##### AnnexureI

##### Scheme of Examination for M.Sc. Forensic Science (CBCS) w.e.f. the session 2017-2018 onwards

## Semester wise distribution of course and credits in Forensic Science

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Paper No.** | **Title of the Paper** | | | **Nature of paper** | **Credits** | **Contact hours per week**  **T + S + P** | **Term Exam. Marks** | **Internal Assessment Marks** | **Total Marks** | **Exam Duration in Hours** |
| **Semester I** | | | | | | |  |  |  |  |
| FSC 101 | General Forensic Science | | | Core | 4 | 4 + 0 + 0 | 80 | 20 | 100 | 3 |
| FSC102 | Instrumental Analysis I | | | Core | 4 | 4 + 0 + 0 | 80 | 20 | 100 | 3 |
| FSC 103 | Forensic Biology and Serology | | | Core | 4 | 4 + 0 + 0 | 80 | 20 | 100 | 3 |
| FSC 104 | Forensic Psychology and Statistics | | | Core | 4 | 4 + 0 + 0 | 80 | 20 | 100 | 3 |
| FSC 105 | Practical (Based on Papers FSC 101 & FSC 102) | | | Core | 4 | 0 + 0 + 8 | 80 | 20 | 100 | 4 |
| FSC 106 | Practical (Based on Papers FSC 103 & FSC 104) | | | Core | 4 | 0 + 0 + 8 | 80 | 20 | 100 | 4 |
|  | **Total** | | |  | **24** | **16 + 0 + 16** |  |  | **600** |  |
| **Semester II** | | | | | | |  |  |  |  |
| FSC 201 | Forensic Chemistry and Toxicology | | | Core | 4 | 4 + 0 + 0 | 80 | 20 | 100 | 3 |
| FSC 202 | Instrumental Analysis II | | | Core | 4 | 4 + 0 + 0 | 80 | 20 | 100 | 3 |
| FSC 203 | Questioned Document Examination | | | Core | 4 | 4 + 0 + 0 | 80 | 20 | 100 | 3 |
| FSC 204 | Forensic Medicine and  Anthropology | | | Core | 4 | 4 + 0 + 0 | 80 | 20 | 100 | 3 |
| FSC 205 | Basics of Forensic Science | | | Open Elective | 2 | 2 + 0 + 0 | 40 | 10 | 50 | 3 |
| FSC 206 | Seminar | | | Core | 1 | 0 + 1 + 0 |  | 25 | 25 | - |
| FSC 207 | Practical (Based on Papers FSC 201 & FSC 202) | | | Core | 4 | 0 + 0 + 8 | 80 | 20 | 100 | 4 |
| FSC 208 | Practical (Based on Papers FSC 203 & FSC 204) | | | Core | 4 | 0 + 0 + 8 | 80 | 20 | 100 | 4 |
|  | **Total** | | |  | **27** | **18 + 1 + 16** |  |  | **675** |  |
| **Summer Training and Project Report (Mandatory) : Minimum Duration 30 days, after examinations of IInd semester in summer vacations during months of May, June and till 15, July.** | | | | | | | | | | |
| **Semester III** | | | | | | |  |  |  |  |
| FSC 301 | Forensic Ballistics and Explosives | | | Core | 4 | 4 + 0 + 0 | 80 | 20 | 100 | 3 |
| FSC 302 | Computer Forensics and Recent Advances | | | Core | 4 | 4 + 0 + 0 | 80 | 20 | 100 | 3 |
| FSC 303 | DNA Profiling | | | Core | 4 | 4 + 0 + 0 | 80 | 20 | 100 | 3 |
| FSC 304 | Advances in Forensic Chemistry- I | | Any one from  FSC 304 and FSC305 | Elective | 4 | 4 + 0 + 0 | 80+20 | | 100 | 3 |
| FSC 305 | Advances in Forensic Biology –I | | Elective | 4 | 4 + 0 + 0 | 3 |
| FSC 306 | Methods of Solving Forensic Cases | | | Open  Elective | 2 | 2 + 0 + 0 | 40 | 10 | 50 | 3 |
| FSC 307 | Seminar | | | Core | 1 | 0 + 1 + 0 |  | 25 | 25 | - |
| FSC 308 | Practical (Based on Papers FSC 301, FSC 302 & FSC 303) | | | Core | 4 | 0 + 0 + 8 | 80 | 20 | 100 | 4 |
| FSC 309 | Practical (Based on Papers FSC 304/FSC 305 | | | Core | 4 | 0 + 0 + 8 | 80 | 20 | 100 | 4 |
|  | **Total** | | |  | **27** | **18 + 1 + 16** |  |  | **675** |  |
| **Semester IV** | | | | | | |  |  |  |  |
| FSC 401 | Forensic Physics | | | Core | 4 | 4 + 0 + 0 | 80 | 20 | 100 | 3 |
| FSC 402 | Forensic dactylography and other impressions | | | Core | 4 | 4+ 0+ 0 | 80 | 20 | 100 | 3 |
| FSC 403 | Advances in Forensic Chemistry- II | Any one from  FSC 402 and FSC 403 | | Elective | 4 | 4 + 0 + 0 | 80+20 | | 100 | 3 |
| FSC 404 | Advances in Forensic Biology - II | Elective | 4 | 4 + 0 + 0 | 3 |
| FSC 405 | Viva of Summer Training and Project Report | | | core | 4 |  |  |  | 100 |  |
| FSC 406 | Practical (Based on Papers FSC 401 & FSC 402) | | | Core | 4 | 0 + 0 + 8 | 80 | 20 | 100 | 4 |
| FSC 407 | Practical (Based on Papers FSC 403/FSC 404) | | | Core | 4 | 0 + 0 + 8 | 80 | 20 | 100 | 4 |
|  | **Total** | | |  | **24** | **12+0+16** |  |  | **600** |  |
| **Grand Total Sem. I to Sem. IV** | | | | | | | | | **2550** |  |

**T – Theory; S – Seminar; P – Practical**

**Total Credits: Core 96 + Seminar 2 + Open 4 = 102**

## 

**PAPER NO. FSC 101**

**GENERAL FORENSIC SCIENCE**

**CREDITS- 4**

Total Marks: 100

Theory Exam. Marks: 80

Internal Assessment: 20

Time: 3 hrs.

**Objective:** To give the basic knowledge to students about the concepts in Forensic Science

**Outcomes:** The students will get to know about the history and background of forensic science. The subject will also discuss the basic laws and principles of forensic science, which will help the students to handle evidences related to crimes and crime scene investigation efficiently.

**Note:**

1. Nine questions will be set in all.

2. Question No. 1, which will be objective/short answer type cover the entire syllabus, will be compulsory. The remaining eight questions will be set section wise selecting four questions from each section (A & B). The candidate will be required to attempt question No. 1 and four more selecting two questions from each section.

3. As far as possible the questions should be divided into sub-parts and marks indicated part wise.

**PART- A**

1. **Forensic Science :**  History, Development, and need of Forensic Science, Forensic Science and its International Perspective, Ethics in Forensic Science, Duties of Forensic Scientist, Basic Principles of Forensic Science.
2. **Organizational setup of Forensic Science Laboratories:** CFSL, FSL, GEQD, DFSS, Central Detective Training School, NCRB, Mobile Forensic Science Laboratory, Branches of Forensic Science.
3. **Crime Scene Investigation:** Introduction, characteristics and types of crime scene, physical evidences, Protection and recording of crime scene, search of physical clues, preservation, chain of custody, packing and forwarding of physical clues, blood pattern analysis.
4. **Fingerprints** - introduction, types, searching methods, collection and preservation and evaluation.

**PART- B**

1. **Forensic Photography**- Basic principles and techniques of Black & White and colour photography, IR photography, working of digital camera and basics of digital imaging.digital photography, Digital videography. Crime scene and laboratory photography, microphotography.
2. **Criminal Justice System**- Structure of Police, Prosecution & Judicial Organizations, Inquest, evidence in enquiries and trials, expert witness, admissibility of forensic reports in court, expert testimony.
3. **Computers:** Introduction, History of Digital computer, computer organization-hardware, circuits for interfacing computer to instruments, computer scanners, imaging softwares (Photo paint, Photoshop etc.), MS word, Data library.

**Suggested Readings**

1. B.R. Sharma: Forensic Science in Criminal Investigation and Trials, Universal Law Publishing; Fourth edition 2013.
2. [David R. Redsicker](http://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22David+R.+Redsicker%22): The Practical Methodology of Forensic Photography, Second Edition CRC Press, 2001.
3. James, S.H and Nordby, J.J.: Forensic Science: An introduction to scientific and investigative techniques 3rd edit. CRC Press, USA.
4. Nanda, B.B. and Tewari, R.K.: Forensic Science in India: A vision for the twenty first century Select Publisher, New Delhi (2001)
5. Richard Saferstein. Criminalistics: An Introduction to Forensic Science. 10th edit. Prentice-Hall, New Jersey.
6. Upshaw Downs, Swienton A. R.: Ethics in Forensic Science, Academic press. 2012.
7. H.L. Blitzer and J.Jacobia: Forensic Digital Imaging and Photography, Academic Press (2002).

**PAPER NO. FSC 102**

**INSTRUMENTAL ANALYSIS- I**

**CREDITS- 4**

Total Marks: 100

Theory Exam. Marks: 80

Internal Assessment: 20

Time: 3 hrs.

**Objective:** To introduce students about the analytical techniques which are being used to analyse the evidences encountered in Forensic investigations.

**Outcomes:** The students will be introduced about the working of microscopic, chromatographic and spectroscopic techniques which are used to examine different trace evidences in forensics.

**Note:**

1. Nine questions will be set in all.

2. Question No. 1, which will be objective/short answer type cover the entire syllabus, will be compulsory. The remaining eight questions will be set section wise selecting four questions from each section (A & B). The candidate will be required to attempt question No. 1 and four more selecting two questions from each section.

