

REVISED UG SYLLABUS UNDER CBCS
(Implemented from Academic Year 2020-21)

PROGRAMME: FOUR YEAR B.Sc. (Hons)

Domain Subject: **B. Sc - Forensic Science**

Skill Enhancement Courses (SECs) for Semester V, from 2022-23 (Syllabus/Curriculum)

Pair Options of SECs for Semester–V

(To choose one pair from the five alternate pairs of SECs)

| Univ. Code | Courses 6&7 | Name of Course | Th. Hrs. / Week | IE Marks | EE Marks | Credits | Prac. Hrs./ Wk | Marks | Credits |
|------------|-------------|---|-----------------|----------|----------|---------|----------------|-------|---------|
| | 6A | Instrumentation | 3 | 25 | 75 | 3 | 3 | 50 | 2 |
| | 7A | Forensic Toxicology | 3 | 25 | 75 | 3 | 3 | 50 | 2 |
| OR | | | | | | | | | |
| | 6B | Forensic Psychology | 3 | 25 | 75 | 3 | 3 | 50 | 2 |
| | 7B | Narcotic Drugs & Psychotropic Substances | 3 | 25 | 75 | 3 | 3 | 50 | 2 |
| OR | | | | | | | | | |
| | 6C | Forensic Physics | 3 | 25 | 75 | 3 | 3 | 50 | 2 |
| | 7C | Forensic Engineering | 3 | 25 | 75 | 3 | 3 | 50 | 2 |
| OR | | | | | | | | | |
| | 6D | Forensic Medicine & Anthropology | 3 | 25 | 75 | 3 | 3 | 50 | 2 |
| | 7D | Wildlife Forensics | 3 | 25 | 75 | 3 | 3 | 50 | 2 |

Note-1: For Semester–V, for the domain subject Botany, any one of the four pairs of SECs shall be chosen as courses 6 and 7, i.e., 6A & 7A or 6B & 7B or 6C & 7C or 6D & 7D. The pair shall not be broken (ABCD allotment is random, not on any priority basis).

Note-2: *One of the main objectives of Skill Enhancement Courses (SEC) is to inculcate field skills related to the domain subject in students. The syllabus of SEC will be partially skill oriented. Hence, teachers shall also impart practical training to students on the field skills embedded in the syllabus citing related real field situations.*

Semester-wise Revised Syllabus under CBCS, 2020-21
Four Year B.Sc. (Hons) - Semester – V (from 2022-23)
Subject: **B. Sc - Forensic Science**
Course-6A: **Instrumentation**
(Skill Enhancement Course (Elective), 5 credits, Max Marks: 100 + 50)

Learning Outcomes:

1. The students will be able to understand about the principle and working of optical and electronic microscope used for characterization of micro evidences.
2. Students will be able to gain knowledge about the concept of different chromatographic techniques which are used to separate chemical compounds.
3. Students will be aware about the basics of Spectroscopy, sources of radiation, their utility and limitations.
4. Student will able to recognize the best suited techniques to be employed for examination of evidence.

II. Syllabus: *(Total Hours: 90 including Teaching, Lab, Field Training and unit tests etc.)*

UNIT 1: Microscopy: Principles and techniques: Light Microscope, Phase contrast, Fluorescence, stereomicroscope, polarizing, comparison and Electron Microscope (Scanning, Transmission), Forensic and their applications.

UNIT 2: Chromatography: Basic principles. Thin Layer Chromatography Theory and Instrumentation, HPLC - Principle and Instrumentation application, HPTLC, densitometer, applications.

Gas chromatography: Principle and Instrumentation, types of GC (GLC, and GSC) and column types, Detectors for GC -TCD,FID, ECD, NPD etc, Pyrolysis GC, GC-MS; applications.

UNIT 3: Spectroscopy: Spectrum of EMR, Interaction of EMR with matter, Source of radiations wavelength selector, Optical detector UV-Visible, IR and Raman spectroscopy Principle of single and double beam spectrophotometer, Instrumentation of IR, UV, spectroscopy qualitative and quantitative analysis of spectroscopy and their Forensic applications.

UNIT 4: Mass Spectroscopy: Principle, instrumentation, ion sources, types mass analyser-quadrupole time of flight, double focusing, tandem mass spectroscopy, detectors for mass spectroscopy their applications.

UNIT 5: NMR Spectroscopy, Neutron Activation Analysis: Principle, techniques and Forensic application. X-rays spectroscopy: Principles of X ray diffraction and X ray florescence technique, their forensic applications.

Instrumentation Practicals:

1. Separation of various compounds by TLC
2. Separation and identification of various compounds by HPLC
3. Separation of various volatile compounds by GC
4. Microscopic examinations of hair and fibers.

Suggested Co-Curricular Activities:

- Visit to IICT, NIN, CDFD, CCMB

Suggested Reading:

1. Instrumental Methods Forensic Science Analysis 2022 Dr A K Jaiswal
2. Forensic Science UGC Net / JRF MCQ's Dr Anusinghla
3. Past 10 Years Question Bank with Answers UGC Net / JRF Khushal Singh
4. Question Answers Criminology & Forensic Science UGC Net/ JRF V N Sehgal
5. Forensic Science UGC Net / JRF MCQ s Anil Kumar Sigh
6. Barbara Wheeler and Lori J. Wilson. Practical Forensic Microscopy: A Laboratory Manual, Wiley
7. Lee and Caensstem. Advances in Forensic Science, Vol. 2. Instrumental Analysis.
8. B. K. Sharma. Instrumental Methods of Chemical Analysis, Goel Publishing House, 26th Edition (2007).
9. D. A. Skoog, D. M. West, F. James Holler and S. R. Crouch, Fundamentals of Analytical Chemistry, 8th Edition, Thomson, 2004.
10. G.Chatwal and S. Anand, Instrumental Methods of Chemical Analysis, 7 Edition Himalaya Publishing House.
11. Hobart H. Willard, Instrumental Methods of Analysis (Chemistry) Wadsworth Publishing Company.

MODEL QUESTION PAPER (Sem-end. Exam)

B. Sc DEGREE EXAMINATION

SEMESTER –V

Course 6A: Instrumentation

Time:3Hrs

Max.marks:75

Section – A

5 x2=10

1. Write down the principle of polarizing microscopy.
2. Draw a hierarchal chart of various chromatographic methods.
3. What is Raman Effect?
4. Pen down the basic principle of mass spectrometry.
5. What do you mean by Neutron Activation Analysis?

