

BHAKTA KAVI NARSINH MEHTA UNIVERSITY



Semester V & VI

(T.Y.B.Sc.)

FORENSIC SCIENCE

SEMESTER – V

Paper No. – V : FS-501 : FORENSIC BIOLOGY, SEROLOGY & ANTHROPOLOGY

Paper No. – VI : FS-502 : FORENSIC CHEMISTRY

Paper No. – VII : FS-503 : FORENSIC PHYSICS

SEMESTER- VI

Paper No. – VIII : FINGERPRINT & QUESTIONED DOCUMENTS

Paper No. – IX : BALLISTIC & EXPLOSIVE

Paper No. – X : CRIME SCENE INVESTIGATION.

INFORCE FROM JUNE -2017

FORWORD

The renewal and updating of the course curriculum are the ingredients to any vibrant academic institution. The revision of the curriculum in the different subjects should be a continuous process with a view to providing the updated and thorough education to the students as well. To meet the requirements in today's perspectives and in order to enhance the quality and standards of education, updating and restructuring the curriculum from time to time must be continued as a perpetual process. In recent past, our University has implemented the Choice Based Credit System (CBCS) which is the need of hour for the sake of the students. We, the member of study board in Forensic Science have designed the new curriculum for the students of third year (i.e. Semester V and VI) Forensic Science. For designing the curriculum we followed the guidelines of UGC with respect to model syllabus. The exercise would not have been possible without the support of our faculty members. We hope that the aims and the objectives of our university will be accomplished and the students will come to the expectations of our society.

**SKELETON OF THEORY EXAMINATION
(EXTERNAL)**

QUESTION 1 – UNIT 1		
Q 1 A	Objective type questions	4 Marks
Q 1 B	Answer in brief (Any 1 out of 2)	3 Marks
Q 1 C	Write a note on (Any 1 out of 2)	7 Marks
QUESTION 2 – UNIT 2		
Q 2 A	Objective type questions	4 Marks
Q 2 B	Answer in brief (Any 1 out of 2)	3 Marks
Q 2 C	Write a note on (Any 1 out of 2)	7 Marks
QUESTION 3– UNIT 3		
Q 3 A	Objective type questions	4 Marks
Q 3 B	Answer in brief (Any 1 out of 2)	3 Marks
Q 3 C	Write a note on (Any 1 out of 2)	7 Marks
QUESTION 4 – UNIT 4		
Q 4 A	Objective type questions	4 Marks
Q 4 B	Answer in brief (Any 1 out of 2)	3 Marks
Q 4 C	Write a note on (Any 1 out of 2)	7 Marks
QUESTION 5 – UNIT 5		
Q 5 A	Objective type questions	4 Marks
Q 5 B	Answer in brief (Any 1 out of 2)	3 Marks
Q 5 C	Write a note on (Any 1 out of 2)	7 Marks
TOTAL MARKS : 70 TOTAL TIME : 2½ HOURS		

PAPER-V FORENSIC BIOLOGY, SEROLOGY AND ANTHROPOLOGY**UNIT – I****I.1 Introduction to various types of body fluids and forensic examination**

- Introduction to various types of body fluids such as blood, saliva, semen urine, etc. and its morphology histology and biochemical properties.
- Identification and examination of various stains of body fluids e.g. Blood Saliva, Semen, Urine, vomit etc. using various techniques, chemical, Spectroscopy, microscopy, electrophoresis method.

I.2 Serology

- Blood – As connective liquid tissue and its composition. .
- Collection and Storage of biological samples.
- Origin of Species – Identification and determination of species by various techniques like tube precipitation technique, gel diffusion techniques etc.
- Blood group Antigens and their significance in forensic investigation.
- Blood Typing / Grouping – ‘ABO’ system by various indirect typing techniques.
- ‘Rh sub types’.
- Inheritance and Signification of blood typing in establishing paternity and criminal investigations.
- Hemoglobin and its variants.
- Application of various polymorphic enzymes and proteins in criminal investigation.

UNIT – II**II.1 Forensic DNA Analysis**

- History of DNA fingerprinting and DNA polymorphism.
- Procedure for collection and preservation of biological sample for DNA analysis.
- Techniques of DNA isolation and its quantization.
- DNA profiling and its forensic application
- RFLP and PCR based techniques in DNA analysis.
- PCR amplification.
- Result of STR marker analysis and its interpretation.
- Y-STR analysis and its significance in establishing paternal relationships.
- Human genome project.