3. As far as possible the questions should be divided into sub-parts and marks indicated part wise.

**PART- A**

1. **Microscopy**: Principles and techniques of Microscopy: Light Microscope, Phase contrast, Fluorescence, stereomicroscope, polarizing, comparison and Electron Microscope (Scanning, Transmission) Forensic application of microscopy. Microspectrophotometry
2. **Chromatography:** IntroductionBasic principles, types of chromatography, partition and adsorption chromatography techniques.

**Thin Layer Chromatography:** introduction theory and Instrumentation of TLC, HPTLC, stationary phases, visualization methods, densitometer, applications.

**Gas chromatography:** introduction, principle and Instrumentation of GC, types of GC ( GLC, and GSC) and column types and structure, Detectors for GC -TCD,FID, ECD, NPD etc, and evaluation of chromatogram; Pyrolysis GC, GC-MS; forensic applications.

**High Performance liquid chromatography:** introduction, principle and Instrumentation of HPLC, injection system, column structure, detectors for HPLC, advantage and limitations of HPLC; their forensic applications.

1. **Spectroscopy**: Basic principles, property of EMR, interaction of radiation with matters, atomic and molecular spectra; source of radiations, radiations detection devices, wavelength selector, basic components of absorption and emission spectroscopy.

**PART-B**

1. **UV-Visible, IR and Raman spectroscopy:** introduction, principles, instrumentation, single beam and double beam spectrophotometer, interpretation of spectra, qualitative and quantitative analysis: advantage and limitations of UV, IR and Raman spectrophotometer, forensic applications.
2. **Atomic absorption/ emission spectroscopy:** introduction, principles, Instrumentation; types of AAS, ICP-AES, quantitative and qualitative analysis, advantage and limitations of AAS and AES, their forensic applications.
3. **Mass Spectroscopy:** principle, instrumentation, ion sources, type of mass anlyser- quadrupole, time of flight, double focusing, tandem mass spectroscopy, detectors for mass spectroscopy ; their forensic applications.
4. **NMR Spectroscopy, Neutron Activation Analysis:** introduction and principle, techniques and forensic application
5. **X-rays spectroscopy;** introduction, principles of X ray diffraction and X ray florescence technique, their forensic applications.

**Suggested Readings**

# [Barbara Wheeler](http://www.amazon.com/Barbara-Wheeler/e/B001JS8OIC/ref=ntt_athr_dp_pel_1) and [Lori J. Wilson](http://www.amazon.com/s/ref=ntt_athr_dp_sr_2?_encoding=UTF8&field-author=Lori%20J.%20Wilson&search-alias=books&sort=relevancerank). Practical Forensic Microscopy: A Laboratory Manual, Wiley

1. Keith Wilson & John Walker; Practical Biochemistry- Principles & Techniques, 5th Edition, Cambridge University Press 2000.
2. Lee and Caensstem. Advances in Forensic Science, Vol. 2. Instrumental Analysis.
3. B. K. Sharma. Instrumental Methods of Chemical Analysis, Goel Publishing House, 26th Edition (2007).
4. D. A. Skoog, D. M. West, F. James Holler and S. R. Crouch, Fundamentals of Analytical Chemistry, 8th Edition, Thomson, 2004.
5. F. Rouessac and A. Rouessac, Chemical Analysis, 4th Edition, John Wiley & Sons Ltd., 2000.
6. G.Chatwal and S. Anand, Instrumental Methods of Chemical Analysis, 7th Edition Himalaya Publishing House.
7. Hobart H. Willard, Instrumental Methods of Analysis (Chemistry) Wadsworth Publishing Company.

**PAPER NO. FSC 103**

**FORENSIC BIOLOGY AND SEROLOGY**

**CREDITS- 4**

Total Marks: 100

Theory Exam. Marks: 80

Internal Assessment: 20

Time: 3 hrs.

**Objective:** To make students understand the basics of biological material and its properties to aid in forensic investigations.

**Outcomes:**

1. The subject will provide information to students regarding the analysis of various evidences of animal or plant origin.
2. It will explicate the insect development and geographical distribution for assistance in estimating the time since death and locating the probable crime scene.
3. It will also provide the information about poaching and hunting of protected animal species and trade in international market.

**Note:**

1. Nine questions will be set in all.

2. Question No. 1, which will be objective/short answer type cover the entire syllabus, will be compulsory. The remaining eight questions will be set section wise selecting four questions from each section (A & B). The candidate will be required to attempt question No. 1 and four more selecting two questions from each section.

3. As far as possible the questions should be divided into sub-parts and marks indicated part wise.

**PART- A**

1. **Forensic Biology:** types of biological evidences, identification, collection, preservation, and significance of biological evidence. Hair and fibers: classification, characteristics, forensic identification and evaluation of hair and fibers evidences.
2. **Microbial forensics and Entomology**: Organisms of Forensic significance, types, isolation and identification. Introduction to forensic Entomology, insects / invertebrates of forensic importance, collection of entomological evidence, their life cycle, the role of aquatic insects in forensics, insects succession on carrion and its relationship to determine time since death.
3. **Forensic Botany:** Introduction, types, significance, location, collection and Forensic evaluation of botanical evidences such as pollen grains, leaves, seeds etc. Wood- types, soft and hard wood. Identification and comparison. Diatoms: types, morphology, methods of extraction from tissue and bones, their identification and Forensic significance

**PART-B**

1. **Wild life Forensics:** scope, different protected and endangered species of animals. Wild life crime investigation- procedure, tools and techniques. Wild life protection act, animal poaching, animal abuse, wild life trading. Identification of pug marks. Identification of wild life clue materials such as hair, skin, fur, bones, nails, horn, teeth etc by conventional and modern methods. Case studies related to wild life crime.
2. **Forensic Serology:** Blood groups – history, biochemistry and genetics of ABO, Rh, MN and other blood group systems, secretors and non secretors, rare alleles. Blood identification, Methods of ABO blood grouping from dried blood stains and other body fluids, species identification, Polymorphic Enzymes (PGM, GLO-I, ESD, EAP, AK, ADA etc)- their forensic significance.
3. **Body fluids:** semen- Introduction, composition, human spermatozoa morphology, Forensic examination and evaluation. Sex determination, X chromosome Inactivation- Barr body.

Other biological fluid clues such as saliva, sweat, urine and milk etc their introduction & collection preservation and examination,

**Suggested Readings**

1. [Richard Li](http://www.amazon.com/Richard-Li/e/B001JRZQRU/ref=ntt_athr_dp_pel_1). Forensic Biology: Identification and DNA Analysis of Biological Evidence, CRC Press.
2. Alan Gunn: [Essential Forensic Biology, 2nd Edition](https://www.google.co.in/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0CCwQFjAA&url=http%3A%2F%2Fwww.wiley.com%2FWileyCDA%2FWileyTitle%2FproductCd-EHEP002322.html&ei=krQ2U_b4FoGPrQe8ooD4DA&usg=AFQjCNHJmiie56jCfjtx9vyduaXULFmN6A&bvm=bv.63808443,d.bmk), John Wiley and Sons. 2009
3. Eckert, W. G. & James, S.H.: Interpretation of Blood Stain, Evidence, Elsevier, New York (1989).
4. Bruce Budowle, et al.: Microbial Forensics 2nd Edition, Academic Press, Wiley-Blackwell, 2012.
5. Robertson, J. Forensic Examination of Hair. Taylor and Francis, USA. 1996.
6. [Heather Miller Coyle](http://www.amazon.com/s/ref=ntt_athr_dp_sr_1?_encoding=UTF8&field-author=Heather%20Miller%20Coyle&search-alias=books&sort=relevancerank), Forensic Botany: Principles and Applications to Criminal Casework. 1st edition, CRC Press; 2004.
7. [Jane E. Huffman](http://as.wiley.com/WileyCDA/Section/id-302477.html?query=Jane+E.+Huffman), and [John R. Wallace](http://as.wiley.com/WileyCDA/Section/id-302477.html?query=John+R.+Wallace), Wildlife Forensics: Methods and Applications, Wiley Blackwell. 2011
8. Chowdhri, S., Forensic Biology B.P.R. &D, Govt. of India

**PAPER NO. FSC 104**

**FORENSIC PSYCHOLOGY AND STATISTICS**

**CREDITS- 4**

Total Marks: 100

Theory Exam. Marks: 80

Internal Assessment: 20

Time: 3 hrs.

**Objective:** To study the human behaviour and importance of Psychological analysis in Criminal trials and implementation of Statistics for veritable reporting of findings.

**Outcomes:**

1. The subject will guide students about the role of psychologists with court officials, preparing written psychological reports, interview criminal defendants and make determinations as to whether a criminal can stand trial.
2. The subject will also familiarise the students with laws concerning mental health and criminal behaviour and will aid in understanding the basic psychological & scientific principles.
3. The study of statistics will aid the students in verifying the laboratory findings, thus establishing the veritability of the outcome of any analysis so conducted in forensic investigations.

**Note:**

1. Nine questions will be set in all.

2. Question No. 1, which will be objective/short answer type cover the entire syllabus, will be compulsory. The remaining eight questions will be set section wise selecting four questions from each section (A & B). The candidate will be required to attempt question No. 1 and four more selecting two questions from each section.

3. As far as possible the questions should be divided into sub-parts and marks indicated part wise.

**PART- A**

1. **Forensic Psychology**: Introduction to Forensic Psychology; scope & ethics; distinction between Forensic and therapeutic evaluation. Genetic basis of Psychology. Legal aspect of forensic psychology practice.
2. **Forensic Psychiatry**: introduction, classification of mental disorders, forensic psychiatric examination. Scope of psychiatric examination in criminal and civil cases
3. **Crime investigation-** types and classification of crimes and criminals, criminal profiling, and modus operandi. Brain Fingerprinting, Polygraph, Hypnosis, Narco Analysis- Principle, technique and their role in criminal justice system.

**PART-B**

1. **Measures of central value:** Arithmetic mean, mode and median Definition, calculation and its properties.

**Measures of Dispersion:**

* 1. Range, Interquartile range, Quartile deviation.
  2. Mean deviation and standard deviation.