Section – B

5x5=25

Answer any four questions. Each answer carries 5 marks
At least 1 question should be given from each Unit

1. What causes chemical shifts in NMR Spectroscopy? Explain with diagram.
2. What are the differences between Raman Spectra and Infrared Spectra?
3. Give the principles of Ultra-Violet Spectrometry & its double beam diagram.
4. Write down the forensic applications of X-Ray Spectroscopy.
5. Write a short note on Tandem Mass Spectroscopy.
6. Explain the principles of TLC.
7. Explain the working of compound microscope with well labelled diagram.
8. Define: FID, TCD and NPD with well labelled diagram.

Section – C

4x10 = 40

Answer any four questions. Each answer carries 10 marks
At least 1 question should be given from each Unit

1. Give selection rule for UV, IR and rotational energies.
2. Write difference between SEM &TEM.
3. Explain instrumentation, working and principle of HPLC.
4. Explain about various detectors of mass spectroscopy with well labelled diagram.
5. Explain stretching & vibrational frequency of IR.
6. Explain with diagram:
 - a) Spin -spin coupling
 - b) Equivalent hydrogen
 - c) Up field & Downfield
 - d) Integral curve
 - e) Coupling constant

Suggested Question Paper Model for Practical Examination

Semester – V/ Course – 6

Time: 3 hrs

Max. Marks: 50

1. To perform the microscopic analysis of hair by compound microscope. 8 M
2. Separation of proteins by TLC. 8 M
3. To separate different inks by TLC. 12 M
4. Scientific observation and data analysis 4 x 3 = 12 M
 - A. HPLC Column (Silica base- Grade A)
 - B. GC Column
 - C. Identification of Stereomicroscope
 - D. Identification of Comparison Microscope.
5. Record + Viva-voce 6+4 = 10 M

Semester-wise Revised Syllabus under CBCS, 2020-21
Four Year B.Sc. (Hons) - Semester – V (from 2022-23)
Subject: **B. Sc - Forensic Science**
Course-7A: **Forensic Toxicology**
(Skill Enhancement Course (Elective), 5 credits, Max Marks: 100 + 50)

Learning Outcomes:

1. Able to describe the major effects on the rate of absorption of alcohol from the stomach into the bloodstream
2. Students will be able to classify various poisons depending on their toxicity
3. Will be able to answer different techniques to detect poisons in viscera sample
4. Post-mortem appearances of poisons in the body
5. Antidotes for lethal poisons

Syllabus: *(Total Hours: 90 including Teaching, Lab, Field Training and unit tests etc.)*

Unit-1: Introduction to Forensic Toxicology - History & Development. Poisons Act 1919, Sections – IPC 193, 201, 202, 270, 271, 272, 273, 274, 275, 276, 277, 278, 284, 328. Cr.P.C. 39, 40, 175. National Poisons Information Centre (NPIC). Definitions – Toxins, Drug, Toxicodynamics, Toxicokinetics, Dose, Lethal Dose, LD50, Tolerance, Role of Forensic Toxicologist in Criminal Justice System.

Unit-2: Poisons – Definition, Forms of Poison – Physical, Chemical & Mechanical state. Classification – Corrosives/caustics – Strong acids & Alkalis, Irritants – Organic (Plant & Animal) Inorganic (Metallic & Non Metallic). Neurotoxic Poisons – Cerebral & Spinal. Cardiovascular Poisons. Asphyxiants. Pesticides.

Unit-3: Toxicokinetics. Routes of Administration of poisons - Inhalation, Ingestion, Injection, Topical etc. Mode of Action, Clinical features, Elimination of poisons - Urinary excretion, Faecal Excretion, and other routes of elimination. Definition of Antidote– Types of antidotes.

Unit-4: Post mortem Toxicology – Types of samples. Collection of visceral samples, other body fluids - Blood, Saliva, Urine, and Stomach washes etc. their Preservation.

Unit-5: Toxicology of alcohol – Alcohol testing for intoxication. Alcohol in Circulatory system. i.e., Mode of Action. Analysis of alcohol samples. Analytical Toxicology – Isolation and Purification, Screening tests, Methods of Identification, Quantitative estimation of individual poisons.

Forensic Toxicology Practicals

6. Preliminary tests for various poisons smell of metallic, Pesticides and Alcohols etc.
7. Detection of Ethanol by Kozelka & Hine Method
8. Identification of pesticides by TLC
9. Separation of Pesticides by HPLC

Suggested Co-Curricular Activities:

- visits to Forensic science Laboratories for detection of different lethal poisons
- visits to botanical gardens containing poisonous plants
- simulation of animal poisoning and their treatment technique

Suggested Readings:

1. Analytical Methods in Forensic Toxicology Dr S N Tiwari
2. Practical Book for Forensic Chemistry and Toxicology Dr Ashok Jaiswal
3. Forensic Toxicology Dr S P Singh
4. Handbook of Environmental Chemical Toxicology Dr B Singh
5. Practical Manual of Food Chemistry and Nutrition Dr Neetu Singh
6. Environmental Administration in India Dr Namita Gupta
7. Environmental Studies Systems & Solutions Dr Archana Mishra
8. Biochemistry U. satyanarayan
9. Practical crime scene analysis and reconstruction Ross m gardner , tom bevel
10. Concise book of forensic medicine and toxicology R.K Sharma
11. Bloodstain pattern analysis Tom bevel
12. Introduction to spectroscopy Pavia
13. Techniques of crime scene investigation Barry A.J fisher
14. Principles of forensic toxicology Nicholas lappas
15. Review of forensic medicine and toxicology Gautam biswas
16. Essentials of forensic medicine and toxicology Anil aggrawal

MODEL QUESTION PAPER (Sem-end. Exam)

**B. Sc DEGREE EXAMINATION
SEMESTER –V
Course 7A: Forensic Toxicology**

Time:3Hrs

Max.marks:75

Section - A

5 x2 =10

1. Define Lethal Dose and LD50.
2. Give the examples of neurotoxic poisons. Mention at least five.
3. What is antidote?
4. What are the types of viscera samples collected at SoC?
5. Give any one identification test for ethanol.

