly signed and sealed by both teacher in charge and Head of the department, should be uploaded to the University during the stipulated time period in the third semester of the programme. Evaluation/examination must

be conducted by 30 weightage pattern, as in the theory courses and the GPA and overall grade of the PCC should be uploaded to the University. Evaluation/ examination on PCC must contain the following components: MCQ type written examination, Data analysis and interpretation, Report on PCC, Presentation on PCC, Viva voce on PCC. Distribution of 30 weightage may be done by the teacher in charge in concurrence with the Head of the department.

FSC2C07 FINGERPRINTS & QUESTIONED DOCUMENTS

(4 credit, 54 hrs)

Module I: **(10 hrs)**

Introduction to fingerprint science

- 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.

Module II: **(10 hrs)**

Fingerprint classification

- 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 III: **(12 hrs)**

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 IV: **(10 hrs)**

Introduction to questioned documents

- Nature and problems of document examination.
- Care of documents.

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

Module V: **(12 hrs)**

Examination of questioned documents

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

Recommended reading:

1. David R. Ashbaugh; Quantitative and Qualitative Friction Ridge Analysis, CRC Press.
2. E. Roland Menzel; Fingerprint Detection, with Lasers, Second edition; Marcel, Dekker, Inc. USA.
3. James F. Cowger; Friction Ridge skin CRC Press London.
4. Mehta, M.K: Identification of Thumb Impression & Cross Examination of Finger Prints, N .M. Tripathi (P) Ltd, Bombay.
5. Moenssens: Finger Prints Techniques, Chitton Book Co. Philadelphia, New York.
6. Chatterjee S.K., Speculation in Finger print identification, Jantralekha, Printing Works, Kolkata.
7. Cowger, James F: Friction ridge skin: Comparison and Identification of Fingerprints; CRC Press, Boca Raton, New York.
8. Cook Nancy: Classifying finger prints -Innovative learning publication Mento Park.
9. J A Seigel, P.J Saukoo and G C Knupfer; Encyclopedia of Forensic Sciences Vol. I, II and III, Acad. Press.
10. Hillison, S; Dental Anthropology, Cambridge Univ. Press, UK.
11. Henry C. Lee & R. E. Ganesslen, Advances in Finger Print Technology, CRC Press, Boca Raton, London.
12. Rev. ED.; Ordway Hilton; Scientific Examination. I of Questioned Documents, Elsevier, New York.
13. Albert S. Osborn; Questioned Documents, Second Ed.; Universal Law Publishing, Delhi.
14. Albert S. Osborn; The Problem of Proof~ Second Ed.; Universal Law Publishing, Delhi.
15. Charles C. Thomas, Typewriting Identification I.S.Q.D.; Billy Prior Bates; Springfield, Illinois, USA.
16. Charles C. Thomas, I.S.Q.D. Identification System for Questioned Documents; Billy Prior Bates Springfield, Illinois, USA.
17. Wilson R. Harrison; Suspect Documents -Their Scientific Examination; Universal Law Publishing, Delhi.

18. Hard less, H.R: Disputed Documents, handwriting and thumbs -print identification: profusely illustrated, Low Book Co., Allahabad.
19. Morris, Ron, N: Forensic handwriting identification, Academic Press, London.
20. Kurtz Sheila: Graphotypes a new plant on handwriting, analysis, Crown Publishers Inc., USA.
21. Lerinson Jay; Questioned Documents, Academic Press, London.

FSC2C08 FORENSIC PHYSICS & BALLISTICS

(4 credit, 54 hrs)

Module I: (12 hrs)

Glass

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

Paint

- Introduction, Composition, Manufacture of Paint; Types of paint.
- Forensic Examination of Paints and Coatings: Collection and Preservation of paint samples, macroscopic and microscopic techniques for the characterization of Paint Fragments, Physical.
- Chemical and Instrumental analysis of paint, interpretation of Paint Evidence, Case studies.

Soil

- Soil and its composition, Classification of soil, Collection and preservation of soil as evidence.
- Analysis of soil samples: Physical, chemical and instrumental, interpretation of soil evidence, Case studies.

Fibre

- Types of fibres (Natural & Artificial), forensic aspects of fibre examination.

Module II: **(10 hrs)**

Tool mark evidences

- Introduction to tool marks, Types of tool marks, Class characteristics and individual characteristics of tool marks.
- Collection and Preservation of tool marks, Forensic examination of tool marks, Case studies.

Restoration of erased/ obliterated marks

- Principle of restoration of erased marks, Techniques involved for alteration of individual markings.
- Restoration of erased and obliterated marks on various surfaces.
- Photography and Forensic assessment of methods for restoration of obliterated marks, case studies.

Bite marks

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

Tyre Impressions

- Introduction to tire impressions, Collection and Preservation of the tire impression evidence.
- Forensic Significance of skid marks, Forensic Examination for identification and comparison, Case studies.

Other physical evidences

- Forensic examination of cables, cut wires, locks, keys, real and imitation, jewellery, Ropes, ligature, tungsten filaments, seals (postal, metallic), fuse, fuse wire, stone, brick, debris, construction materials, iron rods, cloth pieces, knot examination, duplicate labels-container identification.

Speaker identification

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

Module III: **(12 hrs)**

- ***Firearms***

Characteristics and classification of firearms, History and background of firearms, Functional assembly and Operating principle of firearms, Characteristics and Working mechanism of Standard: Rifled firearms, Small arms, Shot guns and Non-standard: Improvised, Country made, Imitative firearms, identification of origin.

- ***Ammunition***

Ammunition and its constructional parts, Classifications of Ammunition on basis of constructional features, Functional assembly of different types of ammunition and their types, Safety aspects for handling firearms and ammunition, cartridge-firing mechanism.

Module IV: **(10 hrs)**

- Internal ballistics: General elementary and other principle problems: Heat problems, Pressure, Recoil, Vibration and Jump, Barrel fouling.
- External ballistics: Trajectory formation & its computation, Vacuum Trajectories & its measurement, Influence of earth trajectory, Effect of air resistance on trajectories, Parameters involved in exterior ballistics.
- Terminal/Wound ballistics: Effect of projectile on target based on: nature of target, bullet shape, striking velocity, striking angle and nature of target, intermediate targets, range, etc. Basic concepts of wound ballistics and phenomenon involved: threshold velocity for penetration of skin / flash / bones, Nature of wound of entry and exit wound, Characterization and evaluation of injuries depending upon Range, Velocity, Projectile Types, Firearm types, etc.

Module V: **(10 hrs)**

- Identification of firearms, ammunition and their components: Principles, Processing of Firearm Exhibits involved, Class characteristics and Individual characteristics (Identifiable marks) produced during firing process on cartridge cases and projectiles and their linkage with firearms.
- GSR –Composition of GSR, Location & Collection, Mechanism of formation, Chemical and Instrumental techniques involved in analysis, Shooter Identification technique.
- Determination of range of fire and its related phenomena, Techniques involved in ballistic studies, Stereo and comparison microscopy, BDAS, IBIS.

Recommended 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; Forensic Science in Criminal Investigation and Trials (3rd Ed.), Universal Law Publishing Co., New Delhi, 2001.
6. Hess, K.P; Textile Fibers and their Use, 6th Edn, Oxford and IBH Publishing Co., 1974.
7. Philip Rose; Forensic Speaker Identification; Taylor and Francis Forensic Science Series, London.
8. Bengold & Nelson Moryson- Speech and Audio signal processing; John Wiley & Sons, USA,
9. Raymond C Murray & John C.F Tedrew; Forensic Geology; Prentice Hall, New Jersey.
10. B. Caddy; Forensic Examination of glass and paints analysis and interpretation, ISBN 0784 05749.
11. Philip Rose; Forensic Speaker Identification; Taylor & Francis Forensic Science series, London.
12. Bengold & Nelson Morgan; Speech and Audio Signal Processing; John Wiley and Sons, USA.
13. Ray D. Kent and Charles Read; Acoustic analysis of speech.
14. Phil Rose & James R Robertson; Forensic speaker identification.
15. J. Howard Mathews; Charles C. Thomas, Firearms Identification, Vols. 1, 2, & 3; Springfield, Illinois.
16. Hatcher, Jury And Weller, Firearms Investigation, Identification And Evidence; Stackpole Books, Harrisburg, P A
17. Vincent Di Maio, Gunshot Wounds; CRC Press, Washington, Dc.
18. Brain J. Heard; Hand Book of Firearms And Ballistics; John Willey, England.
19. TA, Warlow; Firearms, The Law And Forensic Ballistics; Taylor And Francis, London.
20. Karl G. Sellier et al.; Wound Ballistics and the Scientific Background; Elsevier, London.
21. M. Johari, Identification of Firearms, Ammunition and Firearms Injuries; BPR&D, New Delhi.
22. L V. Hogg; The Cartridges Guide - A Small Arms Ammunition Identification Manual; The Stackpole Co., Harrisburg, P A.
23. Gary J. Ordog, Management of Gunshot Wounds, Elsevier, New York.
24. Working Procedures Manual: Ballistics, BPR&D Pub.