1. **Correlation:** Methods studying correlation – Scatter diagram method, Graphic method, Karl Pearson coefficient of correlation, Rank correlation.
2. **Regression analysis** (Regression lines and regression equation.)
3. **Concept of sampling and sampling methods:**  Definition and law of sampling, judgment sampling, Random sampling, stratified sampling, systematic sampling, multi-stages sampling and quota sampling.
4. **Test of significance** for large samples and small samples.
5. **Chi-square analysis**
6. **Analysis of variance**
7. **Probability**: Law of probability, Theoretical probability distribution: Binomial distribution, Poison distribution, Normal distribution.
8. **Computer in Biometrics**
   1. Components of computers
   2. Statistical softwares

**Suggested Readings**

1. Bruce A. Arrigo: Introduction to Forensic Psychology, Academic press London.
2. CR Kothari: Research methodology, Methods and Techniques, 2nd edt. New age International Publishers.
3. Daniel, Wayne W. Bio-statistics: A Foundation for Analysis in the Health Sciences, 7th edition. John Wiley, 2000.
4. David L. Shapiro: Forensic Psychology Assessment and Investigative Approach, Allyn and Bacon Publisher.
5. Goon, A.M, Gupta, M.K and Dasgupta: B Fundamental of Statistics Vol. I.
6. Hess, A. K. and Weiner, I. B.: Handbook of Forensic Psychology, John Wiley & Sons.
7. Smoller: Biostatistics and Epidemiology: A Primer for Health and Biomedical Professionals, Sylvia Wassertheil.

**PAPER – FSC 105**

**PRACTICAL (BASED ON PAPERS FSC 101 & FSC 102)**

**CREDITS- 4**

Total Marks: 100

Theory Exam. Marks: 80

Internal Assessment: 20

Time: 4 hrs.

1. Sketching and photography of mock crime scene.
2. Collection, preservation and packing of physical evidences.
3. Reconstruction and evaluation of various mock crime scene e g accident, theft etc
4. Report Writing in respect of crime scene.
5. Searching of evidence by Polylight.
6. Evaluation of bloodstain patterns
7. Various types of microscopes – their components and working.
8. To demonstrate polygraph test.
9. Electrophoresis techniques – Preparations of gels, media, buffers and demonstration of gel electrophoresis.
10. Thin layer chromatography- Drugs (2)
11. Demonstration of different centrifugation techniques
12. Visit to Forensic Science laboratory and preparation of report
13. Estimation of macro molecules by spectrophotometry.

**PAPER – FSC 106**

**PRACTICAL (BASED ON PAPERS FSC 103 & FSC 104)**

**CREDITS- 4**

Total Marks: 100

Theory Exam. Marks: 80

Internal Assessment: 20

Time: 3 hrs.

1. Morphological examination of human and animal hairs
2. Preparation of slide for scale pattern study of hairs
3. Identification of blood by chemical, micro-chemical test and UV-Visible spectrophotometer.
4. Identification of sex from blood samples
5. Detection of species of origin by immune double diffusion method.
6. ABO typing from dried blood stains.
7. Identification of spermatozoa from dried seminal stains
8. Microscopic study of fur and feathers of various birds
9. Pug marks collection and identification
10. Identification of various body fluids e.g. urine, semen, saliva, milk etc
11. Microscopic and chemical examination of different plants, animals fibers
12. Microscopic examination of soft and hard woods
13. Extraction and morphological study of various diatom genera.

**SEMESTER-II**

**PAPER NO. FSC 201**

**FORENSIC CHEMISTRY AND TOXICOLOGY**

**CREDITS- 4**

Total Marks: 100

Theory Exam. Marks: 80

Internal Assessment: 20

Time: 3 hrs.

**Objective:** To introduce students about the nature and analysis of evidences related to chemistry and toxicological importance in Forensics.

**Outcomes:**

1. The subject will introduce students about the chemical tests that are being used in Forensic Chemistry.
2. It will also provide information about the general chemistry and analysis of legal and illegal alcoholic substances, evidences related to petroleum products and drugs of abuse.
3. The students will learn about the medico legal aspects and analysis of different types of toxic substances related to crime like plant poisons, pesticides etc
4. The subject will also furnish information about the pharmacokinetics of poison in body and its significance in identification of poisons.

**Note:**

1. Nine questions will be set in all.

2. Question No. 1, which will be objective/short answer type cover the entire syllabus, will be compulsory. The remaining eight questions will be set section wise selecting four questions from each section (A & B). The candidate will be required to attempt question No. 1 and four more selecting two questions from each section.

3. As far as possible the questions should be divided into sub-parts and marks indicated part wise.

**PART- A**

1. **Forensic Chemistry:** Introduction, Colour & Spot test, microcrystal tests, inorganic and organic analysis. Analysis of Beverages: alcoholic and nonalcoholic beverages, illicit liquors, detection and estimation of ethanol. Breathe alcohol analyzer. Analysis of trace evidence – cosmetics dyes, pigments, clues of trap cases.
2. **Analysis of Petroleum Products:** Introduction, standard methods of analysis of petroleum product for adulteration as per BIS. Arson Investigation**:** chemistry of fire, Forensic investigation of arson cases.
3. **Drug of Abuse:** introduction, classification, drug of abuse in sports. General chemistry and analysis of narcotic drugs and psychotropic substances as exemplified by cocaine, cannabis, barbiturates, benzodiazepines, amphetamine, opium, hallucinogens, designers drugs. Introduction of NDPS act, drugs and cosmetic act.

**PART – B**

1. **Forensic Toxicology:** Introduction and scope of forensic toxicology, classification of poisons, legal aspects of poisoning, types of poisoning. Antidotes, factors modifying action of poisons, LD-50, sign and symptoms of common poisons. Collection, preservation of samples; Conventional and recent extraction and isolation methods of poisons.
2. **Pharmacology:** theory and principles of absorption, distribution, biotransformation and excretion of drugs/poisons, and their forensic aspects.
3. **General studies and Analysis of vegetable poisons**: Opium, Abrus, Dhatura, Marking nuts, Nux-vomica, Oleander and Aconite. alkaloids: classification and charecterisations .

Snake venoms and insect poisons, Irrespirable gases, food poisoning

1. **Insecticides and Metallic Poisons:**  introduction, types, General methods for their analysis.

**Suggested readings**

1. C.K. Parikh. Parikh’s test book of medical jurisprudence Forensic medicine and toxicology,
2. Dettean J. D. Kirk’s Fire Investigation, 5th Ed., Prentice Hall, Eaglewood Cliffs, N.J (2002)
3. EGC Clarke, Analysis of drugs and poisons. 3rd edition. Vol. 1 and 2, pharmaceutical press.
4. Feigl, Spot Test in Inorganic Analysis, Elsevier Pub. New Delhi (2005).
5. Feigl, Spot Test in Organic Analysis, Elsevier Pub., New Delhi (2005).
6. Maudham Bassett et al. Vogel’s Textbook of Quantitative Chemical Analysis, 6th Ed., Longman Essex (2004).
7. Modi: Textbook of Medical jurisprudence &Toxicology, M.M. Tripathi Publication.
8. R.T. Morrison, R.N. Boyd; Organic Chemistry, 6th Ed., Prentice Hall, New Delhi (2003)
9. S.N. Tiwari: Analytical Toxicology, Govt. of India Publications, New Delhi, 1987.
10. Saferstein, R: Forensic Science Hand Book, Vol I, II and III, Pretince Hall, NI, 1982.

**PAPER NO. FSC 202**

**INSTRUMENTAL ANALYSIS- II**

**CREDITS- 4**

Total Marks: 100

Theory Exam. Marks: 80

Internal Assessment: 20

Time: 3 hrs.

**Objective:** To study the basics of biochemical techniques related to forensic analysis such as DNA amplification, radio immunological techniques.

**Outcomes:**

1. The subject will introduce the principles of enzymatic and radio chemical techniques.
2. The students will also study the factors affecting the DNA amplification (PCR) which may alter the outcome of Forensic DNA profiling.
3. The students will get an insight about the different techniques based on Ag- Ab interaction and their assistance in forensic investigations.

**Note:**

1. Nine questions will be set in all.

2. Question No. 1, which will be objective/short answer type cover the entire syllabus, will be compulsory. The remaining eight questions will be set section wise selecting four questions from each section (A & B). The candidate will be required to attempt question No. 1 and four more selecting two questions from each section.

3. As far as possible the questions should be divided into sub-parts and marks indicated part wise.

**PART- A**

1. **Molecular biology techniques**: isolation of DNA, RNA, purification, restriction, PCR –DNA amplification, autoradiography, and forensic applications.
2. **Cell and tissue culture techniques**: pH and buffers, culture media preparations, sterilization techniques and forensic applications.
3. **Centrifugation Techniques -** Centrifugation, cold and ultracentrifuges basic principle, instrumentation, G-value & relationship between RPM., applications of analytical centrifugation.
4. **Electrophoresis:** Introduction, principles, factors affecting electrophoresis, types of electrophoresis. High and low voltage electrophoresis, capillary electrophoresis. immuno-electrophoresis, SDS-PAGE and iso- electric focusing; their application.

**PART-B**

1. **Enzyme techniques:** Enzyme kinetics, enzyme assay techniques such as visible UV spectrophotometric methods, Luminescence method, Radioisotope methods and Immuno-chemical methods.
2. **Radio chemical techniques:** radioisotope, nature of radioactivity, detection and measurements of radioactivity and forensic applications.
3. **Immunochemical Techniques:** Introduction, Antigen -antibody reactions -theory and principles, Production of antibodies. Immunoprecipitation and agglutination based techniques such as immunodiffusion, cross over electrophoresis etc. Labeling of Antibodies and their detection methods: ELISA, RIA- their basic principle, techniques, and their forensic applications.