Section – B

5x5=25

Answer any four questions. Each answer carries 5 marks
At least 1 question should be given from each Unit

1. Explain in detail Toxic Dynamics.
2. Classify corrosives and irritants with examples.
3. Explain in detail urinary excretion of poisons.
4. Explain the procedure of collection of different visceral samples.
5. Explain mode of action of alcohol. Give flow chart.
6. Discuss various preservatives used while forwarding samples for chemical toxicological analysis.
7. Explain different types of antidotes with their examples.
8. Explain in detail NPIC.

Section - C

4x10 = 40

Answer any four questions. Each answer carries 10 marks)
At least 1 question should be given from each Unit

1. Write down in detail about routes of administration of poisons.
2. Classify poisons with flowchart.
3. Write about history and development of Forensic Toxicology in India.
4. Explain the detection of metal poisons from blood and saliva.
5. Give at least four purification/extraction technique.
6. Explain in detail Toxic Kinetics.

Suggested Question Paper Model for Practical Examination

Semester – V/ Course – 6

Time: 3 hrs

Max. Marks: 50

1. To perform spot test for methanol and ethanol (Kozelka & Hine Method). 8 M
2. To detect Nitrogen, Phosphorous and Potassium. 8 M
3. To extract the metal poison from tissue. 12 M
4. Scientific observation and data analysis 4 x 3 = 12 M
 - A. Bottle of snake venom
 - B. Organophosphorus pesticide (Parathion)
 - C. Viscera sample (Blood/ Tissue)
 - D. EDTA (role of EDTA as preservative)
5. Record + Viva-voce 6+4 = 10 M

Semester-wise Revised Syllabus under CBCS, 2020-21
Four Year B.Sc. (Hons) - Semester – V (from 2022-23)
Subject: **B. Sc - Forensic Science**
Course-6B: **Forensic Psychology**
(Skill Enhancement Course (Elective), 5 credits, Max Marks: 100 + 50)

Learning Outcomes:

1. Description of different interviewing techniques
2. The science of lying
3. Psychophysiological aspect of speech and deception
4. Polygraphy technique of lie detection
5. Brain signature profiling
6. Law related to mental health and psychology
7. Different interrogation techniques
8. Deception Detection Techniques.
9. Legal aspects of Psychology.

Syllabus: *(Total Hours: 90 including Teaching, Lab, Field Training and unit tests etc.)*

UNIT 1: Interviewing and Interrogation Techniques: Importance of Investigative Interviewing, Influence of Psychology, P.E.A.C.E Model of Interviewing, Cognitive Interviewing, Ethical Interviewing, Other Interviewing Techniques.

UNIT 2: Interrogation and the related Techniques, Brain Electrical Oscillation Signature Profiling (BEOS), Voice-Stress Analysis/ Layered Voice Analysis, Reliability, Limitations, NHRC Guidelines, Admissibility in the Court, Case Studies.

UNIT 3: Polygraph/Lie Detector Test: Objectives, theoretical basis, stages of examination (Pre-test, In-test. post-test), Questioning techniques, Stim test, Limitations, Admissibility in the court of law, NHRC guidelines, case studies, etc.

UNIT 4: Brain Fingerprinting/Brain-Mapping: Principle, Importance, History, Process, brain waves (P300, delta, theta, gamma, alpha), reliability, case studies, admissibility, etc. Narco-analysis: Principle, History, drugs used, procedure, reliability, admissibility, limitations, Indian scenario. case studies, etc.

UNIT 5: Legal & Correctional Aspects: The mentally ill, Competency to stand trial Mental Health Act, 1987: (Object, Relevant Definitions, Central & State authority, Reception Orders, Human Rights of Mentally ill persons, Penalties & Case-Studies), Indian Penal Code, 1860 Relevant general exceptions. Rehabilitation & Correctional Treatment of Offender(s)/ Victim(s). Techniques, Strategies and Types of Treatments.

Forensic Psychology Practicals:

1. NEO-PI
2. Minnesota Multiphasic Personality Inventory-2/A (MMPI-2/A)
3. Rorschach Test
4. Bhatia's Battery for Intelligence
5. Thematic Apperception Test
6. Word Association Test
7. Polygraphy / Psychological evaluation test

Suggested Co-Curricular Activities

- Visit to police stations to know the procedure of interrogation
- Visit to polygraphy unit at Forensic Science Laboratory
- Visit to mental hospitals and juvenile courts

Suggested Readings

1. Handbook of Forensic Psychology Prof. (Dr) Vimala Veeraraghavan
2. Criminology Prof. (Dr) Vimala Veeraraghavan
3. Organized Crime Dr Minakshi Sinha
4. 'Handbook of Forensic Psychology, Prof Dr. Vimala Veeraraghwan, Edition 1st , 2009, Selective and Scientific Books Publications, New Delhi.
5. 'Introduction to Forensic Psychology-Research and Application', Curt R. Bartol, Anne M. Bartol, Editon 2nd, 2008,Sage Publication.
6. Psychology, (2006) Ciccarelli, S. K. & Meyer G. E. New Delhi; Perason Education
7. Criminology and Penology', Mittal S., Saxena S. K., [2012], Commonwealth Publishers Pvt. Ltd., New Delhi.

MODEL QUESTION PAPER (Sem-end. Exam)

**B. Sc DEGREE EXAMINATION
SEMESTER –V**

Course 6B: Forensic Psychology

Time:3Hrs

Max.marks:75

Section - A

5 x2 =10

1. Define Forensic Psychology.
2. Write the limitations of BEOSP.
3. Explain reliability of Voice Stress Analysis.
4. Write down the names of instruments used in Polygraph Test.
5. Write down the Sections of General Exceptions (IPC).

Section- B

5x5=25

Answer any four questions. Each answer carries 5 marks
At least 1 question should be given from each Unit

1. Write any 4 Interrogation Techniques.
2. Differentiate Cognitive Interview & Ethical Interview.
3. Write about admissibility of BEOSP in court of law with a case study.
4. What are the three principle of polygraphy? Explain.
5. Write about NHRC guidelines of Polygraphy.
6. Explain principles of Brain Mapping/ Brain Fingerprinting.
7. What are the Human Rights of Mentally challenged Person in India? Explain.
8. What are the various classes of drugs in Narco Analysis?

Section – C

4x10 = 40

Answer any four questions. Each answer carries 10 marks
At least 1 question should be given from each Unit

1. PEACE Model of Interview. Explain in detail with hierarchal chart.
2. Explain the principle & working of BEOSP.
3. Explain the principle & working of Polygraphy.
4. Explain the process of Brain Fingerprinting with all types of waves & their diagrams.
5. Write about rehabilitation and correction treatment given to mentally ill offenders.
6. Write any 3 case studies of polygraphy.