FSC2C09 FORENSIC CHEMISTRY & TOXICOLOGY

(4 credit, 54 hrs)

Module I: **(12 hrs)**

Arson and Explosives

- Introduction to Arson, Types of Fires, and Causes of fire, Patterns of fire.
- Liquid and solid incendiaries, Analysis of Fire Debris, Petroleum products.
- Classification and chemistry of explosives.
- Various types of IEDs and their reconstruction.
- Mechanism of explosion and their effects.
- Examination of explosive and explosion residues.
- Introduction to petroleum products and adulteration in petroleum products.
- Analysis of Petrol, Kerosene and Diesel as per BIS Specifications.

Module II: **(10 hrs)**

Dyes, Pigments, Ink and Polymers

- Bribe Trap Cases: Examination of Chemicals used in bribe trap cases.
- Inks: Forensic Examination of inks by various techniques, Dating and aging of inks.
- Polymers: Forensic examination of plastics and adhesives.

Module III: **(10 hrs)**

Alcoholic and non-alcoholic beverages

- Introduction to Alcoholic and non-alcoholic beverages.
- Analysis of alcoholic beverages, country made liquor, illicit liquor and medicinal preparations.
- Analysis of non-alcoholic beverages like tea, coffee.

Module IV: **(10 hrs)**

Narcotic drugs and psychotropic substances

- Introduction to Controlled drugs and Substances, Classification of controlled substances.
- Narcotic Drugs and psychotropic substances as under NDPS Act.
- Commonly abused drugs.
- Designer Drugs.
- Drug dependence and Drug Tolerance.
- Analysis of Drugs of abuse.

Module V: **(12 hrs)**

Toxicology

- Introduction to toxicology.
- Classification of poisons.
- Mode of action, signs and symptoms of different types of poisons (Pesticides, Metals, Drugs, Solvent, Plants, Insects & Animal poisons).
- Collection and preservation of viscera and biological fluids for toxicological analysis.
- Extraction methods of poisons and drugs from viscera- body fluids.
- Toxicological examination of different poisons including food adulterants.
- Functions and roles of toxicologists in a forensic science lab.
- Significance of toxicological findings.

Recommended reading:

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.
7. Sunshine, I: Handbook of Analytical Toxicology, press, 1969.
8. Mule, S. J. et al.: Immunoassays for Drugs subjects to ab, CRC Press, 1974.
9. Connors, K.: A text book of Pharmaceuticals analysis, Interscience, New York, 1975.
10. Niesink, RJM; Toxicology- Principles and Applications, CRC Press, 1996.
11. Jaisingh P Modi, A Textbook of Medical Jurisprudence and Toxicology ,Edited by Justice K Kannan,26th Edition,2019,LexisNexis .
12. Morrison R.T and Boyd R. N; Organic Chemistry 6th Ed Prentice Hall, 2003.
13. Laboratory procedure Manual, Forensic Toxicology: Directorate of Forensic Science, MHA, Govt. of India, 2005.
14. Laboratory Procedure Manual: Petroleum Products, Directorate of Forensic Science, MHA, Govt. of India, 2005.
15. Working Procedure Manual on Chemistry; Directorate of Forensic Science MHA Govt. of India, 2005.
16. Welcher F; Standard Methods of Chemical Analysis, 6th Ed.Van Nostrand Reinhold, New York, 1969.
17. Watson C. A; Official and Standardised Methods of Analysis, Royal Society of Chemistry, UK, 1994.

FSC2C10 FORENSIC BIOLOGY, SEROLOGY & DNA PROFILING

(4 credit, 54 hrs)

Module I: (12 hrs)

Cell biology, physiology and biotechnology

- Structure and function of cell – Plant cell and animal cell.
- Cellular organelles: Endoplasmic Reticulum, Golgi complex, Mitochondria, Chloroplast and Lysosomes. Organization of nucleus and nuclear transport.
- Basics of Human anatomy and physiology.
- 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.
- cDNA libraries, Gene knockouts, Monoclonal antibodies.

Forensic botany and wildlife forensics

- Various types of woods.
- Varieties of timber, seeds and leaves – their identification and matching.
- Study and identification of pollen grains, starch grains.
- Morphological and anatomical characteristics of plants yielding drugs of abuse like opium, Cannabis, Coca plant, Psilocybin mushrooms, Tobacco, etc.

- Endangered and rare species- examination of physical evidences like hair, nails, teeth, ivory, horn, footprints (pugmarks) etc. by conventional and modern methods.
- Wild Life Protection Act, case studies.

Hair examination

- Morphological, anatomical and microscopic examination of hair- human and animal.
- Characteristics of hair to determine the species origin, race, sex and site; case studies.

Module II: (12 hrs)

Forensic medicine/ Medico legal investigation

- Objectives of medico legal investigation.
- Death and its causes, types of death, signs of death.
- Post mortem changes- classification.
- Determination of cause of death, manner of death.
- Estimation of time since death.
- Post mortem biochemistry of the body fluids- Modern techniques used for the estimation of time since deaths.
- Exhumation.
- Forensic entomology- identification of specific insects and their developmental stages (life cycles), Medico legal importance.
- Asphyxial deaths: Classification of asphyxia deaths- Hanging, Strangulation, evidence collection and analysis, establishing manner of deaths.
- Suffocation, Drowning and traumatic asphyxia, medico legal importance of diatoms.
- Crimes against women- Introduction to sexual offences.
- Natural and unnatural sexual offences, perversions.
- Domestic violence and abuses at work place against women.
- Child abuses and abuses of old people.
- Abortion and infanticide.
- Deaths from starvation.
- Disaster Victim Identification- Examination and identification of dead bodies in mass disasters, mutilated bodies, fragmentary skeletal remains and bones. Determination of age, sex, race and species origin from bones and assessment of stature.
- Mechanical Injuries: Abrasions, Bruises, Lacerations, Incised wounds, Stab wounds, Firearm injuries, Defense injuries, fabricated injuries. Vital clues for establishing the manner of deaths due to various injuries.
- Traffic accident injuries: vehicular injuries, railway injuries & aircraft injuries.
- Thermal injuries: Heat and cold -Burns and scalds.
- Deaths due to electrocution- lightning, electricity.
- Deaths due to explosions- Establishing the causes of deaths and vital clues/evidences to be collected.
- Deaths due to chemical trauma.

Module III: **(8 hrs)**

Basic biochemistry

- Amino acids – structure and functional group properties.
- Proteins and peptides – Composition of proteins – Primary, Secondary and Tertiary structure of protein.
- Chemistry of Carbohydrates - Definition, biological importance and classification. Monosaccharides - Isomerism, anomerism. Sugar derivatives, Disaccharides, Polysaccharides. Structures of starch, glycogen and glycosoaminoglycans.
- Chemistry of Lipids - Definition, Biological importance and classification, Fats and fatty acids, Introduction to compound lipids, Hydrophobic and hydrophilic groups, Cholesterol, Bile salts, Micelle. Bimolecular leaflet, Lipoproteins.

Module IV: **(10 hrs)**

Basic serology

- Blood and its composition.
- Haemoglobin and its variants.
- Theories and biochemical tests for the identification of blood.
- Blood Typing/Grouping – 'ABO' system and its significance in forensic investigation.
- Other blood group antigens - 'Rh sub types', MN, I, P, Kell, Duffy, Kidd, Lewis, Lutheran and Bombay blood group
- Forensic Examination of semen and other body fluids – vomit, feces, urine, saliva and vaginal secretions.
- Overview of cells and organs of immune system and basic immunology.
- Basics of forensic microbiology.

Module V: **(12 hrs)**

Basics of forensic DNA analysis

- Chemical structure of DNA and RNA.
- Overview of DNA replication, transcription and translation.
- Procedure for collection and preservation of biological sample for DNA analysis.
- Techniques of DNA isolation and its quantitation.
- DNA separation techniques.
- Basic methodologies in forensic DNA analysis.
- History of DNA fingerprinting and DNA polymorphism.
- Genes and DNA markers in forensic DNA analysis.
- Introduction to Polymerase Chain Reaction and its applications in forensics.
- Introduction to mitochondrial DNA and its forensic importance.

Recommended reading:

1. Modi JS: Medical Jurisprudence and Toxicology.
2. Taylor: Medical Jurisprudence.
3. Parikh CK: Text book of Medical Jurisprudence and Toxicology.
4. Keith Simpson & Bernard Knight: Forensic Medicine.
5. C.M.V. Cox Medical Jurisprudence and Toxicology.
6. K.S. N. Reddy: Text book of Forensic Medicine &Toxicology.
7. Apurba Nandi: Text book of Forensic Medicine.
8. Krishan Vij: Text book of Forensic medicine.
9. Bisbing, Englewood Cliffs, New Jersy, Printice Hall.
10. Forensic Hair Investigation : Forensic Science Progress, Vol. II – Seta S. Sato, H & B Miyake, Springer – Verlag, Berlin.
11. Laboratory Procedure Manual - Forensic Biology (2005), Directorate of Forensic Science, MHA, New Delhi.
12. The forensic Identification and Association of Human Hair, Saferstein, R., & Hall, A.B. (2020). Forensic Science Handbook, Volume I (3rd ed.). CRC Press.
13. Text book of Forensic medicine and toxicology –V.V.Pillay.
14. The examination and Typing of Blood Stains in the crime laboratory – B J Culliford, U. S. Dept. of Justice, Washington D. C.
15. Blood Group Serology – Boorman KE, Dodd BE and LOncoln PJ, Chuchill Livingstone Inc. New York.
16. Laboratory Procedure Manual - Forensic Serology (2005), Directorate of Forensic Science, MHA, New Delhi.
17. Molecular Biology of the Cell, 6th Edition (2014) – Bruce Alberts, et al., Garland Science, ISBN: 978-0815341055.
18. Forensic DNA Typing, Second Edition: Biology, Technology, and Genetics of STR Markers 2nd Edition (2005) - John M. Butler, Academic Press, ISBN: 0121479528.
19. Forensic Science: An Introduction to Scientific and Investigative Techniques – StuartH. James, Jon J. Nord by, CRC Press, ISBN: 0849327474.
20. Genes XI (2012) – Benjamin Lewin, Jones & Bartlett Learning, ISBN: 978-1449659851.
21. Kuby Immunology6th Edition– Kindt, Goldsby and Osborne, W.H. Freeman and Co. ISBN: 978-0716767640.
22. Lehninger Principles of Biochemistry 6th Edition (2012) – Nelson and Cox, W.H. Freeman, ISBN: 978-1429234146 11. Microbiology 5th Edition – Pelczar et. al., McGraw-Hill Inc., ISBN: 978-0074623206.
23. Prescott's Microbiology 9th Edition (2013) - Joanne Willey, Linda Sherwood, Christopher J. Woolverton, McGraw-Hill Education, ISBN: 978-0073402406.
24. An Introduction to Forensic Genetics 2nd Edition (2010) - William Goodwin, Adrian Linacre and Sibte Hadi, Wiley-Blackwell, ISBN: 978-0470710197.

FSC2L11 PRACTICAL ON FSC2C06 & FSC2C07

***Fingerprints*:**

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

***Questioned documents*:**

8. Identification of Handwriting-general characteristics, fundamental divergences and individual characteristics.
9. Examination and identification of Signature Forgeries.
10. To study the natural variations in handwriting written in different circumstances.
11. Examination of sequence of intersecting strokes.
12. Examination of additions, alterations, and obliterations in the documents.
13. Examination of mechanical and chemical use of erasers on the documents.
14. Examination of indented handwriting.
15. Examination of writing inks by TLC.
16. Familiarization of VSC (Demo only).
17. Familiarization of ESDA (Demo only).

***Forensic Ballistics*:**

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

18. Characteristics of Firearms- Caliber, Choke, Trigger pull, and Proof marks (Demo only).
19. Examination and comparison of fired bullet with reference to caliber, rifling characteristics, and identification of firearm (Demo only).
20. 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).
21. Determination of shot numbers from size and weight of shots.
22. Identification of propellants (Demo only).
23. Chemical tests for powder residue and barrel wash (Demo only).
24. Instrumental examination of GSR (Demo only).

FSC2L12 PRACTICAL ON FSC2C08 & FSC2C09

1. Detection of low explosives by chemical/ color test and TLC.
2. Analysis of phenolphthalein in bribe trap cases.
3. Examinations of petroleum products as per BIS specifications.
4. Identification of NDPS drugs by color test and TLC (Demo only).
5. Identification of acidic and basic drug by UV/ TLC.
6. Identification of alcohol by chemical/ color test.
7. Identification of adulterants in some common food samples by chemical methods/color test (Turmeric, chilli, ghee, honey, pulses, sugar, salt etc.)
8. Analysis of NDPS drugs by instrumental methods (Demo only).
9. Systematic extraction and detection of poisons and drugs from visceral samples by various suitable chemical and instrumental techniques.
10. Detection of metallic poisons from viscera samples and food samples.
11. Identification of plant poisons.
12. Microscopic examination of hairs – identification of species origin.
13. Microscopic examination of diatoms.
14. Different staining procedures for cellular organelles.
15. Physical, biochemical and spectrophotometric examination of blood stains.
16. Examination of seminal stains by crystal tests, biochemical and microscopical analysis.
17. Examination of saliva and its stains.
18. Biochemical and microscopic examination of urine, vomit and sweat.
19. Determination of origin of species from biological fluids.
20. Blood group typing of biological fluid stains by absorption elution, absorption inhibition and mixed agglutination techniques.
21. Experiments on electrophoresis of red cell isoenzymes e.g. PGM, GLO-I, EsD, EAP.
22. Isolation of DNA from blood and its quantification.
23. Collection of body fluids and extraction of DNA using FTA card.
24. Examination of Long bones- Femur, Humerus.
25. Identification of individuals by long bones and stature estimation.
26. Determination of sex and age from skull with mandible.
27. Determination of sex from pelvis and sacrum.
28. Identification of individuals by dental examination.
29. Anthropometry- Identification of individuals (in living).
30. Postmortem examination in various Asphyxial deaths (Video demonstration only).
31. Postmortem examination of various homicidal/ accidental injuries (Video demonstration only).

Courses offered for M.Sc. Forensic science programme under CBCSS pattern in affiliated colleges (2020 onwards)
3rd Semester M.Sc. Forensic Science course

Third semester- Theory and practical courses

Course code No.	Title of the course	Credits	External weightage	Internal weightage
FSC3C13	DIGITAL & CYBER FORENSICS	4	30	5
FSC3C14	CRIME SCENE MANAGEMENT	4	30	5
FSC3E15	QUESTIONED DOCUMENTS & FORENSIC ACCOUNTING#	2	30	5
FSC3E16	FORENSIC DERMATOGLYPHICS#	2	30	5
FSC3E17	PHARMACOLOGY AND PHARMACEUTICAL DRUG ANALYSIS #	2	30	5
FSC3E18	MODERN & APPLIED ANALYTICAL FORENSIC CHEMISTRY#	2	30	5
FSC3E19	MOLECULAR BIOLOGY & GENETICS#	2	30	5
FSC3E20	ENVIRONMENTAL BIOTECHNOLOGY & MICROBIAL FORENSICS#	2	30	5
FSC3L21	PRACTICAL ON FSC3C13 & FSC3C14	4	24	5
FSC3L22	PRACTICAL ON FSC3E15 & FSC3E16#	4	24	5
FSC3L23	PRACTICAL ON FSC3E17& FSC3E18#	4	24	5
FSC3L24	PRACTICAL ON FSC3E19& FSC3E20#	4	24	5

FSC- Forensic Science; C- Core course theory; E- Elective course theory; L- Practical; 3- III semester

#Elective Courses (Two theory courses in any of the following combinations FSC3E15 & FSC3E16; FSC3E17 & FSC3E18; FSC3E19 & FSC3E20 and its corresponding practical need to be opted by the student)

SELECTION OF ELECTIVE COURSES BY THE AFFILIATED COLLEGES:

The college authorities have the absolute discretion to select any two of the elective theory courses and their corresponding practical in the above-mentioned combination#.

BASIC ELIGIBILITY FOR SELECTING ELECTIVE COURSES BY THE STUDENTS:

FSC3E15 & FSC3E16: Students from all streams mentioned in the admission criteria of M.Sc. Forensic Science programme.

FSC3E17 & FSC3E18: Students should have studied Chemistry/ Biochemistry as core/ complementary course for at least 2 semesters at the graduation level.

FSC3E19 & FSC3E20: Students should have studied Zoology/ Botany/ Chemistry/ Microbiology/ Medical Microbiology/ Biochemistry/ Medical Biochemistry/ Biotechnology/ Genetics as core/ complementary course for at least 2 semesters at the graduation level.

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 in combinations as mentioned above.

FSC3C13 DIGITAL & CYBER FORENSICS

(4 credit, 54 hrs)

Module I: (12 hrs)

Computer System Architecture

- CPU, Multiprocessing, Operating System Components, Memory Types, Virtual Memory, Input and Output Devices, Block diagram of a generic computer.
- 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: (12 hrs)

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.
- Analysing and recovering deleted files and folders.

Module III: (10 hrs)

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: (10 hrs)

Web Browsers and Email

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

Module V: (10 hrs)

Smart Phones

- Types of Smart Phones and the Operating Systems.

- Collection and Preservation of Mobile Phone and PDA.
- Analysing mobile phone evidence, Rooting and Jail Braking.
- Virtual Machine and Cloud Technology Forensics.

Recommended reading:

1. Miller M.: Absolute Beginner's Guide to Computer basics (5th Edn.), Que, 2009.
2. Block diagram of a generic computer (Ref: Figure 1-11 of https://www.oreilly.com/library/view/designing-embedded-hardware/0596007558/ch01.html).
3. Bill Nelson, Amelia Phillips; Guide to Computer Forensics and Investigation, ISBN-10: 1435498836, ISBN-13: 978-1435498839.
4. Eric Cole, Network Security Bible, Second Edition ISBN-100470502495 ISBN-13 978-0470502495 [OSI and TCP/IP layers].
5. Harlan Carvey; Windows Forensic Analysis Toolkit, Syngress, 2012.
6. Anthony Reyes, Jack Wiles; The Best Damm Cybercrime and Digital Forensics Book, Syngress, USA, 2007.
7. Aaron Philipp, David Cowen, Chris Davis; Hacking Exposed Computer Forensics Second Edition, McGrawHill, USA, 2010.
8. Cory Altheide, Harlan Carvey; Digital Forensics with Open Source Tools, Syngress, USA, 2011.
9. Andrew Hoog; Android Forensics Investigation, Analysis and Mobile Security for Google Android, Syngress, USA, 2011.
10. Hakima Chaouchi, Maryline Laurent-Maknavicius; Wireless and Mobile Network Security, Wiley, 2007.
11. Dan Kusnetzky; Virtualization: A Manager's Guide, O'Reilly, 2011.