**Suggested readings**

1. Thomas J. Kindt, et al. Kuby Immunology, 6th edition 2001
2. David. L.Nelson & Michael M, Cox Lenninges; Principles of Biochemistry, 4th edition, Freeman Pub. 2005.
3. Keith Wilson & John Walker; Practical Biochemistry- Principles & Techniques, 5th Edition, Cambridge University Press 2000.
4. Peterson: Clinical and Forensic Application of Capillary Electrophoresis, 2001.

**PAPER NO. FSC 203**

**QUESTIONED DOCUMENT EXAMINATION**

**CREDITS- 4**

Total Marks: 100

Theory Exam. Marks: 80

Internal Assessment: 20

Time: 3 hrs.

**Objective:** To study the nature and examination of different documents submitted to the court of Law.

**Outcomes:**

1. The subject will introduce the students with the types of questioned documents and their handling processes.
2. It will also provide information about the fundamentals of handwriting examination.
3. The students will be given information on how to detect alterations in document using conventional and modern tools like ESDA, VSC etc

**Note:**

1. Nine questions will be set in all.

2. Question No. 1, which will be objective/short answer type cover the entire syllabus, will be compulsory. The remaining eight questions will be set section wise selecting four questions from each section (A & B). The candidate will be required to attempt question No. 1 and four more selecting two questions from each section.

3. As far as possible the questions should be divided into sub-parts and marks indicated part wise.

**PART- A**

1. **Document Examination:** introduction and classification of documents, genuine and forged document, and holographic document. Preliminary examination of documents, ways of procurement, handling and marking of document, preservation and reproduction of documents. Basic tools for forensic document examination.
2. **Handwriting:** principle, characteristics of handwriting, identification and evaluation of handwriting. Types of forgery, characteristic of genuine and forged signature and their examination. Identification of writer of anonymous letter.
3. **Ink and paper examination**- their types, composition and forensic examination. Various types of writing instruments, Determination of age of documents.

**PART- B**

1. **Examination of various printing devices** **and forgeries of printed document.** Photostat, scanned and faxed document examination. Examination of typewriters and typed documents, Examination of security documents, fake currency notes, passport, visa, credit cards and ATM. Examination of stamp and seal impressions.
2. **Examination of altered documents:** methods and examination ofalteration, obliterations, erasures, secret writing, intended and charred document; study of advance techniques for examination of alterations such as Projectina, VSC and ESDA.
3. **Misllenious:** Photographic techniques to questioned document, Discovery of facts by comparison with known material. Fry test and Daubert standards**,** Report writing, reasons for opinion, presentation of expert evidence on documents case.

**Suggested Readings**

1. Ellen, D The scientific examination of Documents, Methods and techniques. 3rd ed., Taylor & Francis Ltd. (2006).
2. Hilton, O. The Scientific Examination of Questioned Document, 1982, Elsaevier North Holland Inc. New York.
3. Huber, A. R. and Headrick, A.M.: Handwriting identification: facts and fundamental CRC Press, (1999)
4. Kelly J.S. and Lindblom B.S. Scientific examination of questioned documents. 2nd edition CRC press.
5. Morris R.N. Forensic Handwriting Identification (fundamental concepts and Principals) 1st edition Academic Press Inc. (2000).
6. Osborn, A. S. Questioned Documents 1929, Boyd Printing Co. Chicago.
7. Wilson R. Harrison; Suspect Documents Their Scientific Examination, Universal Law Pub. Delhi Indian.
8. Mehta, M. K. The identification of Handwriting & Cross Examination of Experts, N.M. Tripathi, Allahabad. 1970.

**PAPER NO. FSC 204**

**FORENSIC MEDICINE AND ANTHROPOLOGY**

**CREDITS- 4**

Total Marks: 100

Theory Exam. Marks: 80

Internal Assessment: 20

Time: 3 hrs.

**Objective:** To study the application of medical knowledge in criminal investigation, particularly in establishing the causes of injury or death.

**Outcomes:**

The study of Forensic medicine helps students to know about how a crime was committed including what weapons were used, when the crime happened and where the crime happened.

**Note:**

1. Nine questions will be set in all.

2. Question No. 1, which will be objective/short answer type cover the entire syllabus, will be compulsory. The remaining eight questions will be set section wise selecting four questions from each section (A & B). The candidate will be required to attempt question No. 1 and four more selecting two questions from each section.

3. As far as possible the questions should be divided into sub-parts and marks indicated part wise.

**PART- A**

1. **Forensic Medicine:** Characteristics and cause of death; Aphyxial death- Introduction, characteristics and types of asphyxia death (Hanging, strangulation, drowning etc), thermal death and their medico legal aspects. Estimation of time since death, post mortem examination.
2. **Injuries:** classification, types and characteristics of mechanical injuries, antimortem and post mortem injury, artificial injury, grievous injury, and their medicolegal aspects.

Investigation of sexual offences, abortion and infanticides

1. **Forensic Odontology:** Definition, scope, structural variation and types of teeth. Determination of age and sex from teeth, Gustafson’s method, dental anomalies and their significance

Bite marks: methods of collection, preservation, recording, comparison and their significance.

**PART –B**

1. **Forensic Anthropology:** Definition, scope and problems, structure of bones, morphological study of human skeleton, comparative study of human and animal skeleton. Age, sex and stature determination from skeleton remains.
2. **Osteometry, craniometry:** introduction, methods and their importance in personal identification.
3. **Personal Identification Techniques**: portrait parley/ Bertillon system, superimposition techniques- photographic and video superimposition.

Facial reconstruction: introduction, theory and methods, importance of tissue depth to reconstruct various facial futures, genital and congenital anomalies.

**Suggested Readings**

1. B.C. Smith, et al.: DNA & Forensic Odontology- Manual of Forensic Odontology, Colorado Springs, USA, 1995.
2. J. Kasprzak: Possibilities of Cheiloscopy in Forensic Science 1980.
3. J. P. Modi: Textbook of Medical jurisprudence &Toxicology, M.M. Tripathi Pub.
4. K S Narayan Reddy: The essential of Forensic Medicine and Toxicology.
5. K. Parikh: Parikh’s test book of medical jurisprudence Forensic medicine and toxicology.
6. L.C. Jain: Intelligent Biometric Techniques in Fingerprint and face recognition, CRC Press Ohio, 1999.
7. S. Hillison: Dental Anthropology, Cambridge Univ. Press, UK 1996.
8. Taylor: Forensic Art and Illustration, CRC Press. 2000
9. V. Iannarelli: Ear Identification, Forensic Identification series, Paramount, 1989.

**PAPER NO. FSC 205(Open Elective)**

**BASICS OF FORENSIC SCIENCE**

**CREDITS- 2**

Total Marks: 50

Theory Exam. Marks: 40

Internal Assessment: 10

Time: 3 hrs.

**Objective:** To give the basic knowledge to students about the concepts in Forensic Science

**Outcomes:**

1. The subject will introduce students with the history, development and principles of forensic science which will assist in efficient handling of evidences in criminal investigations.

**Note:**

1. Nine questions will be set in all.

2. Question No. 1, which will be objective/short answer type cover the entire syllabus, will be compulsory. The remaining eight questions will be set section wise selecting four questions from each section (A & B). The candidate will be required to attempt question No. 1 and four more selecting two questions from each section.

3. As far as possible the questions should be divided into sub-parts and marks indicated part wise.

**PART- A**

1. **History and Development of Forensic Science:** Definition of Forensic Science, Scope of Forensic Science, Need of Forensic Science, Basic Principles of Forensic Science, Tools and Techniques of Forensic Science
2. **Organizational setup of Forensic Science Laboratories:** CFSL, FSL, Mobile Forensic laboratory, NCRB.
3. **Handling crime scene:** Definition, types of crime scene, protection and recording of crime scene, search of physical clues, preservation, packing and forwarding of physical clues, chain of custody.
4. **Fingerprints**: introduction types, classification of Fingerprints pattern, characteristics, development methods of Latent Finger Prints, Comparison of Finger Prints.

**PART- B**

1. **Forensic biology:** Introduction , general characteristics of evidences related to biology such as Hair, fiber, semen, saliva, diatom, pollen etc, their significance in crime investigation
2. **Forensic serology and DNA fingerprinting:** Introduction, collection preservation of samples evidence for serological analysis, blood, etc. source of DNA, importance in reconstruction of crime.
3. **Forensic chemistry and toxicology** : introduction of evidences related to chemistry such as drugs of abuse, adulteration in petrol diesel, detection of drunken driving, different types of poisons – homicidal poison, suicidal poison, accidental poison :their significance in crime investigation
4. **Questioned documents Examination:** introduction of evidences related to documents, handwriting, fake vs genuine documents, significance in crime investigation

1. **Forensic physics:** introduction of evidences related to physics such as various impressions- foot, tyre, shoe prints, and analysis of soil, paint, glass etc. and their significance in crime investigation

**Suggested Readings**

1. B.R. Sharma: Forensic Science in Criminal Investigation and Trials, Universal LawPublishing; Fourth edition 2013.
2. James, S.H and Nordby, J.J.: Forensic Science: An introduction to scientific andinvestigative techniques 3rd edit. CRC Press, USA.
3. Nanda, B.B. and Tewari, R.K.: Forensic Science in India: A vision for the twenty firstcentury Select Publisher, New Delhi (2001)
4. Richard Saferstein. Criminalistics: An Introduction to Forensic Science. 10th edit. Prentice-Hall, New Jersey.
5. B. R. Sharma: Firearms in criminal investigation and trials. Universal Law Publishing; Fourth edition, 2012.
6. R. Saferstein: Forensic Science Handbook, Vol.-I, II, Prentice Hall, NJ, 1988.

**SEMESTER – II**

**Paper: FSC 206 (Core)**

**Credits: 1**

**Seminar**

**Total Marks: 25**

**PAPER – FSC 207**

**PRACTICAL (BASED ON PAPERS FSC 201 & FSC 202)**

**CREDITS- 4**

Total Marks: 100

Theory Exam. Marks: 80

Internal Assessment: 20

Time: 3 hrs.