Suggested Question Paper Model for Practical Examination

Semester – V/ Course – 6

Time: 3 hrs

Max. Marks: 50

- | | |
|--|------------|
| 1. To perform NEO- PI. | 8 M |
| 2. To perform MMPI-2/A Test. | 8 M |
| 3. To perform Polygraph Test. | 12 M |
| 4. To perform Psychological Evaluation Test. | 12 M |
| 5. Record + Viva-voce | 6+4 = 10 M |

Semester-wise Revised Syllabus under CBCS, 2020-21
Four Year B.Sc. (Hons) - Semester – V (from 2022-23)
Subject: **B. Sc - Forensic Science**
Course-7B: **Narcotic Drugs & Psychotropic Substances**
(Skill Enhancement Course (Elective), 5 credits, Max Marks: 100 + 50)

Learning Outcomes:

1. To differentiate between various classes of illicit drugs
2. The concept of analytical techniques for analysis of drugs
3. The laws related to narcotic drugs
4. Classification of NDPS and their effect on the human body
5. Trend cases of NDPS in India

Syllabus: *(Total Hours: 90 including Teaching, Lab, Field Training and unit tests etc.)*

Unit-1: Narcotics- Introduction, Legal Definitions, Classification- Sedatives, Stimulants, Hallucinogens, Synthetic Narcotics, Designer Drugs.

Unit-2: Drugs and crimes- nonviolent crimes, violent crimes, drug problems in India-cannabis and poppy cultivation – illegal possession – Smuggling – Transportation – Drug Profiling – Clandestine laboratories – Drug abuse in sports – Preliminary tests for Narcotic Drugs and Psychotropic Substances (NDPS).

Unit-3: Sedatives-opium and opium derivatives- Morphine- Administration, Physiological Effects, Addiction, Identification - Heroin- Abuse, Physiological Effects and Identification -Barbiturates- Nature, Administration and Identification.

Unit-4: Stimulants: Cocaine, Amphetamine, Benzodiazepines and their Use, Abuse, Physiological, Psychological, Effects, Addiction, and Identification. Hallucinogens: Cannabis, Quinazolones- Administration, Effects, Addiction and Identification- LSD (Lysergic Acid Diethylamide), Psylocybin, Mescaline and MDMA: Administration, Effects, Addiction and Identification.

Unit-5: NDPS Act 1985 - Drug law enforcements in India- Narcotic control bureau, Central Bureau of Narcotics, Narcotics Control and Intelligence Bureau– Prevention of Drug trafficking -Penalties for NDPS related offenses – NDPS Amendments 2014 – United Nations Drugs Conventions.

Narcotic Drugs & Psychotropic Substances Practicals:

6. Detection of following of Narcotic Drugs & Psychotropic Substances by spot/colour test

- a. Opiates
- b. Barbiturates
- c. Benzodiazepines
- d. Amphetamines and Cannabis

Suggested Co-curricular activities:

- Visit to narcotics control bureau
- Visits to Rehabilitation Centers

Suggested Readings:

1. Pharmacological classification of drugs K . D Tripathi
2. Essentials of medical pharmacology K . D Tripathi
3. Chromatographic analysis of pharmaceuticals John a adamovics
4. Pharmaceutical analysis David G watson
5. Pharmaceutical chemical analysis: methods for identification and limit test Ole pederson
6. Drug testing in alternate biological specimens Amanda j. jenkins

MODEL QUESTION PAPER (Sem-end. Exam)

**B. Sc DEGREE EXAMINATION
SEMESTER –V**

Course 7B: Narcotic Drugs & Psychotropic Substances

Time:3Hrs

Max.marks:75

Section - A

5 x2=10

1. Define Narcotics.
2. Give any 2 Sections of illegal possessions of drugs.
3. Give at least 5 examples of tranquilizers and 3 examples of benzodiazepines.
4. Write any 2 amendments of NDPS in 2014.
5. What are designer drugs? Give examples.

Section- B

5x5=25

Answer any four questions. Each answer carries 5 marks
At least 1 question should be given from each Unit

1. Give the brief introduction of narcotics with their examples.
2. Explain the role of drugs with respect to different types of crime.
3. Mention 5 drugs which are categorized in drug abuse in sports.
4. Discuss in brief the problems associated with addiction.
5. Explain psychological and physiological effects of barbiturates.
6. Write a short note on dope testing. Give examples.
7. Write a note on NDPS Act 1985 with all transportation & smuggling act.
8. What are the various preliminary test for Narcotic drugs?

Section – C

4x10 = 40

Answer any four questions. Each answer carries 10 marks
At least 1 question should be given from each Unit

1. Give the brief classification of NDPS.
2. Explain in detail issues of drug related law in India with a case study.
3. What are psychological effects, addiction & identification of heroine.
4. Explain the process of extraction of cocaine from blood.
5. Write about Central Bureau of Narcotics & Narcotics Control Bureau in details.
6. Write about administration effects, addiction & identification of LSD.

Suggested Question Paper Model for Practical Examination

Semester – V/ Course – 6

Time: 3 hrs

Max. Marks: 50

1. To detect heroine in given viscera sample. 8 M
2. To extract Nicotine from given sample. 8 M
3. To perform the spot test for Cannabis & LSD. 12 M
4. Scientific observation and data analysis 4 x 3 = 12 M
 - A. Nicotine
 - B. Brown Sugar
 - C. Ketamine
 - D. Diazepam.
5. Record + Viva-voce 6+4 = 10 M

Semester-wise Revised Syllabus under CBCS, 2020-21
Four Year B.Sc. (Hons) - Semester – V (from 2022-23)
Subject: **B. Sc - Forensic Science**
Course-6C: **Forensic Physics**
(Skill Enhancement Course (Elective), 5 credits, Max Marks: 100 + 50)

Learning Objectives: After studying this paper the students learn about

1. Types of glass and their composition.
2. Photographic examination of tool marks.
3. Able to determine direction of force on a piece of glass
4. Able to describe the common methods for the analysis of soil
5. Different types of tools involved in criminal activity
6. How other types of polymer-based evidences are analyzed
7. How paint evidence is encountered, collected and preserved

UNIT 1: Soil, Cement and Concrete - Types and composition of soil, sample preparation, molecular particle size distribution, turbidity test, pH measurements, microscopic examination, density gradient analysis, ignition-loss test, elemental analysis, interpretation of soil evidence. Cement bromoform test, fineness test, ignition-loss test. Identification of adulterated cement. Mortar and concrete analysis.