FSC3C14 CRIME SCENE MANAGEMENT

(4 credit, 54 hrs)

Module I: **(12 hrs)**

Crime scene management

- Introduction to the crime scene, Types of crime scene, Evaluation and processing of crime scene, Securing the scene of crime, Documenting the crime scene (Note making, sketching, photography, videography of crime scene), role of the first arriving officer at the crime scene.
- Digital Imaging of Crime Scene, 3-D scanning technique.
- Searching techniques of Crime scene, Processing of physical evidence-discovering, recognizing and examination of physical evidences.
- Collection, Safety measures for evidence collection.
- Preservation, Packaging, sealing, labelling and forwarding of physical evidences, maintaining the chain of custody, Probative value of physical evidences.
- Introduction to physical evidences, types of physical evidences, classification and role of physical evidences in criminal investigations and trails.

Module II: **(12 hrs)**

Advances in crime scene management and reconstruction:

- Tele forensic technology for crime scene investigation.
- Information, manpower, and logistics management of crime scene.

- Mobile kits and equipment, their utility on crime scene.
- Technology innovation in crime scene management.
- Case studies and report writing of crime scene visits.
- National and International scenario of crime scene management.
- Steps involved in crime scene reconstruction (Recognition of evidence, Documentation of evidence, Collection of evidence, Evaluation of evidence, Hypothesis, Testing, and 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.
- Digital aids in documentation and reconstruction (3-D scanning, computer aided reconstruction).

Module III: (10 hrs)

Forensic Photography

- Definition of photography.
- Cameras and its working, attachments of camera, types of camera lenses.
- Crime scene and laboratory photography, UV and IR photography, Photomicrography and macro photography.
- Digital photography, digital imaging, photogrammetry.
- Basic concepts of videography/high speed videography.

Module IV: (10 hrs)

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, Artefactual bloodstain patterns, Documentation.
- Evaluation and importance of bloodstain evidences.
- Dealing with risks associated with blood-borne pathogens.

Module V: (10 hrs)

Report writing and 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.
- 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, Academic Press, London, 2006.
2. Mordby, J. & Reckoning, D; The Art of Forensic Detection, CRC Press New York, 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, New York, 2003.
7. James, S. H., Kish, P. E., & Sutton, T. P. (2005). Principles of bloodstain pattern analysis: theory and practice. CRC press.
8. Nanda B.B and Tewari, R.K; Forensic Science in India- A vision for the Twenty First Century, Select Publisher, New Delhi, 2001.
9. James, S.H and Nordby, J.J; Forensic Science- An Introduction to Scientific and Investigative Techniques, CRC Press, USA, 2003.
10. Saferstein; Criminalistics- An Introduction of Forensic Science, Prentice Hall Inc, USA,2007.

FSC3L21 PRACTICAL ON FSC3C13 & FSC3C14

(Minimum 75% of the experiments from each section shall be performed)

Practical on Digital and Cyber Forensics

- Identification of storage media and its authentication.
- Collection of digital evidences using different software.
- Imaging the seized storage media with different imaging format.[Disk Forensics]
- Recovering the deleted files and folders. [Disk Forensics]
- Analysing the image file for hidden files and folders including slack space. [Disk Forensics].
- Collection and Preservation of Volatile data from the standalone computer.
- Network data collection and preservation. [Network Forensics].
- Capture and Analysis the TCP packet from the LAN. [Network Forensics].
- Collecting Registry, Event logs and Executable files details using Forensic Tools.
- Analysis the browser detail of Internet Explorer and Header details of email.

Practical on Crime Science Management

- Forensic crime Scene Management.
- Sketching and photography of scene (Indoor & outdoor) of crime.
- Collection and packing of physical clues (Biological/Physical/Chemical) at the scene of crime. Reconstruction and evaluation of scene of crime.
- Blood Spatter Analysis (Height of fall, Angle of Impact, etc.).

FSC3E15 QUESTIONED DOCUMENTS & FORENSIC ACCOUNTING

(2 credit, 54 hrs)

Module I: **(12 hrs)**

- 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: **(12 hrs)**

- 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: **(10 hrs)**

- Examination of Photostat (Xerox) copies, carbon copies, fax message, typewriting, printed matter: letterpress printing, intaglio printing, offset printing, screen printing and its related concepts
- Types of printing of security documents.
- Examination of counterfeit currency notes, passports, visa, credit cards, debit cards, pan card, license, stamp papers, legal deeds, postal stamps, etc., related case studies.

Module IV: **(10 hrs)**

- Determination of age of document and writings.
- Types of computer printers and their working: dot-matrix, daisywheel, line printers, ink-jet, thermal jet and laser printers, examination of computer printouts.
- Forensic linguistics and stylistics, its importance in writer identification.
- Examination of e-documents and digital signatures.
- Opinion- Reporting to the court juxtaposed charts - evidence in the court- cross examination, related case studies.

Module V: **(10 hrs)**

- 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 Bates Springfield, Illinois, USA (1971).
5. Wilson R. Harrison; Suspect Documents Their Scientific Examination, Universal Law Pub. Delhi Indian Reprint (2001).
6. Hard less H.R; Disputed Documents, Handwriting and Thumbs – Print Identification, profusely illustrated, Law Book, Allahabad (1988).
7. Morris Ron N; Forensic Handwriting Identification, Academic Press, London (2001).
8. Lerinson Jay; Questioned Documents, Acad. Press, London (2001).
9. Mcmenamin, Gerald R; Forensic Linguistics- Advances in Forensic Stylistics, CRC Press, Washington, D.C. (2002).
10. Ellen David; Questioned Documents- Scientific Examination, Taylor & Francis, Washington (1997).
11. Roy A Huber, A.M. Headrick; Handwriting Identification- Facts and Fundamental, CRC Press (1999).

FSC3E16 FORENSIC DERMATOGLYPHICS

(2 credit, 54 hrs)

Module I: (14 hrs)

Fingerprints and Palm prints

- History and development of dermatoglyphics.
- Fingerprint: Nature, Location, Classification, Types, Patterns of Fingerprints.
- Poroscopy and Edgeoscopy.
- Classification of Fingerprints: Henry's Classification, Single Digit Classification, Extended Henry's system.
- Types of Fingerprints, Invisible finger marks development methods.
- Recent techniques (Digital imaging & enhancement, laser & other radiation based techniques).
- Preservation and photography of fingerprints on various surfaces.
- Ridge counting, ridge tracing, minutiae identification and matching.
- Palm Prints.

Module II: **(13 hrs)**

Footwear impressions and Gait pattern analysis

- Footwear Impressions-Introduction-Forms of footwear impressions-Information from footwear impressions.
- Location and recovery of footwear impressions-Enhancement methods-Preparation of exemplars-The examination process.
- Gait pattern.
- Case histories.

Module III: **(13 hrs)**

Tire impressions

- Introduction-Original equipment tires, Replacement tires and tire construction.
- Tread nomenclature and sidewall information-Tread wear indicators-Retreated tires-Tire reference material and databases.
- Tire track evidence and recovery-Known tires and exemplars.
- Tire impressions examination process.
- Case histories.

Module IV: **(14 hrs)**

Imprints

- Lip Prints-Introduction- Scope-Application in crime detection.
- Ear Prints-Introduction-Morphology of ear – Ear prints location-Producing standards from suspects-Identification and comparison.
- Bite marks-Introduction-Significance-Judicial Acceptance-Description of prototypical bite marks-Evidence collection on victim and suspects-Identification and comparison.
- Case histories.

Recommended reading:

1. Bridges, B.C; Criminal Investigation, Practical Fingerprinting, Thumb Impression, Handwriting expert Testimony, Opinion Evidence., Univ. Book Agency, Allhabad,2000
2. Mehta, M.K; Indentification of Thumb impression & cross examination of Fingerprints, N.M. Tripathi Pub. Bombay, 1980.
3. Chatterjee, S.K; Speculation in Fingerprint Identification, Jantralekha printing Works, Kolkata, 1981.
4. Cowger James F; Friction Ridge Skin- Comparison & Identification of Fingerprints, CRC Press, NY, 1993.
5. Cossidy, M.J; Footwear Identification, Royal Canadian, Mounted Police, 1980.
6. Iannavelli, A.V; Ear Identification, Forensic Identification Series, Paramount, 1989.
7. Henry, C.L. & Ganesslen, R.E; Advances in Fingerprint Technology, CRC Press, London, 1991.

FSC3L22 PRACTICAL ON FSC3E15 & FSC3E16

(Minimum 75% of the experiments from each section shall be performed)

Practical on Forensic Document examination:

- Working and handling of Stereo Zoom Microscopes, Video Spectral Comparator, Electrostatic Detection Apparatus (Demo only).
- Forensic identification of class and individual characteristics of handwriting.
- To detect and decipher alterations in a document.
- To decipher secret writings, indentations and charred documents.
- To study the handwriting of ethnic and population groups.
- Reconstruction of torn sheets of paper.
- Examination of creases and folds and determination of sequence of strokes.
- Examination of paper.
- Analysis of inks by TLC.
- Identification of normal/ disguised writings.
- Detection of built-up documents.
- Examination of anonymous letters.
- Application of Forensic stylistics in personal identification.
- Effect of writing instruments, posture and emotions on handwriting.
- Examination of rubber stamp impressions and other mechanical impressions.