1. Chemical and spectrophotometric analysis of phenolphthalein in trap cases.
2. Tests for metallic poisons- Preliminary and Confirmatory
3. Estimation of ethanol, and methanol from blood/ urine samples.
4. Extraction and identification of drugs from blood and urine sample
5. Extraction and identification of insecticides from biological materials.
6. Identification of phosphine by colour tests
7. Practical demonstration of petroleum analysis by GLC
8. Screening of common drugs by UV – Vis spectrometry
9. Separation and identification of plant poisons and cometics dyes by TLC
10. To perform chemical tests for plant poisons
11. To perform TLC separation of drugs
12. Preparation of media sterilization techniques maintenance of microbial culture and standard plate count.

**PAPER – FSC 208**

**PRACTICAL (BASED ON PAPERS FSC 203 & FSC 204)**

**CREDITS- 4**

Total Marks: 100

Theory Exam. Marks: 80

Internal Assessment: 20

Time: 3 hrs.

1. Identification of normal/ disguised writing- wring movement, ratio of letters etc
2. Examination of alteration and obliteration in documents.
3. Detection of simulated and traced forgeries.
4. Examination of security documents.
5. Examination of mechanical and chemical erasure in documents.
6. To examine printed document.
7. To examine intended writing.
8. To examine counterfeit currency.
9. Morphological identification of Human and animal bones
10. Determination of sex from skull and pelvic girdle.
11. Determine of age from bones.
12. Estimation of stature from long bones
13. To perform craniometric measurements on skull.
14. Lifting identification and comparison of bite marks

**SEMESTER-III**

**PAPER NO. FSC 301**

**FORENSIC BALLISTICS AND EXPLOSIVES**

**CREDITS- 4**

Total Marks: 100

Theory Exam. Marks: 80

Internal Assessment: 20

Time: 3 hrs.

**Objective:** To study the nature and scientific examination of evidences concerned with the firearms and ammunition

**Outcomes:**

1. The subject will introduce students with the classification and characteristics of firearms involved in various crimes.
2. It will also provide information about the basics and examination process of various evidences related to firearms for the reconstruction of the crime scene related to shooting incidence.
3. Students will get to know the types, chemistry and examination of evidences related to explosive substances.

**Note:**

1. Nine questions will be set in all.

2. Question No. 1, which will be objective/short answer type cover the entire syllabus, will be compulsory. The remaining eight questions will be set section wise selecting four questions from each section (A & B). The candidate will be required to attempt question No. 1 and four more selecting two questions from each section.

3. As far as possible the questions should be divided into sub-parts and marks indicated part wise.

**PART- A**

1. **History and Background of Firearms**, classification and characteristics of firearms, components of firearms, firing mechanism, smooth bore and rifled bore firearms. Country made firearms: introduction, constructional features and identification. Ammunition: classification and composition of cartridges, propellents, cartride case, wads, compositional aspects of various types of bullets and shotgun projectile.
2. **Forensic Ballistic**:Definition and back ground, internal and external ballistics, factors affecting internal and external ballistics such as size, shape and ignition of propellants, barrel length, pressure curve, recoil, ballistics coefficient, air resistance, rifling and bullet stability, measurements of trajectory parameters, ricochet phenomenon.
3. **Terminal Ballistics:** factors affecting wound ballistics, Bullet penetration phenomena, characteristic of rifled firearm injury and smooth bore firearm injury, Forensic evaluation of firearms injury.

**PART-B**

1. **Firearms and Ammunition Linkage:** principles, comparison of fired cartridge case and bullets. Gunshot residues: introduction, composition and its forensic evaluation, chemical and instrumental methods of GSR analysis.
2. **Reconstruction of Shooting Incidence:** theory of shooting reconstruction, mathametics of shooting reconstruction, accidental discharge, determination of range and time of fire. Shot pattern testing, laboratory examination of firearms. Law related to examination of firearms in Indian arms act.
3. **Explosive:** - classification, types, composition and characteristic of low explosives, and high explosive such as black powder, NC, NG, TNT, RDX, PETN, HMX, Dynamite, ANFO etc. Detonators, blasting cap, explosive train, IEDs and pyrotechniques, explosion process and effects, effects of blast wave on structures and human. Specific approach to scene of explosion, reconstruction of sequence of events, post blast residues, collection, analysis of explosion residues.

**Suggested Readings**

1. B. R. Sharma: Firearms in criminal investigation and trials. Universal Law Publishing; Fourth edition, 2012.
2. J. H. Mathews and C. C. Thomas. Firearms Identification. Vol.-I, II & III, Springfield Illinois.
3. J. Schwoeble and David L. Exline: Current methods in forensic gunshot residue analysis CRC Press, 2000.
4. Karl G. Sellier et al; Wound Ballistics and The Scientific Background, Elsevier Pub. Co.London, 1994.
5. Peter F. Mahoney et al., Ballistic Trauma, a Practical Guide. Second Edition, 2005 Springer-Verlag London Limited.
6. Yinon Jitrin. Modern Methods & Application in Analysis of Explosives, John Wiley & Sons, England, 1993.
7. Exlopsive analysis manual, Directorate of Forensic Science, MHA, Govt. of India
8. Hueske E. E., Practical Analysis and Reconstruction of Shooting Incidents, 2006, CRC Press.
9. Vincent J. M., Di Maio, Gunshot woundsPractical Aspects of Firearms, Ballistics, and Forensic Techniques Second Edit. 1999, CRC Press .

**PAPER NO. FSC 302**

**COMPUTER FORENSICS AND RECENT ADVANCES**

**CREDITS- 4**

Total Marks: 100

Theory Exam. Marks: 80

Internal Assessment: 20

Time: 3 hrs.

**Objective:** To study the various computer and internet related crimes and the laws governing them.

**Outcomes:**

1. The students are taught numerous methods for revealing the information needed in a case such as the recovery of deleted, encrypted, or damaged files to reveal information stored in a computer.
2. Information regarding biometrics, quality management teaches students, the advanced methods of analysis available and being devised in the scientific community.
3. The distribution and security of intellectual property enlightens the students about the legal guidelines on access and distribution of information.

**Note:**

1. Nine questions will be set in all.

2. Question No. 1, which will be objective/short answer type cover the entire syllabus, will be compulsory. The remaining eight questions will be set section wise selecting four questions from each section (A & B). The candidate will be required to attempt question No. 1 and four more selecting two questions from each section.

3. As far as possible the questions should be divided into sub-parts and marks indicated part wise.

**PART- A**

1. **Computer Crime:** basics of computers, hardware accessories operating system and software. Types of computer crime, networked computer crime, unauthorized access, program manipulation, software piracy.
2. **Cyber Crime:** Introduction, Internet, definition, common principles, classification of cyber crimes. Hacking, virus, obscenity and pornography, encryption and description methods, Investigation of cyber crime: Search and seizure of computer system, computer based evidence and jurisdiction. Tools for analysis
3. **Fundamental of Computer Security:** risk assessment and mitigation developing secure system, security models, damage control, assessment and auditing, and network security.Recent advances in computer forensics: computer simulation, image processing and pattern recognition, stenography and cryptography, Forensic linguistics, e- documents, digital signature.

**PART-B**

1. **Quality Management** (ISO/ IEC-17025, NABL): Introduction, general requirement for competence of testing, standardization and calibration of forensic laboratories. Management and technical requirements for quality assurance.
2. **Biometrics:** definition, scope, types of biometric tool, fingerprint, face, Iris and retina imaging, ear, speech recognition, pattern comparison, human gait pattern. Professional ethics and conduct of forensic expert, dealing with news media.
3. **Intellectual property right**: copyright and patent, IT act 2000- introduction to offences and penalties.

**Suggested Readings**

1. Tewari, R.K., et al.: Computer Crime & Computer Forensics selects Publisher, New Delhi, 2003.
2. John R. Vacca: Biometric technologies and verification system, 2007.
3. Anil K. Jain, Rund Bolle, Sharath Rankanli: Biometrics - Personal Identification in networked society, 1999.
4. Vacca John R: Computer Forensics, Computer Crime Scene Investigation, Firewall Medial, An imprint of Laxmi Pub.
5. Casey Eoghan: Handbook of Computer Crime Investigation, Forensic Tools & Technology, Academic Press.
6. L C Jain, H Hallic, I Hayaush, S. B Lee & S Tulsui: Intelligent Biometric Techniques in fingerprint and Face Recognition, CRC Press .

**PAPER NO. FSC 303**

**DNA PROFILING**

**CREDITS- 4**

Total Marks: 100

Theory Exam. Marks: 80

Internal Assessment: 20

Time: 3 hrs.

**Objective:** To introduce students about the basic concepts of DNA fingerprinting and issues related to examination of evidences submitted in criminal cases.

**Outcomes:**

1. Students will study the basic principle of DNA profiling and extraction of DNA by conventional and recent methods.
2. The subject will also deal with the study of DNA amplification and various DNA typing methods such as RFLP, STR, and SNPs with their limitations and advantages.
3. The various issues related to reporting DNA as evidence to court such as contamination, low copy number, sample degradation will also be discussed.

**Note:**

1. Nine questions will be set in all.

2. Question No. 1, which will be objective/short answer type cover the entire syllabus, will be compulsory. The remaining eight questions will be set section wise selecting four questions from each section (A & B). The candidate will be required to attempt question No. 1 and four more selecting two questions from each section.

3. As far as possible the questions should be divided into sub-parts and marks indicated part wise.

**PART- A**

1. **Introduction of Human Genome:** Human chromosomes and karyotype, human nuclear genome. Mutation-types and cause, gens and alleles, human genetics and heredity. Calculation of allele frequencies. types and properties of DNA, mt DNA, DNA modifying enzymes, restriction enzymes
2. **Forensic DNA Profiling:** History and development of DNA finger printing

**Basic Genotyping:** VNTR, STR, SNPs polymorphism and other classes of DNA polymorphism. DNA markers

1. **Methods of DNA profiling**: Introduction, principle, techniques of RFLP, STRs, SNP profiling, assessment of STR profiling their advantage and limitations.