UNIT – III Enzyme Techniques

- Classification, nomenclature and action mechanisms of enzymes
- Enzyme kinetics
- Purification and protein estimation
- Enzyme assay technique
- Visible & ultraviolet Spectrophotometric methods
- Immobilized enzymes.

UNIT – IV

IV.1 Forensic Botany and Palynology

- Development of forensic botany
- Application of botany in aid of forensic science
- Morphological and anatomical characteristics of plants yielding drugs of abuse like opium, Cannabis, Coca plant, Tobacco, etc
- Development of palynology, Study and identification of pollen grains, starch grains.

IV.2 Forensic microbiology

- Development of forensic microbiology, Understanding Bioterrorism and biological warfare agents

IV.3 Wild Life Forensics

- Importance of wild life species in ecosystem.
- Endangered and rare species
- Sanctuaries and its importance
- Wild life Management, Economic value of wild life.
- Different methods of killing and poaching of the wild life animals.
- Forensic methodologies to identify wild life animals - examination of physical evidences like hair, nails, teeth, horn, footprints (pugmarks), and scats etc. by conventional and modern methods.
- Wild Life Protection Act.

IV.4 Forensic Entomology

- Identification of specific insects and their developmental stages (life cycles)
- Medico legal importance General entomological significance in forensic investigations and determination time importance of death

UNIT – V

V.1 Anthropology

- Forensic Anthropometry, osteometry & Personal identity. Examination and identification of mutilated bodies, fragmentary remains and bones. Their role in mass disasters. Determination of site, age, sex, race and species origin from bones and measurement of stature . Karl Pearson formula, Trotter and Glesser, Pan formula

V. II Odontology

- Type and Structure of Teeth, Age determination, Disease of teeth and their significance in personal identification.

Suggested experiments

1. Examination and identification of blood stains: Benzidin test, Hemin test.
2. Determination of origin of species (Tube method and agar gel method).
3. Determination of blood groups from fresh and dry blood sample.
4. Examination and identification of semen stains: Acid phosphate test, Microscopic examination of spermatozoa.
5. Estimation and identification of saliva stains: Amylase test, Microscopic examination of epithelial cells.
6. Examination and identification of urine stains.
7. Identify the given pugmark of wild animal and give its characteristics.
8. Determination of the side and measurement of Long bones for stature estimation
9. Determination of sex from Skull and pelvis.
10. Identification of teeth
11. Measurements of living- anthropometry.

Paper – VI Forensic Chemistry

Unit – I Introduction to Forensic Chemistry and its legal aspects

- General introduction, Types of cases/exhibits, preliminary screening, presumptive test (colour and spot test), Organic and Inorganic analysis,
- micro- chemical methods of analysis
- Examination procedures involving standard methods and instrumental techniques.
- Legal aspects of forensic chemistry

Unit – II Narcotic drugs and psychotropic substances

- Introduction to NDPS Drugs, Classification of NDPS Drugs, Precursor chemicals, Narcotic raids and clandestine drug laboratories
- Mandatory provisions of NDPS Act, 1985
- Drug dependence and Drug Tolerance
- Biotransformation of drugs, Pathways of drug metabolism, drug toxicity, excretion of drugs like paracetamol and Diazepam
- Analysis of Drug by various chemical and instrumental methods

Unit – III Forensic Toxicology and poisons

- **III.1 Toxicology:** - Introduction and concepts of forensic toxicological examination and its significance.
- **III.2 Poisons:** - Classification, Extraction, isolation of poison (General procedure) Gaseous and volatile poison, analysis of acidic drugs, basic drugs and neutral organic poison.

Unit – IV Petroleum Products and Arson

IV.1 Petroleum Products: - Various fractions and their commercial uses, standard method of analysis of petroleum products for adulteration.

IV.2 Arson: - Chemistry of fire, definition, scientific investigation and evaluation of clue materials, analysis of arson exhibits by instrumental methods, managements of arson cases,.

Unit – V Forensic analysis of Products

V.1 Forensic Analysis of beverages:-

- Introduction and definition of Alcohol and illicit liquor, proof spirit
- Absorption, De-Toxification and Excretions of Alcohol
- Alcohol and prohibition, Consequences of Drunken Driving
- Analytical techniques in the analysis of alcohol and other illicit liquor

V.2 Adulterated Food Analysis

- Introduction, Prevention of food adulteration, Analytical techniques for analysis of Exhibits involved in food and other materials

V.3 Bribe Trap Cases:

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

Suggested experiments

1. Systematic extraction and identification of acidic and basic drugs from viscera. (Simulated sample).
2. Identification of vegetable poisons (Datura etc.)
3. Identification of methanol mixed in ethanol.
4. Examinations of petroleum products such as petrol HSD, Kerosene, as per BIS specifications.
5. Arson residue analysis by GC.
6. Analysis of phenolphthalein (qualitative) in bribe traps cases.
7. Analysis of adulteration in food samples by chemical methods.