Practical on Dermatoglyphics:

- To obtain class characteristics of fingerprints.
- To obtain individual characteristics of fingerprints
- Study of pores on friction ridges.
- To perform ridge tracing and ridge counting.
- Fingerprint classification using Henry system.
- Latent Fingerprint Development using Powder methods.
- Casting/Lifting/Evaluation of Footprints/Footwear Impressions.
- Casting/Lifting/Evaluation of Tyre marks/skid marks.
- Casting/Lifting/Evaluation of tool marks on different objects.
- Classification/Lifting/Analysis of Lip prints.
- Casting/Lifting/Evaluation of Ear prints.

FSC3E17 PHARMACOLOGY AND PHARMACEUTICAL DRUG ANALYSIS
(2 credit, 54 hrs)

Module I: **(12 hrs)**
Basic Principles of Pharmacology

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

Module II: **(12 hrs)**
Pharmacokinetics

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

Module III: **(10 hrs)**
Pharmacology and Pharmaceutical Analysis

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

Module IV: **(10 hrs)**
Pharmacology and Pharmaceutical Analysis

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

Module V: **(10 hrs)**

Pharmacological action and pharmaceutical analysis

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

Recommended reading:

1. Jaisingh P Modi, A Textbook of Medical Jurisprudence and Toxicology, Edited by Justice K Kannan, 26th Edition, 2019, LexisNexis.
2. Simpson's Forensic Medicine, 14th Edition, Edited By Jason Payne, James Richard, Martin Jones, 2020.
3. The Principles and Practice of Medical Jurisprudence / by Alfred Swaine Taylor, 2015.
4. Polson's Essentials of Forensic Medicine, 5th Edition, Christopher Milroy, Michael Polanen, David Wells, 2009.
5. KS Narayan Reddy, The essentials of Forensic Medicine,33rd Edition, KSN Reddy, Jaypee,2017.
6. Moffat, A.C. : Osselton, D. M. Widdop, B. : Clarke's Analysis of Drugs and Poisons in Pharmaceuticals, body fluids and postmortem material, 3rd ed., Pharmaceutical Press2004.
7. Rang, P.H., Dale, M.M., Ritter, M.J.: Pharmacology, 4th ed., Harcourt/Churchill Livingstone, 2000.
8. Paranjape, H.M., Bothara, G.K., Jain, M.M.: Fundamentals of Pharmacology, 1st ed., Nirali Prakashan, 1990.
9. Sunshine, I: Handbook of Analytical Toxicology, press, 1969.
10. Mule, S. J. et al.: Immunoassays for Drugs subjects to ab, CRC Press, 1974.
11. Connors, K.: A text book of Pharmaceuticals analysis, Interscience, New York, 1975.
12. Niesink, RJM; Toxicology- Principles and Applications, CRC Press, 1996.

FSC3E18 MODERN & APPLIED ANALYTICAL FORENSIC CHEMISTRY
(2 credit, 54 hrs)

Module I: **(12 hrs)**

Petroleum Chemistry and Forensic Analysis of Petroleum products

- Paraffins, Iso-olefins, Olefin Hydrocarbons, Naphthenes, Cycloparaffins or Aromatic Hydrocarbons, Sulphur Compounds, Nitrogen Compounds, Oxygen Compounds, Organo-Metallic Hydrocarbons; H/C Ratio of Hydrocarbons.
- Physical Properties of Petroleum Products : Density, Viscosity, Surface Tension, Color, Fluorescence, Cloud Point, Pour Point, Aniline Point, smoke point, boiling point, Optical Properties, Flash Point, Refractive Index and Calorific Value, Determination of Cetane and Octane number.

- Analytical Techniques: Quantitative and Qualitative Analysis of Petroleum products.

Module II: (10 hrs)
Arson chemistry and Forensic analysis

- Scientific Investigation of Fire, The chemistry and physics of combustion, Dynamics of Fire, Development of fire patterns.
- Separation and analytical techniques of ignitable liquid residues, Field tests, Interpretation of Data Obtained from Fire Debris, Quality Assurance in Fire debris Analysis.

Module III: (10 hrs)
Explosives chemistry and Forensic analysis

- Introduction and assessment of explosives , Oxygen balance, Explosive Power Index, Heat and Temperature of Explosion, Pressure of explosion, Mechanism of Ignition and hot spot formation.
- Thermal decomposition, physical and chemical aspects of combustion, Deflagration and Detonation, Kinetics of explosive reactions.
- Analysis of low and high explosives by different instrumental techniques, Quality control, Proficiency Testing, Interpretation and significance of results.

Module IV: (10 hrs)
Food Chemistry and forensic food analysis

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

Module V: (12 hrs)
Drug Chemistry and Forensic drug analysis

- Introduction to Drugs, Forensic examination of drugs/Narcotics (Cannabis), Phenethylamines (Amphetamine, Methamphetamine), Hydroxyl derivative (Ephedrine) Ketone Derivative (Cathinone), Methoxy Derivative (Mescaline) Tertiary Amines (Cocaine and Opiates) Tryptamines (Psilocin and Psilocybin).
- Anabolic Steroids, Miscellaneous Controlled Substances (Barbiturates, Benzodiazepines, GHB, Ketamine and LSD).
- Sample Preparation, Extraction Techniques- Chemical-color test, Microcrystal techniques and other instrumental techniques involved in analysis.

Recommended Reading:

1. Bassett: Vogel's Text Book of Quantitative Inorganic Analysis, Longman, 1978.
2. Vogel, A. I: Text Book of Practical Organic Chemistry including Qualitative Organic Analysis, ELBS, 1971.
3. Skoog, D. A., West, D. M. and Holler, F. J: Analytical Chemistry: An Introduction, Saunders College, 1994.

4. Siegel, J. A, Saukko, P. J. and Knupfer, G. C: Encyclopedia of Forensic Sciences, Academic Press, 2000.
5. Townsends, A. (Ed): Encyclopedia of Analytical Science, Academic Press, 2005.
6. Beveridge, A: Forensic Investigation of Explosives, Taylor & Francis, 2000.
7. Yallop, H. J: Explosion Investigation, Forensic Science Society & Scottish Academic Press, 1980.
8. Narayanan, T. V: Modern Techniques of Bomb Detection and Disposal, R. A. Security System, 1995.
9. Yinon, J. and Zitrin, S: The Analysis of Explosives, Oxford: Pergamon, 1981
10. Kinghorn: Introduction to Petrochemicals Sukumar Maiti
11. D.W.Waples : Geochemistry in Petroleum Exploration
12. A.L.Waddams : Petroleum Geochemistry and Geology Chemicals from Petroleum
13. Day & Underwood :Analytical Chemistry
14. H. J. Arnikar Essentials of Nuclear Chemistry, 4th Edition Wiley Eastern (1987).
15. H. J. M. Bowen. Buttler and Tanner Chemical Applications of Radioisotopes, (1969).
16. G Friedlander, T. W. Kennedy, E. S. Macias and J. M. Miller, Introduction of Nuclear and Radiochemistry, 3rd Edition, John Wiley (1981).
17. P.D. Vowels and D.W: Experiments in Environmental chemistry.
18. Curry: Analytical Methods in Human Toxicology, Part II, 1986.
19. Curtis Klaassen, Casarett & Doll Toxicology: The Basic Science of poisons, 8th Edtion, Mc Graw Hill,2013
20. 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.
21. Holfmann, F.G.: Handbook of Drug and Alcohol Abuse.
22. Sunshine, I: Guidelines for Analytical Toxicology Programme, Vol-I, CRC press, 1950.
23. Sunshine, I: Handbook of Analytical Toxicology, press, 1969.
24. Mule, S. J. et al.: Immunoassays for Drugs subjects to ab, CRC Press, 1974
25. Connors, K.: A text book of Pharmaceuticals analysis, Interscience, New York, 1975
26. Niesink, RJM; Toxicology- Principles and Applications, CRC Press, 1996
27. Jaisingh P Modi, A Textbook of Medical Jurisprudence and Toxicology ,Edited by Justice K Kannan,26th Edition,2019,LexisNexis
28. Morrison R.T and Boyd R. N; Organic Chemistry 6th Ed Prentice Hall, 2003
29. Laboratory procedure Manual, Forensic Toxicology: Directorate of Forensic Science, MHA, Govt.
30. of India, 2005
31. Laboratory Procedure Manual : Petroleum Products, Directorate of Forensic Science, MHA, Govt. of India, 2005
32. Working Procedure Manual on Chemistry ; Directorate of Forensic Science MHA Govt. of India,2005
33. Welcher F; Standard Methods of Chemical Analysis, 6^{th} Ed. Van Nostrand Reinhold, New York,1969
34. Watson C. A; Official and Standardised Methods of Analysis, Royal Society of Chemistry, UK, 1994.