**Gender identification:** Y-STR and mt-DNA profiling.

1. **DNA Amplification (PCR)-** principle, method, factors affecting PCR, advantage of PCR based techniques over RFLP.
2. **Blotting techniques:** Southern, Northern, Western, dot-, slot- and vacuum blotting.

**PART-B**

1. **DNA sample preparation:** sample sources for DNA, collection and preservation of samples for DNA testing, conventional and recent methods of DNA extraction, separation, DNA Quantitation methods, , DNA sequencing. DNA data base- CODIS
2. **Nucleic acid hybridization:** Preparation of nucleic acid probes for DNA profiling Single locus and multi locus probes, and cDNA probes; Methods of labeling of DNA probes – Radioactive and non-radioactive labeling; detection methods, DNA Micro array technology.
3. **Forensic Issues:** degraded DNA, contamination, mixed samples and low copy number. Result interpretation, Quality assurance in DFP testing. Legal standards for admissibility of DNA profiling
4. **Forensic Signification of DNA Profiling:** personal identification, paternity testing, wild life forensics, veterinary, agriculture and mass disaster. Report writing and presentation of report in case of DNA profiling.

**Suggested Readings**

1. Daniel L. Hartl & Elizabeth W. Jones; Genetics- Principle & Analysis, 4th Ed., Jones & Bartlet Pub. 1998.
2. Jaiprakash G. Shewale, Ray H. Liu Forensic DNA Analysis: Current Practices and Emerging Technologies, CRC Press, 2013
3. John M Butler: Forensic DNA Typing. Elsevier Academic Press.
4. Keith Immen and Norah Rudus, 1997. An introduction to Forensic DNA Analysis. CRC Press, New York.
5. Lee M.C. and Gaenesten, R.E: DNA and other Polymorphism in Forensic Science. Year book Medical Published.

**PAPER NO. FSC 304**

**Advances in Forensic Chemistry- I**

**CREDITS-4**

Total Marks: 100

Theory Exam. Marks: 80

Internal Assessment: 20

Time: 3 hrs.

**Objective:** To introduce students about the basics of alcoholic products, adulteration in petroleum etc and detailed analysis of evidences related to Forensic chemistry.

**Outcomes:**

1. The subject will introduce students about the descriptive analysis of different adulterants in liquors which are being used in Forensic Chemistry.
2. The students will learn about the detailed process of extraction and isolation of drugs/ poisons from samples related to forensic toxicology

**Note:**

1. Nine questions will be set in all.

2. Question No. 1, which will be objective/short answer type cover the entire syllabus, will be compulsory. The remaining eight questions will be set section wise selecting four questions from each section (A & B). The candidate will be required to attempt question No. 1 and four more selecting two questions from each section.

3. As far as possible the questions should be divided into sub-parts and marks indicated part wise.

Part A

1. **Analysis of Beverages**: Alcoholic and non-alcoholic beverages and their composition, Analysis of alcoholic beverages as per BIS and PFA Act,
2. Detection and determination of ethanol, furfural, organic acids, aldehydes, chloral hydrate and, methanol in liquors by color tests, TLC, GC, and GC-MS methods.
3. **Analysis of petroleum products and residues**: Distillation and fractionation, Standards/methods of commercial analysis of petroleum products as per ASTM and BIS,

Analysis of traces of petroleum products in forensic exhibits, Comparison of petroleum products, Adulteration of petroleum products,

1. **Oils and fats : introduction,** analysis and characterization of various oils and fats
2. Analysis of gold & other metals in cheating cases

**Part B**

1. **Extraction and isolation of poisons/ drugs from biological samples:**

**Volatile compounds:** Industrial solvent acid and basic Distillation,

**Non-volatile organic compounds:** Neutral non volatile compounds( pesticides/insecticides- oragnophosphorous compound, chlorinated, compounds, carbamates, and pyrethroids ), acidic and basic non volatile compounds -Stas-otto method, Dovbriey Nickolls (Ammonium sulphate) method, acid digest and Valov(Tungstate) methods, Solvent extraction,

**Toxic Cations:** lead, mercury, arsenic -Dry Ashing and Wet digestion process,

**Toxic Anions:** Dialysis method, total alcoholic extraction method.

1. **Recent methods of sample extraction from body fluid:** Solid phase extraction, Solid phase micro extraction techniques, liquid phase micro extraction methods.
2. **Examination process of suspected poison sample:** chemical tests, TLC methods, UV Vis methods, IR spectrometry, GC-MS.

References:

1. Clarke E.G.C, Clark’s Isolation and Identification of Drugs, Publisher Pharmaceutical Press. (1986)
2. Kobilinsky Lawrence, Forensic Chemistry Handbook; 1st Edt; John wiley & sons publishing house; Canada
3. Suzanne Bell, Forensic chemistry; 2nd Edition; Pearson Higher Education
4. Houck Max M, Forensic Chemistry; 1st Edition; Elsevier science publication. ( 2015) Amsterdam
5. Modi: Textbook of Medical jurisprudence &Toxicology, M.M. Tripathi Publication.
6. R.T. Morrison, R.N. Boyd; Organic Chemistry, 6th Ed., Prentice Hall, New Delhi (2003)
7. S.N. Tiwari: Analytical Toxicology, Govt. of India Publications, New Delhi, 1987
8. Forensic Chemistry Manual, Directorate of Forensic science, MHA Government of India
9. Sharma B.R. Forensic Science in Criminal Investigation & Trials, Universal Law Publishing Company.
10. Johll Mathew E, Investigating Chemistry: A forensic science perspective; 2nd Edition; W.H.Freeman and Company; New York, 2009
11. Christian Donell R, Khan Javed, Kennedy Thomas, Basic Principles of   
     Forensic Chemistry; 1st Edition, Humana Press, 2011

**PAPER NO. FSC 305**

**ADVANCES IN FORENSIC BIOLOGY- I**

**CREDITS-4**

Total Marks: 100

Theory Exam. Marks: 80

Internal Assessment: 20

Time: 3 hrs.

**Objective:** To make students understand the basics of biological material and its properties to aid in forensic investigations.

**Outcome:**

1. The subject will provide information to students regarding the analysis of various evidences of animal or plant origin.
2. It will explicate the insect development and geographical distribution for assistance in estimating the time since death and locating the probable crime scene.
3. It will also provide the information about poaching and hunting of protected animal species and trade in international market.

**Note:**

1. Nine questions will be set in all.

2. Question No. 1, which will be objective/short answer type cover the entire syllabus, will be compulsory. The remaining eight questions will be set section wise selecting four questions from each section (A & B). The candidate will be required to attempt question No. 1 and four more selecting two questions from each section.

3. As far as possible the questions should be divided into sub-parts and marks indicated part wise.

## PART- A

1. **Hair examination:** Hair structure, growth and replacement of hair. Identification: Species of origin, variation in different major population groups, somatic origin.

Individualization: Blood grouping, enzyme typing and DNA typing

1. **Botanical evidences:** Introduction, types, location, collection evaluation and forensic significance.

**Wood:** Type of wood and their identification and comparison.

**Leaves:** Identification of various types of leaves and their anatomy, methods of comparison.

**Pollens:** Structure, function, methods of identification and comparison.

**Diatoms:** Nature, location, structure, extraction from various body tissues, including bone marrow, preparation of slides, methods of identification and comparison, forensic significance.

1. **Forensic Microbiology:** Types and identification of microbial organisms of forensic significance.

**PART- B**

1. **Wild Life Forensics:** Introduction, importance, protected and endangered species of Animals and Plants. Identification of wild life materials such as skin, fur, bones, nails, horn, teeth, flowers and plants, by conventional and modern methods, Identification of Pug marks of various animals.
2. **Forensic Entomology:** Introduction, general entomology and arthropod biology, insects of forensic importance, collection of entomological evidence during death investigations, the role of aquatic insects in forensic investigations, Insect succession on carrion and its relationship to determine time since death, its application to Forensic Entomology.

**Suggested Readings**

1. Richard saferstein; Forensic Science Hand book, Vol (I); Prentice Hall, Publications.
2. Jason H. Byrd and James L. Castner; Forensic entomology, CRC Press LLC, 2001.
3. Robertson (1999) : Forensic examination of Hair. Francis & Taylor, USA.
4. Safersstein, R. (1982) Science Handbook; Vol. III, Prentice Hall, New Jersey.
5. Curry, A. S. (1965) Methods of Forensic Science, Vol. IV, Interscience, New Youk.
6. Chowdhuri, S. (1971) : Forensic Biology, B P R & D Govt. of India.

**PAPER NO. FSC 306 (Open Elevtive)**

**METHODS OF SOLVING FORENSIC CASES**

**CREDITS- 4**

Total Marks: 50

Theory Exam. Marks: 40

Internal Assessment: 10

Time: 3 hrs.

**Objective:** To introduce the students with the various methods which are being used in Forensic Investigations

**Outcome:** Knowledge of basics will assist the students in understanding the various Forensic examinations so conducted in the laboratories, thus aiding in better understanding and implementation of scientific principles in

criminal cases.

**Note:**

1. Nine questions will be set in all.

2. Question No. 1, which will be objective/short answer type cover the entire syllabus, will be compulsory. The remaining eight questions will be set section wise selecting four questions from each section (A & B). The candidate will be required to attempt question No. 1 and four more selecting two questions from each section.

3. As far as possible the questions should be divided into sub-parts and marks indicated part wise.

**PART- A**

1. **Methods of interrogation:**  introduction,Principle, Importance as an investigative tool, method and of Polygraphy, Narco Analysis, Brain Fingerprinting, and Hypnosis, their Legal aspects.
2. **Voice Analysis:** Introduction, Significance, Characteristics, Voice Spectrography.
3. **Tool Marks**: Types of tool marks, Class characteristics and individual characteristics, Lifting of tool marks, Examination and comparison of tool marks. Significance in reconstruction of crimes.