UNIT 2: Paint - Types of paint and their composition, macroscopic and microscopic analysis of paint pigments, pigment distribution, micro-chemical analysis- solubility test, pyrolysis gas chromatography, IR spectroscopy and X-ray diffraction, elemental analysis, interpretation of paint evidence.

UNIT 3: Types of fibres, forensic aspects of fibre examination- fluorescence, optical properties, refractive index, birefringence, dye analysis. IR-micro spectroscopy, Py-MS. Difference between natural and man-made fibres.

UNIT 4: Glass - Types of glass and their composition-soda-lime, boro-silicate, safety glass, laminated, light sensitive, tempered/ toughened, wire glass, coloured glass. Forensic examinations of glass fractures- rib marks, hackle marks, cone fracture, wavy, backward fragmentation, concentric and radial fractures. Refractive index, density gradient, becke-line, specific gravity examination.

UNIT 5: Toolmarks - Types of toolmarks- compression marks, striated marks, combination of compression and striated marks, repeated marks, class characteristics and individual characteristics, tracing and lifting of marks. Restoration of crased/ obliterated marks- Method of making-cast, punch, engrave, method of restoration- etching (etchings for different metals), magnetic, electrolytic etc.

Forensic Physics Practicals:

1. Microscopic examination of soil.
2. Particle size distribution of soil sample.
3. Density gradient method for soil
4. Microscopic examination of Paint.
5. Examination of glass fracture.
6. Examination and Comparison of tool marks.
7. Restoration of erased/obliterated punch marks.

Suggested co-curricular activities

- Visit to glass manufacturing units
- Examination of window glass, or car front glass

Suggested Readings:

1. Physical Evidence in Criminal Investigation and Trials Dr B P Maithil
2. Forensic Evidence Real Cash Study Dr H K Pratihari
3. Introduction to Forensic Science in Crime Investigation Dr Rukmani Krishnamurty
4. Caddy, B; Forensic Examination of Glass and Paint Analysis and Interpretation, CRC Press, New York, 2001.
5. Shaw, D; Physics in the Prevention and Detection of Crime, Contem Phys. Vol.17, 1976.
6. Saferstein, R; Forensic Science Handbook. Vol. I,II, (Ed.), Prentice Hall, New Jersey, 1988.
7. Working Procedure Manual; Physics BPR&D Publication, 2000.
8. Sharma, B.R; Forensic Science in Criminal Investigation and Trials (3rd Ed.), Universal Law Publishing Co., New Delhi, 2001.
9. Working Procedure Manual- Physics, BPR&D Publication. 2000
10. Hess, K.P; Textile Fibers and their Use, 6th Edn, Oxford and IBH Publishing Co., 1974.
11. Trace Evidence By Max M. Houck.
12. Laboratory Procedural manual , Physics Section, DFSL, Mumbai.
13. Forensic science in criminal investigation and trail by B R Sharma
14. Forensic Science in Criminal Investigation & Court Evidence V N Sehgal

MODEL QUESTION PAPER (Sem-end. Exam)

**B. Sc DEGREE EXAMINATION
SEMESTER –V**

Course 6C: Forensic Physics

Time:3Hrs

Max.marks:75

Section - A

5 x2 =10

1. Explain in brief the composition of soil and their types.
2. Mention at least 5 methods of physical examination of fibers.
3. Explain in detail “4R” rule of glass fracture
4. Write a short note on methods of documenting and recording toolmarks.
5. Describe the forensic significance of paint evidence.

Section- B

5x5=25

Answer any four questions. Each answer carries 5 marks
At least 1 question should be given from each Unit

1. Difference between natural fibers and manmade fibers.
2. Explain the modes of adulteration in cement and their detection methods.
3. Write short note on physical measurement refractive index density gradient, of glass evidences
4. Discuss in brief the technique of casting a toolmark.
5. Write a short note on class characteristics and individual characteristics of tool marks.
6. Discuss the process of collection and preservation of glass evidence.
7. Give a brief explanation on types of paints and their composition.
8. Write a note on forensic significance of fibre as evidence.

Section – C

4x10 = 40

Answer any four questions. Each answer carries 10 marks
At least 1 question should be given from each Unit

1. Explain in detail the forensic examination of glass evidences and fracture
2. Discuss the process of restoration of erased
3. Write a short note on elemental analysis of paint.
4. Give detailed information of tools in crime and types of tool marks.
5. What are fibres? Explain their types and in detail.
6. Discuss about elemental analysis of soil in detail.

Suggested Question Paper Model for Practical Examination

Semester – V/ Course – 6

Time: 3 hrs

Max. Marks: 50

1. To perform the microscopic analysis of fibre. 8 M
2. Comparison of glass fragments and Study of fractures in forensic material 8 M
3. Perform a particle size distribution of questioned and standard soil sample and compare the results. 12 M
4. Scientific observation and data analysis 4 x 3 = 12 M
 - A. Pattern of glass fracture identification
 - B. Identification of the tools from image of toolmarks
 - C. Microscopic identification of paint sample
 - D. Identification from different cement samples
5. Record + Viva-voce 6+4 = 10 M

Semester-wise Revised Syllabus under CBCS, 2020-21
Four Year B.Sc. (Hons) - Semester – V (from 2022-23)
Subject: **B. Sc - Forensic Science**
Course-7C: **Forensic Engineering**
(Skill Enhancement Course (Elective), 5 credits, Max Marks: 100 + 50)

Learning Outcomes:

1. This paper describes and explains the investigation of various accidents.
2. Use of forensic investigation techniques to determine of causes failure.
3. assess vulnerable engineering details such as electrical MCB Circuit, eccentric connections, rating criteria of electrical appliances, using well documented failure case studies.
4. Rigorous assessment and evaluation of engineering mistakes such as fire cases .
5. Causes of arson -automotive failure- vehicular fire

Syllabus: (*Total Hours: 90 including Teaching, Lab, Field Training and unit tests etc.*)

UNIT 1: Introduction to Forensic Engineering and Various Types of Failures, Initiation of Failures and associated investigations (Electrical, Mechanical, Structural)- An overview of Electrical System failure (House hold materials such as cables, wires, switchboards/MCBs, MCB faults, Improper Ratings/layout of appliance fitting according to safety criterion etc.) Mechanical Failures manufacturing defects, inadequate quality control measures,

Structural Failures (Structural material composition analysis leading to failures, an investigation view of multi components failures due to any one module manufacturing defects, etc.)