FSC3L23 PRACTICAL ON FSC3E17& FSC3E18

(Minimum 75 % of the total experiments shall be performed)

- Systematic extraction, isolation, purification and identification of volatile, acidic, basic and neutral drugs by various analytical techniques.
- Qualitative and quantitative analysis of Pharmaceuticals by various chemical and instrumental techniques.
  - Presumptive/ screening tests.
  - Microscopic analysis
  - Microcrystalline test
  - UV spectroscopy
  - HPLC, LC-MS, GC, GC-MS, GC-IR
- Separation of alkaloids, glycosides, tryptamines by TLC.
- Separation of Psychotropic substance by TLC.
- Separation of Cannabis/Opium by TLC.
- Separation of lipids by TLC.
- Analysis of high explosives by color test and TLC.
- Extraction of caffeine from tea leaves, characterization by IR.
- Estimation of protein in food samples.
- Analysis of calcium and magnesium in milk.
- Analysis of fire residues by GC.
- Analysis of adulterated and non-adulterated oil by chemical/Color Test and TLC method.
- Analysis of dye in petrol and kerosene by UV spectrophotometry and TLC.
- Estimation of nitrite/nitrate in water samples.
- Separation of amino acids by thin layer chromatography.
- Analysis of NDPS drugs and explosives by instrumental techniques.

FSC3E19 MOLECULAR BIOLOGY & GENETICS
(2 credit, 54 hrs)

Module I: (12 hrs)

Immunology

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

- Lectins and their forensic significance.

Module II: **(12 hrs)**

DNA, RNA and Protein Metabolism

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

Module III: **(10 hrs)**

Population Genetics and Bioinformatics

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

Module IV: **(10 hrs)**

Advanced methodologies in Forensic DNA analysis

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

Module V: **(10 hrs)**

Recent developments and future directions in DNA profiling

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

Recommended Reading:

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

FSC3E20 ENVIRONMENTAL BIOTECHNOLOGY & MICROBIAL FORENSICS
(2 credit, 54 hrs)

Module I: (12 hrs)

Introduction to Recombinant DNA technology, Bioprocess and Bio-chemical engineering

- DNA modifying enzymes.
- Cloning strategies: Genomic libraries, cDNA libraries, single gene cloning.
- RAPD, RFLP and AFLP.
- Vectors: Types of vectors and choice of vectors- Plasmids, cosmids, lamda phage vectors, shuttle vectors, BACs and YACs.
- Transformation and Transfection.
- Expression systems in Eukaryotic cells, Yeast, Bacteria, Insect cell lines, Gene screening.
- Biosafety guidelines and containment strategies.
- Bioreactor design: Body construction, aeration and agitation, operation and applications.
- Microbial Growth: measurement, batch and continuous culture and its kinetics.
- Downstream processing: recovery and purification of products.
- Strains improvement.
- Fermentation economics.

Module II: (10 hrs)

Animal and Plant biotechnology

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

Module III: (10 hrs)

Bio therapeutics and industrial microbiology

- Introduction to industry important recombinant proteins, recombinant protein stability,
- Improvised recombinant protein secretion,
- Introduction to industrially important primary and secondary metabolites from plants and microbes
- Microbial production: Antibiotics, acetic acid, lactic acid, wine, beer, SCP.
- Food borne – shigella, salmonella. etc. Forensic aspects of biological toxins.

Module IV: **(10 hrs)**

Regulatory affairs and IPR

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

Module V: **(12 hrs)**

Microbial Forensics

- Defining the microbial forensics program, epidemiology, microbial forensic tools.
- Dynamics of disease transmission, Outbreak Investigation., Deliberate introduction of a biological agent.
- Microbes of Forensic Importance: *Bacillus anthracis, Yersinia pestis, Francisella tularensis, Brucella spp., Burkholderia Pseudomallei, Clostridium botulinum, Listeria monocytogenes* and their morphological and 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 outbreaks of viral diseases.
- Biosafety and biosecurity, Bio surveillance, documentation, and case studies.

Recommended Reading:

1. Pharmaceutical Biotechnology: Concepts & Applications – Gary Walsh (Wiley).
2. Modern Industrial Microbiology and Biotechnology – Nduka Okafor (Science Publisher).
3. Biotechnology and Biopharmaceuticals – Rodney J.Y.H.O and Milo Gibaldi (Wiley).
4. Biotechnology in Healthcare – Gavin Brooks (PLP).
5. Gene Therapy: Protocols - Joseph M. Le Doux (Humana Press).
6. Biotehnology – Applying the genetic revolution – David P. Clark and Nanette J. Pazdarnik, Academic Press, ISBN: 978-0121755522.
7. Molecular Biotechnology: Principles and Applications of Recombinant DNA, 4th Edition – Bernard G. Glick, Jack J. Pasternak and Cheryl L. Patten, ASM Press, ISBN: 978-1555814984.
8. Plant, Gene and Crop Biotechnology, 2nd Edition – Maarten J. Chrispeels and David E. Sadava, Jones and Bartlett Publishers, ISBN: 978-0763715861.

9. Biotechnology – U. Satyanarayana, Books and Allied (P) Ltd.
10. Plant Tissue Culture by MK Razdan & SS Bhojwani (1996) Elsevier.
11. Freshney, Culture of Animal Cells, 5th Edition, Wiley-Liss, 2005.
12. Ed. John R.W. Masters, Animal Cell Culture - Practical Approach,3rd Edition, Oxford University Press, 2000.
13. Microbial Forensics : Roger G Breeze, Bruce Budowle, Steven E Schutzer.
14. Microbial Forensics : Bruce Budowle, Steven E Schutzer, Roger G Breeze, Paul S Keim, Stephen A Morse.
15. Chemical and Physical Signatures for Microbial Forensics: Cliff, J.B, Kreuzer, H.W, Ehrhardt C.J, Wunschel, D.S.

FSC3L24 PRACTICAL ON FSC3E19 & FSC3E20

(Minimum 75 % of the total experiments shall be performed)

- Extraction of proteins from various biological samples.
- Protein estimation by different techniques.
- SDS-PAGE for protein analysis.
- DNA extraction from various forensic samples.
- Polymerase chain reaction.
- STR Genotyping and interpretation.
- Sequence comparison using BLAST.
- Construction of Phylogenetic tree from nucleotide and protein sequences.
- Analysis of protein structure using RASMOL.
- Validation of various instruments.
- Isolation of bacteria by different methods.
- Genomic and Plasmid DNA Isolation from bacteria.
- Restriction digestion of DNA.
- RAPD/AFLP for GMO detection.
- Agarose gel electrophoresis.
- Western Blotting.
- Preparation of the competent cells for transformation.
- Selection of the transformed cells.
- Growth curve of *E. Coli* and determination of growth rate and generation time.
- Microbial production of citric acid.

DRAFT

UNIVERSITY OF CALICUT

SYLLABUS

for

M.Sc. Forensic Science

(CBCSS PG 2019)

Under Choice Based Credit Semester System

(w.e.f. 2020 Admission)

Courses offered for M.Sc. Forensic science programme under CBCSS pattern in affiliated colleges (2020 onwards)
4th Semester M.Sc. Forensic Science course

Fourth semester- Theory and practical courses

Course code No.	Title of the course	Credits	External weightage	Internal weightage
FSC4P25	PROJECT	4	24	5
FSC4V26	COMPREHENSIVE VIVA	4	24	5
FSC4E27	MODERN TRENDS IN FINGERPRINT SCIENCE*	4	30	5
FSC4E28	FORENSIC PHOTOGRAPHY & BIOMETRICS *	4	30	5
FSC4E29	EXPLOSIVE ANALYSIS & POST BLAST INVESTIGATION*	4	30	5
FSC4E30	SCIENTIFIC PROTOCOLS FOR FIRE INVESTIGATION*	4	30	5
FSC4E31	FORENSIC- ANTHROPOLOGY, ENTOMOLOGY & ODONTOLOGY*	4	30	5
FSC4E32	WILDLIFE FORENSICS*	4	30	5
FSC4L33	PRACTICAL ON FSC4E27&FSC4E28*	4	24	5
FSC4L34	PRACTICAL ON FSC4E29&FSC4E30*	4	24	5
FSC4L35	PRACTICAL ON FSC4E31&FSC4E32*	4	24	5

FSC- Forensic Science; C- Core course theory; E- Elective course theory; L- Practical; P- Project; V- Comprehensive viva; 4- IV semester. *Elective Courses {Two theory course (corresponding to the elective courses in the 3rd Semester) in any of the following combinations FSC4E27 & FSC4E28; FSC4E29 & FSC4E30; FSC4E31 &FSC4E32; and its corresponding practical need to be opted by the student}.

FSC4P25 PROJECT

The teacher who gives guidance to project work can select any topic from the syllabi related to the core/ preferably to the elective course. The topic shall be assigned to each student. The research work on this topic shall be carried out by each student under the supervision of the teacher. The report of the research work shall be submitted by each student in the form of a Dissertation which shall be attested by the Head of the Department and shall be submitted for the evaluation. A declaration by the student to the effect that the dissertation submitted by him/ her has not previously been formed the basis for the award of any degree or diploma and a certificate by the supervising teacher to the effect that the dissertation is an authentic record of work carried out by the student under his/her supervision are to be furnished in the dissertation.