**PART- B**

1. **Personal Identification:** methods of personal identification, anthropometry, Fingerprints, Hair analysis, DNA fingerprinting, somatoscopy, somatometery, osteometery and craniometery and their importance. facial superimposition
2. **Forensic Odontology**: Dentition, types of teeth and their functions, collection and preservation of bite marks, photography of bite marks, and evaluation of bite marks, Legal aspects of bite marks.
3. **Forensic Medicine**: medico legal aspects of death, types of injuries, ante-mortem and post-mortem injuries, aging of injuries, artificial injuries**.**
4. **Writing Examination:** features, principles, type of signature forgery, simulated and trace forgery, their identification.

**Suggested Readings**

1. Smith, B.C. DNA & Forensic Odontology- Manual of Forensic Odontology, Colorado Springs, USA, 1995.
2. Modi J. P. Textbook of Medical jurisprudence &Toxicology, M.M. Tripathi Pub.
3. Reddy K.S.N. The essential of Forensic Medicine and Toxicology.
4. Parikh K. Parikh’s test book of medical jurisprudence Forensic medicine and toxicology.
5. Jain L.C. Intelligent Biometric Techniques in Fingerprint and face recognition, CRC Press Ohio, 1999.
6. Hillison S. Dental Anthropology, Cambridge Univ. Press, UK 1996.
7. James S.H and Nordby J.J. (2003), Forensic Science: An introduction to scientific and investigative techniques, CRC Press, USA.
8. O’Hara C.E. and Osterburg J.W. (1949). Introduction to Criminalistics, The MacMillan Co.
9. Saferstien R. (8th Edition) (1976), Forensic Science Handbook, Prentice Hall Inc. USA.
10. Gaensselen R., Harris H. and Lee H. (2007), Introduction to Forensic Science and Criminalistics, McGraw-Hill Education.
11. Sharma B.R. (2003) Forensic Science in Criminal Investigation and Trials, Universal Law Publishing Company.
12. Wentworth and Wilder (1948), Personal Identification, R. G. Badger, Boston.
13. Huber A. R. and Headrike A.M. (1999), Handwriting identification: facts and fundamental, CRC LLC.

**SEMESTER – III**

**Paper: FSC 307 (Core)**

**Credits: 1**

**Seminar**

**Total Marks: 25**

**PAPER – FSC 308**

**PRACTICAL (BASED ON PAPERS FSC 301, FSC 302 & FSC 303)**

**CREDITS- 4**

Total Marks: 100

Theory Exam. Marks: 80

Internal Assessment: 20

Time: 3 hrs.

1. Examination and Comparison of fired bullets

2. Examination of characteristics of Firearms – Calibre, Choke etc.

3. Examination and Comparison of fired Cartridges/cases.

4. Determination of shot number from size and weight of shots.

5. To perform chemical tests for powder residues and Barrel wash.

6. To determine range of firing.

7. Examination of Firearms injuries

8. Identification of explosives by chemical color test.

9. Identification of explosives by TLC methods

10. Image processing using tools like photoshop, photopaints etc .

11. Email Investigation

12. Phishing case report

13. Virus attack case report

1. Preparation of human karyotype.
2. Extraction of DNA from blood etc.
3. DNA Quality check: Agarose gel electrophoresis.
4. DNA Quantitation by UV Spectrophotometry.

**PAPER – FSC 309**

**PRACTICAL (BASED ON PAPERS FSC 304)**

**CREDITS- 4**

Total Marks: 100

Theory Exam. Marks: 80

Internal Assessment: 20

Time: 3 hrs.

1. Analysis of alcoholic liquor as per BIS specifications.
2. Determination of methanol and ethanol in alcoholic liquors.
3. Analysis of gasoline as per BIS specifications.
4. Detection of metallic poisons (arsenic and mercury) in viscera and food stuff (simulated samples).
5. Systematic extraction and identification of acidic and basic drugs from viscera (simulated sample).
6. Qualitative Analysis of explosion residues
7. Systematic extraction and identification of organophosphorous, organo- chloro pesticides from food materials and viscera

**PAPER – FSC 309**

**PRACTICAL (BASED ON PAPERS FSC 305)**

**CREDITS- 4**

Total Marks: 100

Theory Exam. Marks: 80

Internal Assessment: 20

Time: 3 hrs.

## 1. Determination of age from skull sutures.

2. Determination of age from Teeth.

3. Determination of sex from skull.

4. Determination of sex from Pelvis.

5. To Perform osteometric measurements on Long bones.

6. To Perform craniometric measurements on skull.

7. To perform somatometric measurement on living.

(a) Height vertex, (b) Head length

(c) Head breadth (d) Foot length

(e) Foot breadth (f) Nasal height

(g) Nasal breadth (h) External biorbital breadth

(i) Internal bi-orbital breadth (j) Bigonial breadth

(k) Bizygomatic breadth.

8 To prepare slides of scale patterns of human hair.

9 To examine human hair for cortex and medulla.

10 To identify blood stains.

11 To identify semen stains.

12 To identify saliva stains.

13 To identify various type of fibers.

14 To determine species of origin from blood.

15 To determine blood group from fresh blood and blood stains.

**SEMESTER IV**

**PAPER NO. FSC 401**

**FORENSIC PHYSICS**

**CREDITS- 4**

Total Marks: 100

Theory Exam. Marks: 80

Internal Assessment: 20

Time: 3 hrs.

**Objective:** To study the types, nature and examination of physical evidences of Forensic importance

**Outcomes:**

1. The subject will introduce students with the composition and examination process of various physical evidences such as glass, soil, building materials, and examination of various tool marks.

2. The students will also read about the classification and composition of the fingerprints and various methods for the development of latent prints.

3. The students will also learn various methods available for retrieving information from available foot/ tyre impression from different surfaces.

**PART- A**

**Forensic Physics:** Introduction and scope, tools and techniques, examination of vehicle in case of road traffic accident, skid marks evaluation.

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

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

**Fibre**: Types of fibres, forensic aspects of fibre examination- fluorescence, optical properties, refractive index, birefringence, dye analysis. Physical fit and chemical testing. TLC, IR-micro spectroscopy, Py-MS. Difference between natural and man-made fibres.

**Miscellaneous Evidences:** wire, broken bangles, seals, counterfeit coins, ropes/ strings, synthetic fibers etc their introduction & forensic examination.

**PART –B**

**Building Materials:** Cement- composition, types, Forensic Analysis- bromoform test, fineness test, ignition-loss test, Identification of adulterated cement. Mortar and concrete analysis.

**Soil**: Types and composition of soil, sample preparation, removal of contaminants, colour, molecular particle size distribution, turbidity test, pH measurements, microscopic examination, density gradient analysis, ignition-loss test, elemental analysis, interpretation of soil evidence.

**Tool Marks:** theory,types of tool marks,and theirforensic examination, Restoration methods of obliterated marks.

**Voice Analysis and Tape Authentication:** theory of voice production, theory of voice identification, the sound spectrograph, voice comparison -standards and methods of voice comparison, significance.

**Suggested readings:**

1. B.R. Sharma, Forensic Science in Criminal Investigation and Trials, Universal Law Publishing; Fourth edition 2013.

2. David A. Crown, The Forensic Examination of Paints and Pigments, Toylor &amp; Francis, NY, 2001.

3. N. Gilbert: Criminal Investigation; Third edition, Macmillan Publishing Company.

4. Noon: Forensic Engineering Investigation, 2000.

5. Saferstein : Forensic Science Handbook, Vol. I, II &amp; III, Prentice Hall Inc. USA.

6. Richard Saferstein. Criminalistics: An Introduction to Forensic Science. 10th edit. Prentice-Hall, New Jersey.

**PAPER NO. FSC 402**

**FORENSIC DACTYLOGRAPHY AND OTHER IMPRESSIONS**

**CREDITS- 4**

Total Marks: 100

Theory Exam. Marks: 80

Internal Assessment: 20

Time: 3 hrs.

**Objective:** To study the types, nature and examination of physical evidences of Forensic importance

**Outcomes:**

1. The subject will introduce students with the composition and examination process of various physical evidences such as glass, soil, building materials, and examination of various tool marks.

2. The students will also read about the classification and composition of the fingerprints and various methods for the development of latent prints.

3. The students will also learn various methods available for retrieving information from available foot/ tyre impression from different surfaces.

**Part - A**

**History and development of finger prints**: development and morphology of ridged skin, types, and variations in finger prints: Causes and genetics, population variations. Finger Prints Bureau.

**Sample collection:** Basics of taking inked prints, collection of prints samples of living and deads, devices and material for recording prints. Classification of finger Prints, pattern types, pattern area.

**Classification systems**: Henry system of classification (Primary to tertiary and key classification) extension of Henry system searching of finger prints, , single finger print.

**Chance Finger Prints:** Latent prints, plastic prints, causes, composition of sweat. Development of latent finger prints: powder methods: such as fluorescent powder, magnetic powder. Fuming methods: Iodine and cynoacrylate methods. Chemical methods: Ninhydrin and its analogue silver nitrate, application of laser technologies, metal deposition method. Biological methods of development of latent prints on skin.

**Part- B**

**Latent print processing** Systematic approach to latent print processing, preserving and lifting of finger prints. Photography of Finger Prints, comparison of finger prints: basis of comparison, class characteristics, individual characteristics, various types of ridge characteristics.

**Automatic Finger Print Identification system (AFIS**) and its variants, digital Image processing of finger prints and their enhancement. Presentation of expert evidence on finger prints in court.

**Foot / footwear/ tyre impressions:** introduction, class and individual characteristics, types, collection, preservation and forensic examination and evaluation of impressions, Gait pattern.

**Lip Prints and Ear Prints** – Nature, location, collection, forensic examination, and significance.

**Suggested Readings**

1. B.R. Sharma, Forensic Science in Criminal Investigation and Trials, Universal Law Publishing, 2013.

2. Bridges BC: Criminal Investigation, Practical Finger Printing, Thumb Impressions, Hand writing Expert testimony opinion Evidence, University Book Agency, Allahabad.