Paper – VII Forensic Physics

Unit – I Physical Properties

- I.1 Glass:- Types of Glass and their compositions, Forensic Examination of Glass Fractures, determination of direction of impact: Cone fracture, rib marks, hackle marks, backward fragmentation, color and fluorescence, physical matching, density comparison, physical measurements, refractive index by refractometer,
- I.2 Soil: - Formation and types of Soil, Composition and color of soil, particle size distribution, turbidity test, microscopic examination, density gradient analysis.

Unit – II Physical Marks

- II.1 **Foot Prints**:- Importance, Gait pattern, Casting of Foot Prints in different medium, Electrostatic lifting of latent foot prints, taking of control samples.
- II.2 **Tool Marks**:- Types of Tool marks : Compression marks, striated marks, combination of compression and striated marks, repeated marks, class characteristics and individual characteristics, tracing and lifting of marks, photographic examination of tool marks and cut marks on clothes etc.
- II.3 **Tyre Marks and Skid Marks**:- Examination and Taking of Control Samples.

Unit – III Other Clue materials and Restoration of marks

- III.1 **Miscellaneous clue materials**:- Physical, chemical and instrumental methods of examination of String/ropes, fibers, threads , wires/cables, seals, counterfeit coins, physical matches of broken objects.
- III.2 **Restoration of erased/obliterated marks**:- Method of marking- cast, punch, engrave, methods of obliteration, method of restoration – etching (for different metals, magnetic electrolytic etc.,) recording of restored marks- restoration of marks on wood, leather, polymer etc.

Unit – IV Speaker identification and tape authentication

- IV.1 **Voice production theory**:- Vocal anatomy, speech signal processing, and pattern recognition- basic factors of sound in speech acoustic characteristics of speech signal, Fourier analysis, frequency and time domain representation of speech signal, Acoustic theory of speech production.
- IV.2 **Tape authentication**:- Analysis of audio- video signal for authenticity, introduction to the techniques of pattern recognition and comparison.

Unit – V Forensic Photography and Material Science

V.1 Photography:- Basic principles and techniques of black and white and color cameras and lenses, exposure index, aperture, depth of field development and printing, different kinds of developers and fixtured, crime scene photography and cardinal rules .

V.2 Material Science: - Types of Glue (sticking material), Paint and its types with forensic importance.

Suggested experiments

1. Density gradient analysis of soil samples.
2. Comparison of identity of small glass pieces by flotation methods.
3. Determination of refractive index of glass and liquid.
4. Comparison of broken glass bangles.
5. Physical matching of broken pieces of different objects.
6. Comparison of strings/threads/ropes.
7. Comparison of tool marks.
8. Physical analysis of paint samples.

Paper-VI Forensic Fingerprint and Questioned Documents

Unit – I History and Development of Fingerprints

- **History and development:** - History of Fingerprint Science, main function of FPB, Development of Fingerprint Science, Composition of sweat and secretion of sweat, Pattern types & Ridge characteristics, Ridge tracing, Ridge counting
- **Classification of fingerprint:** - Various systems for FP classification, Henry classification system, numerical value, symbol, primary classification, secondary classification, subsecondary classification and final classification, NCIC classification, AFIS classification.

Unit – II Types of fingerprint and developmental methods

- Development, Identification & Presentation of FP
- Known prints & Rolled impressions, Direct or Inked prints.
- Development of Latent Prints & Lifting techniques
- Physical & chemical Methods: Powder techniques & Various chemical techniques, Processing of Post developed prints.
- Taking of finger and palm prints from living and dead person, postmortem fingerprint
- Types of fingerprint like Chance prints, latent and visible prints, plastic prints

Unit – III Questioned Document

- **Nature and Classification of Document:** - Nature and problems of documents examination, classification of documents, procurements of standard admitted/ specimen writing, handling and marking of document.
- **Examination of Questioned documents:** - Preliminary examination of document, basis of handwriting identification, individuality of hand writing, variation in genuine handwriting, natural variation, Principles of hand writing & signature identification, process of comparison.
- **Types of Document and Writing features:** - Various types of documents- genuine and forge documents and holographic documents, various writing feature and estimation, general characteristic of handwriting, individual characteristics of handwriting, basic tools needed for forensic document examination and their use

Unit – IV Examination of Documents

- **Disguised writing and Anonymous letters:** - Identification of writer, examination of signature, writing instrument and their influence on handwriting.
- **Changes in documents and examination:** - Examination of alteration, erasures, overwriting, addition, and obliteration.