UNIT 2: Investigation of Arson and Incendiary Fires - General - Arsonist Profile - Typical Characteristics of an Arson or Incendiary Fire Daisy Chains and Other Arson Precursors - Liquid Accelerant Pour Patterns, Spalling, Detecting Accelerants after a Fire

Automotive Fire Failure: General, Vehicle Arson and Incendiary Fires, Electrical and Mechanical Causes

UNIT 3: Traffic, Road Safety Failures - Vehicle Performance: Engine Limitations, Deviation from Theoretical Mode, Peel Out, Lateral Tyre Friction, Bootlegger's Turn

UNIT 4: Traffic Accidents: General, Basic Momentum Equations, Properties of an Elastic Collision, Coefficient of Restitution, Properties of Plastic Collision, Analysis of Forces during Fixed Barrier Impact, Energy Losses, Centre of Gravity, Moment of Inertia, Torque, Angular Momentum, Simple Skids, Tyre Friction, Skid Deceleration and Speed Reduction, Brake Failure, Low Velocity Impacts, Measuring Roadway Curvature, Motorcycle Turns, Simple Vehicular Falls

UNIT 5: Investigation of Civil and Structural Failures - Forensics of Building Failure - Forensics of Bridge Failure - Forensics of Civil Engineering Materials Failure (Bricks, Mortar, Concrete etc.) Buildings/ Bridges / Flyovers / Roads Multi storeyed Buildings / Parking Lots - Surface Inadequacies of Road Profile- Airport Runways and Railway Tracks - Forensics of Civil Engineering Structures after Natural Disasters

Building Collapses, Bridge Collapses - Activities in the Investigation Process, Site Investigation and Sample Collection

Forensic Engineering Practicals

6. Analysis of fire debris by GC
7. Collection of samples at scene of fire
8. Analysis of cement samples
9. Examination of mortar samples
10. Examination of bricks samples

Suggested curricular activities:

- Accident Reconstruction Project
- Road accident crime scene visits
- Learning Techniques of collection of tyre impressions from RTO offices
- Visits to RTO offices
- Visits to fire station
- Guest lectures on structural failures on building
- Learning the rules for prevention of automotive accident

Suggested reading:

1. Structure Elucidation of Organic Compounds by Spectroscopic Techniques
Dr. Pradip V Tekade
2. Crime Scene Management A Forensic Approach Dr M S Rao
3. Recurrent Neural Network and Application Neeraj Sahu
4. Network Analysis Technique for Project Management Dr R K Tewari
5. Forensic Engineering Fundamentals By Harold Franck.
6. Elements of Civil Engineering By Mimi Das Saikia
7. Electronic Principles By Albert Malvino and D. J. Bates.
8. Electronics Communication Systems By Kennedy and Davis
9. Measurement, Instrumentation and Experiment Design in Physics and Engineering By Michael Sayer and Abhaaiman Singh.
10. Randall K. Noon: Forensic Engineering Investigation CRC Press, 2000
11. Robert R.: Forensic Structural Engineering Handbook. 2a edn. McGraw-Hill, 2009
12. Robert D.: Forensic Geotechnical and Foundation Engineering, 2a edn. McGraw-Hill, 2011
13. Stephen E. P.: Forensic Engineering: Damage assessments for Residential and Commercial Structures. CRC Press. 1^o edn, 2013
14. Kennet L. C.: Forensic Engineering, (Civil engineering- Advisors). 2nd edn. 1998
15. Harol F., Darren F.: Forensic Engineering Fundamentals. CRC Press. 1^o edn. 2012

MODEL QUESTION PAPER (Sem-end. Exam)

**B. Sc DEGREE EXAMINATION
SEMESTER –V**

Course 7C: Forensic Engineering

Time:3Hrs

Max.marks:75

Section - A

5 x2= 10

1. What is the quality control measures of NCB?
2. Write 2 reasons of structural failure of buildings.
3. Write any 3 arson patterns.
4. Write the dimensions of wheel base.
5. What are different types of skid marks?

Section – B

5x5=25

Answer any four questions. Each answer carries 5 marks
At least 1 question should be given from each Unit

1. Explain the procedure of short circuit.
2. Explain crime scene management of arson case.
3. Explain the causes of vehicular failure.
4. Explain reconstruction of bridge failure.
5. Briefly explain laws of momentum & law of inertia with examples.
6. Write down the procedure for diagnosis & assessment of deterioration in structures with examples,
7. What are electrical and mechanical causes of vehicular arson cases?
8. Write road safety measures to prevent accidents.

Section – C

4x10 = 40

Answer any four questions. Each answer carries 10 marks
At least 1 question should be given from each Unit

1. Explain the crime scene management of structural failure of building.
2. Explain collection techniques of accelerants of arson case & their detection techniques.
3. Discuss classification & chemistry of fire. Write its chemical equilibrium.
4. Write in detail quality control measures of civil engineering materials.
5. Explain the types of collisions and their role in vehicular accidents.
6. Illustrate in detail about utilization of the energy method in forensic engineering.

Suggested Question Paper Model for Practical Examination

Semester – V/ Course – 6

Time: 3 hrs

Max. Marks: 50

1. To perform procedure for collection of cement sample. 8 M
2. To examine the bricks sample. 8 M
3. To analyse the fire debris sample in Gas Chromatography. 12 M
4. Scientific observation and data analysis 4 x 3 = 12 M
 - A. Temperature Test for Cement
 - B. Strength Test for Cement
 - C. Identification of different cement samples.
 - D. Identification of mortar samples.
5. Record + Viva-voce 6+4 = 10 M

Semester-wise Revised Syllabus under CBCS, 2020-21
Four Year B.Sc. (Hons) - Semester – V (from 2022-23)
Subject: **B. Sc - Forensic Science**
Course-6D: **Forensic Medicine & Anthropology**
(Skill Enhancement Course (Elective), 5 credits, Max Marks: 100 + 50)

Learning Outcomes:

1. Able to define the postmortem interval and explain how short- and long-term PMIs are estimated
2. Able to define and describe the medicolegal autopsy and explain when a coroner or medical examiner must perform an autopsy
3. Define and distinguish between the cause of death and the manner of death
4. Able to describe the development and structure of bones
5. The various anthropological tests that can be done on skulls to help identify them
6. Able to describe how bones are individualized

Syllabus: *(Total Hours: 90 including Teaching, Lab, Field Training and unit tests etc.)*

Unit-1: Introduction to Forensic Medicine – Pathology, Medical Jurisprudence. Medical Law and Ethics. Introduction, History & Development of Forensic Anthropology & Archaeology, F.Odontology & F.Taphonomy. Role of Anthropologist.