3. Cowger, James F: Friction ridge skin- Comparison and Identification of fingerprints, CRC Press, 1993.

4. William J. Bodziak: Footwear Impression Evidence Elsevier Science Publishing Co. New York.

5. R. Saferstein: Forensic Science Handbook, Vol.-I, II, Prentice Hall, NJ, 1988.

6. C. Champod et al. Ridge skin impression, CRC Press, London, 2004.

7. Richard Saferstein. Criminalistics: An Introduction to Forensic Science. 10th edit. Prentice-Hall, New Jersey.

**PAPER NO. FSC 403**

**Advances in Forensic chemistry II**

**Credits-4**

Total Marks: 100

Theory Exam. Marks: 80

Internal Assessment: 20

Time: 3 hrs.

**Objective:** To introduce students about the basics and detailed analysis of narcotic and Psychotropic substances and plants alkaloids

**Outcomes:**

1. The subject will introduce students about the descriptive analysis of different adulterants NDPS substances.
2. The students will learn about the detailed chemistry and analysis process of plants alkaloids and plant poisons of forensic significances,

**Note:**

1. Nine questions will be set in all.

2. Question No. 1, which will be objective/short answer type cover the entire syllabus, will be compulsory. The remaining eight questions will be set section wise selecting four questions from each section (A & B). The candidate will be required to attempt question No. 1 and four more selecting two questions from each section.

3. As far as possible the questions should be divided into sub-parts and marks indicated part wise.

**Part A**

**Analysis of Narcotic Drugs and Psychotropic Substances**:Introduction classification of narcotic substances, natural narcotics, semi synthetic and synthetic narcotic substances.

**Opiate**: extraction of alkaloids from plant materials, a analysis of opium alkaloids, and derivatives using spot tests, microcrystal tests, TLC, UV- vis spectrometry, IR spectrometry, GC-MS,

**Cannabis:** introduction, chemistry, analysis by spot tests, TLC, and UV, and IR, spectrometry, GC – MS.

**Barbiturates: chemistry, types, extraction and isolation,** characterization by spot tests, TLC, and IR spectrometry, HPLC – MS.

**Benzodiazepines:**  Introduction, types and classification, chemistry, characterization by spot tests, TLC, and UV and IR spectrometry, GC – MS etc.

**Amphetamines: chemistry,** characterization by spot tests, TLC, and UV and IR spectrometry, GC – MS, NMR etc.

**Hallucinogens (LSD, psilocybine and mescaline):** Introduction, analysis: spot tests, TLC, and IR spectrometry, HPLC – MS, GC- MS.

**Part B**

**Plants poisons:** Introduction and classification of plants alkaloids, analysis of different plants poisons of forensic significance using spot tests, microcrystal tests, TLC and other sophisticated techniques. **Poisonous seeds:** Abrus precatorius, Atropa belladonna, Argemone mexicana, Cerbera thevetia, Croton tiglium, Datura fastuosa, Ricinus communis. **Poisonous fruits:** Semicarpus anacardium, Urginea scilla. **Poisonous roots:** Digitalis, Aconitum napellus, Plumbago rosea. Poisonous Mushrooms

Suggested Readings:

1. Modi: Textbook of Medical jurisprudence &Toxicology, M.M. Tripathi Publication.
2. S.N. Tiwari: Analytical Toxicology, Govt. of India Publications, New Delhi, 1987
3. Clarke E.G.C, Clark’s Isolation and Identification of Drugs, Publisher Pharmaceutical Press. 1986
4. Kobilinsky Lawrence, Forensic Chemistry Handbook; 1st Edt; John wiley & sons publishing house; Canada
5. Suzanne Bell, Forensic chemistry; 2nd Edition; Pearson Higher Education
6. Houck Max M, Forensic Chemistry; 1st Edition; Elsevier science publication. 2015 Amsterdam
7. Forensic Chemistry Manual, Directorate of Forensic science, MHA Government of India
8. Sharma B.R. Forensic Science in Criminal Investigation & Trials, Universal Law Publishing Company.
9. Johll Mathew E, Investigating Chemistry: A forensic science perspective; 2nd Edition; W.H.Freeman and Company; New York, 2009
10. Christian Donell R, Khan Javed, Kennedy Thomas, Basic Principles of   
     Forensic Chemistry; 1st Edition, Humana Press, 2011

**PAPER NO. FSC 404**

**ADVANCES IN FORENSIC BIOLOGY- II**

**CREDITS- 4**

Total Marks: 100

Theory Exam. Marks: 80

Internal Assessment: 20

Time: 3 hrs.

**Objective:** To make students understand the basics of biological processes and its properties to aid in forensic investigations.

**Outcomes:**

1. The subject will provide information to students regarding the immunological responses of the body and their application in forensic examination.
2. It will explicate the students about the details of DNA profiling techniques, its applications, limitations and assistance in criminal cases.

**Note:**

1. Nine questions will be set in all.

2. Question No. 1, which will be objective/short answer type cover the entire syllabus, will be compulsory. The remaining eight questions will be set section wise selecting four questions from each section (A & B). The candidate will be required to attempt question No. 1 and four more selecting two questions from each section.

3. As far as possible the questions should be divided into sub-parts and marks indicated part wise.

**PART- A**

1. **Immunology:** Immune system, immune response, innate and acquired immunity and antigens, haptenes and adjuvants.

Immunoglobulin: Types, physio-chemical properties and function, raising of antisera.

1. **Lectins:** Forensic significance, buffers and serological reagents, methods of sterilization employed for serological work.
2. **Antigen-Antibody Reactions:** Precipitation, agglutination, complement, neutralization, immunofluorescence.
3. **HLA system:** Its applications in paternity testing, pitfalls of HLA system.

**PART-B**

1. **Forensic examination of Body fluids:**

Blood: Identification (Preliminary and confirmatory tests), species of origin (Immunodiffusion and Immunoelectrophoresis), Individualization: Blood grouping, enzyme typing,

Semen: Composition, functions and morphology of spermatozoa,

Identification (Preliminary and confirmatory tests including Azoospermic semen stains), Individualization (Blood Grouping, seminal fluid isozymes typing, Composition, functions and forensic significance of saliva, sweat, milk, urine, faecal matter, vaginal secretions and tests for their identification including the presence of blood group specific ABH substances.

1. **Polymorphic enzymes:** Forensic significance, identification from fresh blood and stains.
2. **Paternity disputes:** Causes, Various serological and biochemical methods, calculation of paternity index and probability for paternity and maternity.

**Suggested Readings**

1. Modi, J.K. (1988): Medical Jurisprudence and Toxicology, N.M. Tripathi Pvt. Ltd.
2. Boorman, K. E: Blood Group Serology, Churchill, and Lincolin, P. J. (1988)
3. Race, R. R. and Sangar, R. (1975): Blood Groups in Man. Blackwell Scientific, Oxford.
4. Barris, H. and Hopkinson, D. A. (1976): Handbook of Enzyme, Electrophoresis, Elsevier, North, Holland, New York.
5. Gilblet, E. (1969): Marker’s in Human Blood, Davis, Pennsylvania.
6. Culliford, B. E. (1971), The examination and Typing of Blood Stains, US Deptt. of Justice, Washington.
7. Chowdhuri, S. (1971): Forensic Biology, B P R & D, Govt. of India.
8. Dunsford, I. and Bowley, C. (1967): Blood Grouping Techniques, Oliver & Boyd, London.
9. Eckert, W. G. & James, S.H. (1989): Interpretation of Blood Stain, Evidence, Elsevaier, New York.

**SEMESTER – IV**

**Paper: FSC 405**

**Credits: 4**

**Viva of summer training and project report**

**Total Marks: 100**

**PAPER – FSC 406**

**PRACTICAL (BASED ON PAPERS FSC 401 & FSC 402)**

**CREDITS- 4**

Total Marks: 100

Theory Exam. Marks: 80

Internal Assessment: 20

Time: 3 hrs.

1. Physical examination of glass fragments.
2. Density measurement of (soil, paints, glass) by density gradients methods
3. Comparison of tool marks with comparison microscope.
4. Physical and chemical examination of paints.
5. Collection of plain and rolled inked fingerprints and to identify patterns and ridge characteristics.
6. Analyse the finger prints- 1st , 2nd and 3rd level details.
7. Developing and comparison of latent fingerprints with powder, fuming and chemical methods.
8. To prepare cast of foot wear/ tyre impression mark and their comparison.
9. To record foot marks by tracing method.

**PAPER – FSC 407**

**PRACTICAL (BASED ON PAPERS FSC 403)**

**CREDITS- 4**

Total Marks: 100

Theory Exam. Marks: 80

Internal Assessment: 20

Time: 3 hrs.

1. Systematic identification of Narcotic Drugs and Psychotropic substances (opiates, cannabis and barbiturates, benzodiazepines and amphetamines) by spot colour tests.
2. Thin layer chromatographic analysis of NDPS substances.
3. U.V/Vis spectrophotometric analysis of barbiturates, benzodiazepine and amphetamines.
4. IR/FTIR analysis of drug of abuses.
5. Identification of vegetable poisons through microscopy.
6. Systematic analysis of plant poisons (Datura, abrus, Nicotine, Argemone etc).

**PAPER – FSC 407**

**PRACTICAL (BASED ON PAPERS FSC 404)**

**CREDITS- 4**

Total Marks: 100

Theory Exam. Marks: 80

Internal Assessment: 20

Time: 3 hrs.

1. To determine titre of antisera.

2. To prepare anti-H from seeds of ulex europeous.

3. To perform precipitin test for species of origin determination.

4. To perform Immunodiffusion test for species of origin.

5. To determine blood group from stains of blood and various body fluids with Absorption-inhibition, mixed agglutination and absorption-elution techniques.

6. To prepare gel plates for electrophoresis.

7. Examination of diatoms.

8. Examination of hair of different animals as cat, dog, cow, horse and goat.

9. Extraction and isolation of DNA from blood and other body fluids.

10. DNA Quality check: Agarose gel electrophoresis.

11. DNA Quantitation by UV Spectrophotometry.