Unit – V Age of Documents, Type of Forgery and Sequence of Strokes

- Types of Forgery, Age of Documents and Sequence of strokes
- Identification of Currency notes, counterfeit coins, passport and stamp papers.

Suggested experiments

1. To take plain and rolled finger prints and to identify the patterns.
2. To identify ridge characteristics.
3. To perform ridge tracing and ridge counting.
4. Perform Henry ten digit classification for given fingerprint slip.
5. To classify webbed and missing fingers.
6. To compare fingerprints.
7. To develop latent finger prints with powder, fuming and chemical methods.
8. AFIS- Automated Fingerprint Identification System.
9. Identification of Handwriting- general characteristics, natural variations, fundamental divergences and individual characteristics.
10. To detect simulated, traced forgeries and disguised handwriting.
11. Examination of additions, alterations and obliterations in the documents.
12. Examination of mechanical and chemical use of erasures on the documents.
13. Examination of writing inks by TLC.
14. Examination of security documents (currency notes, stamps, passports, lottery etc.)

Paper – IX Forensic Ballistic and Explosives

Unit – I History and Development of Firearms

- **History of firearms:** - History and background of firearms, Ballistics & its forensic aspects,
- **Conventional Concepts of firearms:** their classification and characteristics, various components of small arms, smooth bore and rifled firearms.
- **Operational features of firearms:** Barrel, body, Firing pin, Breech face, trigger, cork, and firing mechanism, measurement of strength of barrel & trigger pull.
- **Rifled Firearms:** Caliber, Rifling, purpose of rifling, types of rifling and methods to produce rifling to produce rifling,
- **Smooth bore firearms:** Bore, Choking& types of choking, Methods of choking purpose of choking, method of choking, purpose of choking.
- **Illegal firearms:** AK-47, SKS and M16/AR15 Assault Rifles ,Improvised/ country made/ imitative firearms and the constructional features.

Unit – II Ballistics of firearm – 1

- **Ammunition:-** Types of ammunition, classification and construction features of different types of cartridge, types of primers and priming composition, propellants and their composition, various types of bullets and compositional aspects.
- **Core concepts of Internal Ballistics:** Definition, ignition of propellants, shape and size of propellants, manner of burning, various factors affecting the internal ballistics: lock time, ignition time, barrel time, erosion, corrosion and gas cutting, equation of motion of projectile, Density of loading, Pressure, Heat problems, Vibration & jump, Measurement of strength of firearm, projectile velocity determination, theory of recoil, methods for measurement of recoil.

Unit – III Ballistics of firearm – 2

- **Core concepts of External Ballistics:** principal of external ballistics: vacuum trajectory, Trajectory Formation & its computation, effect of air resistance on trajectory, Angle of Fall, Influence of Earth on Trajectory, base drag, yaw, shape of projectile and stability, ballistics coefficient and limiting velocity, Ballistics tables, measurements of trajectory parameters, Escape velocity & Ricochet.

Terminal Ballistics: Effect of projectile on hitting the target: function of Bullet shape, striking velocity, striking angle and nature of target, tumbling of bullets, effect of instability of bullet, effect of intermediate targets, Influence of range Cavitations- Temporary and permanent cavities, Ricochet and its effects, stopping power

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

Unit – IV Identification of Firearms

IV.1 Principles:- Principles and practice of identification of firearms, ammunition and their components, different types of marks produced during firing process on cartridge- firing pin marks, breech face marks, chamber marks, extractor and ejector marks, and on bullet number/direction of lands and grooves, striation marks on lands and grooves, identification of various parts of firearms, techniques of obtaining test material from various types of weapons and their linkage with fire ammunition, class and individual characteristics, determination of range of fire- burning, scorching, blackening, tattooing and metal fouling, shot dispersion and GSR distribution, time of firing, different methods employed and their limitations, stereo and comparison microscopy, automatic bullet and cartridge comparison system.

IV. 2 Automated Techniques used in Ballistics

Basic Introduction to Integrated Ballistic Identification System (IBIS) and Ballistic Data Acquisition System (BDAS).