Unit-2: Introduction to Human anatomy and Physiology- Axial Skeleton- Skull, Sutures of skull, Cranial bones, Facial bones, Sternum, thoracic bones, vertebral column, Appendicular Skeleton- Bones of Upper limbs, Lower limbs, Pelvic Girdle etc. Determination of sex & age from skull, mandible, pelvis, Femur, scapula etc.

Unit-3: Medico-legal Autopsy- Death and its Causes- External examination of deceased body – Internal Examination- Determination of time since death and cause of death- Injuries - classification- Medico-legal aspects of injuries- Postmortem changes. Exhumation process and its importance.

Unit-4: Sexual offences- rape- unnatural sexual offences- sexual perversions- Abortion- Infanticide- foeticides- impotence and sterility- virginity, Thermal deaths- electrocution- starvation Asphyxia- Drowning deaths.

Unit-5: Forensic Odontology- Basic principles, Applications in crime investigations- Bite mark Analysis, Age estimation etc., Development of teeth- Dentition, Architecture of teeth, growth of teeth- Milk, Permanent. Dentition Library, Forensic Odontology limitations.

Forensic Medicine & Anthropology Practicals

7. Autopsy

- i) External Examination of Deceased body
- ii) Internal Examination of Deceased body
- iii) Post-mortem Changes

8. Collection and Preservation of Visceral Samples.

9. Identification and differentiation of Human Bones (Male & Female)

- i) Skull
- ii) Pelvis
- iii) Upper limbs
- iv) Lower limbs

Suggested cocurricular activities:

- visits for post-mortem autopsy
- visits to clinical laboratories for testing procedures
- handling and studying human skeleton

Suggested reading:

- Forensic Medicine and Toxicology S N Tiwari
- A Handbook of Forensic Anthropology Meenal Dhall Renu Tyagi Prof. Anup Kumar Kapoor
- Handbook for Forensic Odontology Dr Vikram Ahuja
- Anthropology and Forensic Science the Current Dynamism Prof. Anup Kumar Kapoor
- Practical Manual on Human Physiology Prof. Sunita Mishra
- Nutrition Health and Life Style Management Pro Sunita Mishra
- Forensic Science in India, A Vision for the Twenty first Century B B Nanda
- Forensic Biology Dr Rukmani Krishnamurty
- Forensic Serology & Blood Examination Dr Archana Tripathi
- An Introduction to Forensic Hair Examination Shubhra Goutam
- Women Victimization Dr Deepti
- Forensic Science for Criminal Justices System Dr Anu Singhla
- An Interdisciplinary Approach to Forensic Science Dr P K Janjua
- Women Nutrition and Health Dr Neetu Sing
- Perceived Status of Women in India Prof. Vimala Veerarghavan
- Introduction to Forensic Anthropology, Steven N. Byers, Pearson/Allyn and Bacon, 2011.
- Forensic Anthropology Laboratory Manual, Steven N. Byers, Pearson Education, USA, 2011.
- Forensic Anthropology: Current Methods and Practice, Angi M. Christensen, Nicholas V. Passalacqua and Eric J. Bartelink, Academic Press, USA, 2014.

MODEL QUESTION PAPER (Sem-end. Exam)

**B. Sc DEGREE EXAMINATION
SEMESTER –V**

Course 6D: Forensic Medicine & Anthropology

Time:3Hrs

Max.marks:75

Section- A

5 x2 = 10

1. Define inquest, its role and classification.
2. Mention objectives of medico legal autopsy.
3. Write the names of sutures of skull.
4. Define Rape & related sections in IPC.
5. Write Dental Formula.

Section- B

5x5=25

Answer any four questions. Each answer carries 5 marks
At least 1 question should be given from each Unit

1. Define Forensic Anthropology.
2. Write a short note on facial reconstruction.
3. Write note on the estimation of stature from bones.
4. Define cause of death, manner of death and mode of death.
5. Explain about types of drowning.
6. How can you estimate age of a person on the basis of teeth examination?
7. Define forensic medicine and medical jurisprudence.
8. Explain the determination of time and cause of death using skeletal remains.

Section- C

4x10 = 40

Answer any four questions. Each answer carries 10 marks
At least 1 question should be given from each Unit

1. Elaborate on the subject matter, scope and application of Forensic Anthropology.
2. Elaborate on the methods of determining sex and age from skull and bones.
3. Describe early signs of post mortem changes with the help of examples.
4. Describe the classification of injuries. Support the answer with the help of examples.
5. Explain:
 - a) Sodomy
 - b) Tribadism
 - c) Bestiality
 - d) Buccal Coitus
 - e) Electrocutation
6. How Forensic Odontology can be useful in Mass Disaster cases?

Suggested Question Paper Model for Practical Examination

Semester – V/ Course – 6

Time: 3 hrs

Max. Marks: 50

1. To differentiate between Male & Female Pelvis. 8 M
2. To observe the post mortem changes of deceased body. 8 M
3. To perform external examination of deceased body. 12 M
4. Scientific observation and data analysis 4 x 3 = 12 M
 - A. Skull (Sex)
 - B. Teeth (Age)
 - C. Upper limbs.
 - D. Lower limbs.
5. Record + Viva-voce 6+4 = 10 M

Semester-wise Revised Syllabus under CBCS, 2020-21
Four Year B.Sc. (Hons) - Semester – V (from 2022-23)

Subject: **B. Sc - Forensic Science**

Course-7D: **Wildlife Forensics**

(Skill Enhancement Course (Elective), 5 credits, Max Marks: 100 + 50)

Learning Outcomes:

1. To be able to define entomology and forensic entomology and give example
2. To be able to list and describe the various types of arthropods that invade a body after death
3. to be able to describe the contributions of forensic entomology to the determination of the presence of drugs and poisons in a body
4. able to classify endangered species of animal wildlife.
5. To identify the natural habitat of different species
6. To investigate the drowning cases using diatoms
7. Analysis of Botanical evidences

Syllabus: *(Total Hours: 90 including Teaching, Lab, Field Training and unit tests etc.)*

UNIT 1: Wildlife Forensics - Importance of wildlife and Environment; Wildlife (Protection) Act-1972, Protected and endangered species of animals and plants; Sanctuaries and their importance; Types of wildlife crimes, Recovering evidence at poaching scenes, locating the burial: Wild animals as pharmacopeias, Wildlife artifacts (Bones, skin, fur, hair, nails, blood, feather, etc.), Trade in wild animals.