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

FSC4 E27 MODERN TRENDS IN FINGERPRINT SCIENCE

(4 credit, 54 hrs)

Module I: Powder Method (10 hrs)

- Fundamental principles of fingerprint science
- Anatomy of skin, biological significance of skin - Composition of sweat, secretary glands eccrine glands apocrine glands, sebaceous glands chemical composition.
- 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: Chemical methods (12 hrs)

- Cyanoacrylate esters acceleration procedures, chemical reaction, Post treatment procedures.
- Fluorescent and other chemical alternatives, DFO.
- Ninhydrin analogues, silver nitrate reagent, amino acid reagents, reaction mechanism.
- Special surfaces and situations- bloody prints, tape and sticky surfaces and skin.
- Iodine fuming, Iodine fixation, Operational uses- vapor method, dusting method, Solution method, miscellaneous fuming method-Osmium/ruthenium Tetroxide, soot method, Disulfur dinitrite, etc.
- Postmortem fingerprinting techniques.

Module III: Metal deposition and Advanced Methods (12 hrs)

- Silver nitrate, Physical developer- Chemistry and mechanism, 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.
- 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.
- Skin- Iodine silver plate transfer, Electronography, Powder method, Cyno-acrylate fuming, Iodine-Napthoflavone.

Module IV: Latent print enhancement technique (10 hrs)

- Using photo luminescent nano particles.
- Basics of phase resolved imaging.
- Fingerprint treatments- lanthanide based procedures.
- Photo luminescent fluorescence and phosphorescence
- Use of Nano particles- cadmium, zinc, silver salts.

Module IV: Automated Fingerprint Identification System (10 hrs)

- Introduction, emerging application System architecture, sensing, finger print representation.
- Minutiae feature extraction, orientation, estimation, segmentation.
- Segmentation, ridge detection, finger print matching enhancement.
- Challenges, system issues system evaluation.
- Types of AFIS searches: Ten print to Ten print search, Latent to ten print searches, Latent to latent search.
- AFIS report: Ten print report and latent print report.
- Scope of research on DNA from fingerprint residues.

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.
9. Ratha Nalini; Automatic Fingerprint recognition system, Springer Pub., NY (2004).
10. Maltoni, Davide; Handbook of fingerprint recognition, Springer Verlag, NY (2003).

FSC4E28 FORENSIC PHOTOGRAPHY & BIOMETRICS

(4 credit, 54 hrs)

Module I: **(12 hrs)**

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

Module II: **(10 hrs)**

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

Module III: **(12 hrs)**

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

Module IV: **(10 hrs)**

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

Module V: **(10 hrs)**

Gait Pattern, Keystroke Analysis, Signature Analysis, Voice pattern Analysis, Heartbeat Analysis, 3D face recognition, Geometric-Morphometrics, automatic forensic dental identification, hand vascular pattern technology, Multibiometric systems, Recent Advances in Biometrics for Security Prospects, biometric databases.

Recommended reading:

1. Blitzer, H.L and Jacob, J; Forensic Digital Imaging and Photography, Academic Press, 2002.
2. Henry Horeustein; Colour Photography -A working Manual, Little Brown Co.Boston (1995).
3. B.H.E. Jacobson, Ray GG Attridge; The Manual of Photography, Focal Press, London (1988).
4. Jahne B; Digital Image Processing, Heidelberg Springer (1996).
5. Workinson J; Art of Digital Video, Oxford Focal Press (1994).

6. Upton Kobre, Brill; Photography, Pearson Education, Inc (2006).
7. H.L. Blitzer and J.Jacobia; Forensic Digital Imaging and Photography, Academic Press (2002).
8. David R.Redsicker; The Practical Methodology of Forensic Photography- 2nd Ed. CRC Press LLC (2001)
9. R.E. Jacobson, S.F.Ray, G.G.Attridge, The Manual of Photography- Photographic and Digital Imaging, N.R. Oxford.
10. Miriam Leah Zelditch, Donald L. Swiderski, H. David Sheets, William L. Fink, Geometric Morphometrics for Biologists, Academic Press, 2004.
11. Massimo Tistarelli, Christophe Champod, Handbook of Biometrics for Forensic Science, Springer Cham, 2017.

FSC4L33 PRACTICAL ON FSC4E27 & FSC4E28

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

FSC4E29 EXPLOSIVE ANALYSIS & POST BLAST INVESTIGATION

(4 credit, 54 hrs)

Module I: Explosive Chemistry (12 hrs)

- 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: Explosions and hazards (10 hrs)

- 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: Types of explosives **(12 hrs)**

- Black powder, Nitro Cellulose, Nitro Glycerin, Dynamite, Ammonium nitrate.
- Commercial explosives (permitted explosives, ANFO and slurry explosives).
- Military explosives (picric acid, tetryl, TNT, Nitro guanidine, PETN, RDX, HMX and polymer bonded explosives).
- Bombs, Crude bombs, Home-made bombs, Improvised Explosive Devices (IEDs), Molotov Cocktail.

Module IV: Bomb disposal and Post Blast Investigation **(10 hrs)**

- Disposal of bombs, Explosions effects, Role of Forensic Scientist in Post blast investigation.
- Collection of samples and methods for extraction of explosive from post blast material/ and debris.
- Evaluation and assessment of explosion site and reconstruction of sequence of events.

Module V: Bomb/explosive detection & Explosive residue analysis **(12 hrs)**

- Equipments used for detection of explosives and explosive devices.
- Qualitative analysis of explosives and explosion residue by colour tests.
- TLC, HPTLC, High Performance Liquid Chromatography, FTIR, GC-MS, X- ray diffraction, ICP.

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
5. India (2005).
6. Cooper PW and Kurowski S R; Introduction to the Technology of Explosive VCH Publisher.
7. Cooper P. W; Explosive Engineering, VCH publisher (1997).
8. Urbanski T; Chemistry and Technology of Explosives, Pergamon Press (1985).
9. Lurie Iras & Witwer J D; High Performance Liquid Chromatography in Forensic Chemistry, Marcel Dekker (1983).
10. Feigl F; Spot Test in Inorganic Analysis, Elsevier Publ. New Delhi (2005).
11. Yallop H J; Explosion Investigation, Forensic Science Society Academy press (1980).

FSC4E30 SCIENTIFIC PROTOCOLS FOR FIRE INVESTIGATION
(4 credit, 54 hrs)

Module I: Fire and science (10 Hrs)

- Introduction, national fire protection association.
- Fire and arson, motives and pathology of arson.
- Scientific approach to fire investigation, modern fire analysis.

Module II: Chemistry and Physics of combustion (10 Hrs)

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

Module III: Fire dynamics (10 Hrs)

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

Module IV: Fire and Arson Investigation (12 Hrs)

- Introduction, need and presumption of accidental causes, planning of investigation, survey and documentation, Determination of origin and cause of fire, Reconstruction, inventory, avoiding spoliation.
- Mythology of arson investigation (sources of error in fire and arson investigation).
- Eliminating accidental cause, investigating fatal fire and vehicular fire.
- Origin determination, hypothesis development and testing of hypothesis.
- Evidence collection, preservation.
- Reporting procedures and conclusion.
- Professional practice of fire investigation.

Module V: Analysis of ignitable residues and evaluation of ignition sources (12 Hrs)

- Introduction, Evolution of separation and analytical techniques and standard methods.
- Isolation of the residue, Analysis of ILR (ignitable liquid residue).
- Criteria for identification 1) Identification of gasoline 2) distillates and other classifiable products.
- Improving sensitivity and estimation of the degree of evaporation.
- Reporting procedures, quality assurance and conclusion.
- Evaluation of ignition sources.
- Introduction 1) Joint examination of physical evidence appliances and electrical components 2) Testing of ignition scenario, spontaneous ignition tests, conclusion.

Recommended reading:

1. Scientific protocols for fire investigation John J. Lentini CRC press.
2. Practical fire and arson investigation David R. Redsicker, John J.O 'Connor CRC press.
3. Laboratory Procedure Manual: Petroleum Products, Directorate of Forensic Science, MHA, Govt. of India, 2005
4. Working Procedure Manual on Forensic Chemistry: Directorate of Forensic Science MHA Govt. of India, 2005.
5. Welcher F; Standard Methods of Chemical Analysis, 6th Ed.Van Nostrand Reinhold, New York, 1969.
6. Watson C. A; Official and Standardised Methods of Analysis, Royal Society of Chemistry,
7. UK,1994.
8. Bassett: Vogel's Text Book of Quantitative Inorganic Analysis, Longman, 1978.
9. Vogel, A. I: Text Book of Practical Organic Chemistry including Qualitative Organic Analysis, ELBS, 1971.
10. Skoog, D. A., West, D. M. and Holler, F. J: Analytical Chemistry: An Introduction, Saunders College, 1994.
11. Siegel, J. A, Saukko, P. J. and Knupfer, G. C: Encyclopedia of Forensic Sciences, Academic Press, 2000.

FSC4L34 PRACTICAL ON FSC4E29 & FSC4E30

- TLC analysis of explosive residues.
- HPTLC analysis of explosive residues
- HPLC analysis of explosive residues.
- Identification and comparison of explosives by FTIR.
- GC-MS analysis of explosive residues.
- Analysis of fire residues by GC.

FSC4E31 FORENSIC- ANTHROPOLOGY, ENTOMOLOGY & ODONTOLOGY
(4 credit, 54 hrs)

Module I: Forensic Anthropology (10 hrs)

- Introduction to forensic anthropology.
- Forensic Anthropometry, osteometry.
- Relative dating techniques, Chronometric dating techniques.
- Identity of missing person by superimposition techniques.
- Facial reconstruction method.
- Portrait parley.