Unit – V

V.1 Analysis of GSR:- Mechanism of formation of GSR sources and collection, spot test, chemical test, identification of shooter and instrumental methods of GSR analysis, management and reconstruction of crime scene

V.2 Explosives:- Definition, classification, nature, composition, chemistry and characteristics of explosives, pyrotechniques, IEDs. Specific approach to scene of explosion. Systematic examination of explosive and explosion residue in the laboratory using chemical and instrumental techniques in the laboratory and interpretation of results, explosive act.

Suggested experiments

1. Identification of Gun and its parts.
2. Characteristics of firearms- Calibre, choke, trigger pull, proof marks etc.
3. Examination of and comparison of fired bullet- calibre, rifling characteristics, probable type of firearms.
4. Examination and comparison of fired cartridges/cases (calibre, firing pin, breech face, extraction/ejector marks etc.)
5. Chemical test for powder residues (Walker test, Harrison and Gilroy test).

PAPER – X CRIME SCENE INVESTIGATION

UNIT – 1 Crime scene management:

- Introduction, Evaluation and processing of scene of crime.
- Documenting the scene, Crime scene sketching, Steps in sketching a crime scene.
- Method of sketching a crime scene.
- The crime scene search, Crime scene search method, Processing of physical evidence
- Discovering, recognizing and examining of physical evidence.
- Collection, Safety measures for evidence collection
- Preservation, Packaging, sealing, labeling and forwarding of physical evidences, Maintaining the chain of custody, Probative value of physical evidences, Reconstruction of scene of crime.
- Introduction to physical evidences, Types of physical evidences, Classification and Role of physical evidences in Criminal Investigations & Trails
- Tele forensic Technology for crime scene investigation and creating digital crime Scene

UNIT – II DEATH SCENE INVESTIGATION

- Cause of death, Natural deaths, Accidental deaths, Suicide, Homicide.
- Stage of death, Signs of struggle.
- Examination of dead body at crime scene.
- Classification of death.
- The signs and time scene death, Early signs, Late signs.
- Examination of the body, Identifying the victim.
- Examination of scene of crime.

UNIT – III General and medico legal aspects of injuries/ traumatology

- Mechanical Injuries: Abrasions, Bruises, Lacerations, Incised wounds, Stab wounds, Firearm injuries, Defense injuries,
- Traffic accident injuries: vehicular injuries, railway injuries & aircraft injuries.
- Thermal injuries: Burns and scalds, Lightning, Electricity, Explosions.
- Introduction to various types of sexual offences – unnatural and perversions.
- Abortion & Infanticide

UNIT – IV FORENSIC PSYCHOLOGY

- Introduction, Scientific aids to interrogation.
- Introduction, The instrument, scientific basis of polygraph operation, Testing

procedure, Modified polygraph technique.

- Narco Analysis – An interview technique, Narco interview – technique for crime investigation, Technique of Eliciting Evidence from Brain.

- Brain mapping, Forensic psychiatry

UNIT - V Cyber Security and Digital Forensics

V.1 Introduction to Cyber Crime and Digital Evidence

- Incident Response

- Cyber Forensics Investigation

- Data and Evidence Recovery

- Internet Protocol and E-Mail Investigation

- Electronic World

V.2 E-Governance

V.3 E-Commerce – Concerns for E-Commerce Growth, Frauds in E-Commerce

V.4 E-Banking – RTGS, NEFT, Internet Banking, Mobile Banking

V.5 Cyber Cash, Digicash, Bit Coin, Digital signature

V.6 Forensic Auditing

- o Introduction to Forensic Accounting

- o Roles of Forensic Accountant

V.7 Types of Frauds

V.8 Forensic Investigation of Social Media and Instant Messaging Apps

V.9 Information Technology Law

V.10 Cyber Forensic Tools and Utilities

Suggested Experiments

1. To sketch and photograph the scene of crime.
2. To collect and pack physical clues at the scene of crime.
3. Draw a fine sketch of an indoor scene of crime.
4. Draw a fine sketch of an outdoor scene of crime.
5. Reconstruction and evaluation of indoor scene of crime.
6. Reconstruction and evaluation of outdoor scene of crime.
7. Use of Internet – Visiting websites with given URL, searching information using search engine.
8. Use of E – mail – Creating e – mail ID, sending & receiving e – mails with attachments.
9. Tracing and analysis of E – mail – Finding senders IP Address of received e – mail, tracing route of e – mail received using tools available on internet
10. Study of FTK software

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