UNIT 2: Entomology – introduction, Insects & their Biography, the life cycle of insects, collecting insects at the scene of crime, the PMI, classification of insects, rearing insects' calculation if PMI, other Forensic use and case study.

UNIT 3 : Forensic Botany, Botanical Evidence - Introduction, types, location, collection evaluation and forensic significance of fungi and plants in forensic science, wood and pollen grains, Methods of identification and comparison, various types of planktons and diatoms and their forensic importance; Limnology.

UNIT 4: Environmental Forensics - Introduction to Environmental Forensics. Mercury- Natural and anthropogenic sources, detecting mercury in indoor environment and forensic aspects. Asbestos-sources and detection in air, water, fibres etc. Arsenic- sources, compounds, analytical methods and forensic aspects.

UNIT 5: Environment and Ecosystems - Concept of biosphere, communities and ecosystems; Ecosystem characteristics structure and function; Xenobiotic and recalcitrance, Bioremediation using microorganisms and plants, Genetically Modified Organisms to treat effluents; introduction to BOD and COD, use of biosensors, bioremediation of solid waste, industrial effluent containing organic pollutants and metal ions. Environmental Management Introduction and scope of environmental management, basic concepts of sustainable development, Environmental Impact Assessment. Wildlife Protection Act 1972, Forest Conservation Act 1981, Environment (protection) Act 1986.

Wildlife Forensics Practicals

8. Identification of starch granules
9. Identification and classification of diatoms
10. Identification of pollen grains to genus level
11. Identification of wood using physical and anatomical features
12. Section and cutting of plant material and their examination
13. Staining techniques and laboratory exercises for identification of different plant cell types
14. Collection and packaging of wildlife evidences.
15. Extraction of plant poisons
16. Separation of plant poisons by TLC.
17. Quantification of plant poisons by UV-Visible spectrophotometer

Suggested co-curricular activities

- Visits to wildlife sanctuaries and zoos
- Visits to botanical gardens for poisonous plants
- Visits to LaCONES, CCMB & CDFD
- Collection of pollen grains related to criminal activities

Suggested readings:

1. Forensic biology – Richard Li
2. Forensic Medicine – P.V. Guharaj & M. R. Chandran
3. A textbook of Medical jurisprudence and toxicology- Modi
4. Wildlife forensic investigation-Principles and practice: Cooper and Cooper, CRCpress
5. Forensic Palynology in the United States of America (1990)- Bryant, V.M. Jr, Mildenhall, D.C. and Jones, J.G.14.PP.193-208
6. Textbook of Pollen Analysis 4th Edition- Faegri, K. Iverson, J. and Krzywinski, K. John Wiley & Sons, New York 1989.
7. Microbial forensics -Roger Breeze, Bruce Budowle, Steven E. Schutzer. Elsevier Academic Press
8. The Forensic Laboratory Handbook Procedures and Practice - Ashraf Mozayani, Carla Noziglia. 2nd edition. 2011. Human Press.
9. Forensic Science in Wildlife Investigations - Adrian Linacre Taylor and Francis,2009
10. The Wildlife Detectives: How Forensic Scientists Fight Crimes Against Nature B Donna M.
11. Jackson, Wendy Shattil, Bob Rozinski Universal Athenaeum (Denver, CO, U.S.A.)
12. Forensic palynology Dallas Mildenhall, Patricia Wiltshire, Vaughn Bryant Elsevier, 2006
13. Forensic palynology: an in-depth look at its indispensable value National University, SanDiego,2002
14. Medical microbiology by Ananthnaraya.

MODEL QUESTION PAPER (Sem-end. Exam)

**B. Sc DEGREE EXAMINATION
SEMESTER –V**

Course 7D: Wildlife Forensics

Time:3Hrs

Max.marks:75

Section - A

5 x2= 10

1. Define Wildlife Forensics.
2. What do you understand by entomology?
3. What are types of fungi?
4. What are the important aspects of environmental forensics?
5. What is xenobiotic?

Section- B

5x5=25

Answer any four questions. Each answer carries 5 marks
At least 1 question should be given from each Unit

1. Define in brief about the basic elements in Wildlife Forensics.
2. What do you understand by Endangered Species? Give examples.
3. How diatoms can be useful in forensic investigation?
4. Write a short note on the analytical chemical techniques.
5. What are biosensors? What is the use of biosensors?
6. Establish the link between Wildlife crime and Forensic Science with the help of a case study.
7. Describe various ethical issues to be followed in Wildlife Forensics.
8. Classify types of insects with well labelled diagram.

Section- C

4x10 = 40

Answer any four questions. Each answer carries 10 marks
At least 1 question should be given from each Unit

1. Outline and explain the objectives of Wildlife Protection Act 1972.
2. Give a detailed description of a Wildlife Crime Case and establish the role of Wildlife Forensic Scientist.
3. “Endangered species are most prone to wildlife crimes”. Justify the statement.
4. What are the various sources, compounds and various analytical methods for Arsenic?
5. What is the various forensic significance of Wood, Pollen grains, Planktons, Fibers, Insects?
6. What are various wildlife artifacts? Also comment on Trade of Wild life animals in India.

Suggested Question Paper Model for Practical Examination

Semester – V/ Course – 6

Time: 3 hrs

Max. Marks: 50

1. To perform Acid Digestion Test. 8 M
2. To extract plant poisons from blood. 8 M
3. To quantify plant poisons by UV- Visible Spectrophotometer. 12 M
4. Scientific observation and data analysis 4 x 3 = 12 M
 - A. Wood
 - B. Starch Granules
 - C. Pollen Grains.
 - D. Diatoms.
5. Record + Viva-voce 6+4 = 10 M