Module II: Personal Identification of Living & Dead (12 hrs)

- Identification through somatometric and somatoscopic observation.
- Genetic traits of forensic significance.
- Sexing human skeletal remains.
- Racial differences in human skeleton.
- Distinguishing humans from other non- human skeletal remains.

Module III: Bio-archaeology (10 hrs)

- 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.

Module IV: Forensic Entomology (12 hrs)

- Taxonomy and biology/ life cycle of forensically important insects: Coleoptera – General characters.
- Taxonomy and biology/ life cycle 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.
- Collection of entomological evidence during legal investigations.
- Laboratory rearing of insects of forensic significance.
- Entomo-toxicology and chemo-ecology.
- Molecular methods for forensic entomology.

Module V: Forensic Odontology (10 hrs)

- Types of dentitions, basic structure of human teeth.

- Types of teeth and their morphology.
- Identification of individuals from teeth, ante-mortem and post-mortem dental records.
- Ages of eruption and other individual characteristics.
- Dental anomalies and their role in personal identification.
- Bite marks: Types and forensic importance.
- Role of Forensic Odontology in mass disaster victim identification.

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. The use of Forensic Anthropology, Robert Pickering & David Bachman CRC Press.
6. Physical Anthropology, B.R.K. Shukla & Sudha Rastogi Palaka Prakashan.
7. The Forensic Anthropology Laboratory, Michael W. Warren, Heather A.Haney& Laurel E. Freas; CRC Press, (2008).
8. Forensic recovery of human remains: Dopras, Schultz, Whirler, Williams.
9. Advances in Forensic Taphonomy, Method theory and Archaeological perspective.
10. Forensic Dental evidence, Mike Bowers, Elsevier Publ.
11. Practical forensic odontology, DH Clark, Butterworth-Heinemman Publ.
12. Bite Mark Evidence, Robert BJ Dorian, 1st Ed, CRP Press, 2004.
13. Forensic Dentistry, Senn DR and PG Simson, 2nd Ed, CRP Press, 2010.
14. Forensic Entomology: Jason H Byrd & James L Castner.
15. Insect Biology: Hovard Evan
16. Fundamentals of Entomology, Richard J. Flzinga Prentice hall of India Pvt. Ltd., (1978)
17. Entomology & death- A procedural guide, Catts E.P & Haskell NH; Joyce's print shop (1990).
18. A manual of Forensic Entomology Smith DGV; Ithaca NY Camstock Univ. Press, USA (1986).
19. General text book of Entomology, O.W. Richards & R.G. Davis; Chapman & hall ltd, (1973).

FSC4E32 WILDLIFE FORENSICS
(4 credit, 54 hrs)

Module I: **(10 hrs)**

- Biogeographic zones of India- wildlife sanctuaries, national parks, biosphere reserves, world heritage sites, ramsar sites, special focus on Western Ghats.
- Definition of wildlife, causes of wildlife depletion, economic importance of wildlife, need for wildlife conservation.
- History of wildlife management and conservation in India.
- Forensically important wild flora and fauna- rare, endangered, threatened and endemic species of fishes, amphibians, reptiles, birds and mammals in India; India as a mega wildlife diversity country.
- IUCN revised red list categories, Red Data Book and red listing.

Module II: **(10 hrs)**

- Overview of Wildlife (Protection) Act, 1972 and subsequent amendments; Wildlife Crime Control Bureau; The Indian Forest Act 1927 and subsequent amendments; Forest Conservation Act 1980 and Rules; Biodiversity Act 2002; Biodiversity Rules 2004; Plant Varieties Protection and Farmer's Rights Act 2001; Geographical Indications of Goods Act 1999; The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act 2006.
- Overview of Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), International Tropical Timber Agreement.
- Types of wildlife crimes- extent and kind of wildlife trade at national and international levels.
- Ramification of wildlife trade on in-situ conservation specially related to species demography.
- Illegal trade in flora and fauna with special reference to turtles, reptiles, birds and mammals and plant trade in India.
- Identification of species from different parts of reptiles, birds, mammals and plants.

Module III: **(12 hrs)**

- Approaching, defining and securing wildlife crime scene; Scene processing steps, Mapping and sketching the scene.
- Identification of physical evidence of wildlife crime.
- Evidence collection, preservation and processing of a wildlife crime scene.
- Trace evidence associated with fish and reptiles – scales, skin, and fish fillet identification.

- Trace evidence associated with avian/ mammal species– feathers, hair, bones, horns, nails; elephant teeth and tusk; tiger fur etc.
- Timber identification- Sandalwood, Teakwood, etc., Medicinal plants (MPs) and its identification.

Module IV: **(10 hrs)**

- Entomology and botany in wildlife forensic investigation.
- Decomposition analysis.
- Killing of wildlife animals- evidence of hunting, poisoning, bait bombs, electrocution etc.
- Differentiation of human and animal blood- field and laboratory analysis.
- Aspects of wildlife osteology- species identification, carcass identification. Morphometric identification.
- Live animal examinations, necropsy overview, samples from live and dead animals.
- Pugmark identification of various animals.

Module V: **(10 hrs)**

- DNA and its practical applications in wildlife crime scene processing.
- Collection, preservation and transportation of Blood – Blood stains – Feces (or Scat) – Hair/ Feathers – Horn/ Ivory/ Bone – Meat – Skin – soft tissue for DNA analysis.
- DNA isolation from fresh blood with sodium per chlorate - soft tissues (meat, cooked meat, flesh, dried meat and skin pieces) - Blood and blood stains - Bone, tusk, teeth and horns – Hair – Feathers.
- Quantification and quality check of DNA.
- Species identification technique- Mitochondrial cytochrome b (Cytb), BLAST, NCBI data base, Consortium of Barcode of Life (COBOL), genetic markers for plant and animal identification.
- Microsatellite genotyping for individual identification of animals.
- Relatedness and paternity analysis, report writing and court room presentation, case studies.

Recommended reading:

1. Berwick, S.H. and Saharia, V.B. 1995. Wildlife Research and Management. OUP, New Delhi.
2. Dasmann, R.F. 1982. Wildlife Biology.
3. Rajesh, G. Fundamentals of Wildlife Management, Justice Home, Allahabad.
4. Sawarkar B. Wildlife Management.
5. Mullineaux, E., & Keeble, E. (2016). *BSAVA manual of wildlife casualties* (No. Ed. 2). British Small Animal Veterinary Association.
6. Practical Crime Scene Processing and Investigation; Ross M. Gardner, 2nd Edition, Taylor & Francis Group, LLC, 2012.

7. Wildlife Forensic Investigation: Principles & Practice; John E. Cooper, Margaret E. Cooper. CRC Press, 2013.
8. UNODC. (2016). Best practice guide for forensic timber identification. *United Nations office on drugs and crime: international consortium on combating wildlife crime*.
9. Bhat, K. V., Balasundaran, M., & Balagopalan, M. (2006). Identification of *Santalum album* and *Osyris lanceolata* through morphological and biochemical characteristics and molecular markers to check adulteration. *Kerala Forest Research Institute, Thrissur, India*.
10. Arun Suma, E. M. Muralidharan, P. Sujanapal, M. Balasundaran. Identification of market adulterants in East Indian sandalwood using DNA barcoding. Annals of Forest Science, Springer Nature (since 2011)/EDP Science (until 2010), 2014, 71 (6), pp.517-522. ff10.1007/s13595-013-0354-0ff. ffhal01101762.
11. Handbook: Standard Operating Procedures for forensic investigations of suspected illegal killings of Wildlife. Research Institute of Wildlife Ecology (FIWI) of the University of Veterinary Medicine Vienna, Austria /Alpbionet 2030 projectISBN: 978-3-200-06798-1.
12. Negi, S. B. (2013). Wildlife crime investigation a hand book for wildlife crime investigation officers. *New Delhi: Wildlife Crime Control Bureau, Ministry of Environment and Forests Government of India*.
13. Gaur, A., & Reddy, A. (2017). DNA techniques in wildlife forensics (animals): standard operating procedures (SOP). *CSIR Centre for Cellular and Molecular Biology, Hyderabad*, *37*.
14. Dormontt, E. E., Boner, M., Braun, B., Breulmann, G., Degen, B., Espinoza, E., ... & Lowe, A. J. (2015). Forensic timber identification: It's time to integrate disciplines to combat illegal logging. *Biological Conservation*, *191*, 790-798.

FSC4L35 PRACTICAL ON FSC4E31 & FSC4E32

- Examination of skeletal remains- long bones- Femur, Humerus.
- Identification of individuals by long bones and stature estimation
- Determination of sex and age from Skull with mandible.
- Determination of sex from pelvis and sacrum.
- Identification of individuals by dental examination.
- Anthropometry- Identification of individuals (in living).
- Sampling of various evidences related to wildlife crimes for forensic analysis.
  - Carcasses/baits
  - Blood
  - Scat (feces)
  - Meat
  - Horn/Ivory/Bones/teeth
  - Skin/Hairs/feathers
  - Insects
  - Fragments from deforming bullets/ pellets
  - Weapons
- Microscopic examination of hairs – identification of species origin.
- Identification of forensically important insects and examining the developmental stages (life cycles) for determination of Post-mortem Interval.

- Species identification from DNA isolated from confiscated animal remain of unknown origin (Collection, extraction, quantification, amplification, Cytb analysis & BLAST).
- Identification and individualization of timber.
- Identification of medicinal plants (MPs).