# Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore
# Shri Vaishnav Institute of Forensic Science

## B.Sc. /B.Sc. +M.Sc. Forensic Science – Batch (2021-2024)
## SEMESTER V

### BSFSN501 FORENSIC BALLISTICS

| COURSE CODE | CATEGORY | COURSE NAME | TEACHING & EVALUATION SCHEME | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | THEORY | | | PRACTICAL | | L | T | P | CREDITS |
| | | | END SEM University Exam | Two Term Exam | Teachers Assessment* | END SEM University Exam | Teachers Assessment* | | | | |
| BSFSN501 | DC | Forensic Ballistics | 60 | 20 | 20 | 30 | 20 | 4 | 0 | 2 | 5 |

**Legends**: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;

***Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class,given that no component shall exceed more than 10 marks.**

**Course Objectives:** After studying this paper the students will know –

1. The classification of firearms and their firing mechanisms.
2. The characteristics of ammunition.
3. The importance of firearm evidence.
4. The methods for characterization of gunshot residue.
5. The nature of firearm injuries.

**Course Outcomes:**

1. Student will be able to understand the historical development and basic concepts of Firearms and Ammunition.
2. Student will be able to to know the classification of firearms.
3. Students will be familier with the various aspects of internal ballistics and external ballistics.
4. Student will be able to to evaluate and interpret crucial information from firearm injuries and
5. Understand the concepts behind linkage of firearm and ammunition.

**Unit 1: Firearms**

Definition of Firearms, History and development of firearms- Early history of firearms, the earliest firearms, the fifteenth century Match lock, sixteenth & seventeenth century small arms, The age of the Flint lock, the percussion lock firearms.

**Classification of firearms:** Characteristics and firing mechanism of smooth bored firearms (M.L., B.L.) Rifled firearms (Pistol, Revolver, Rifles, and Machine Guns), Classification, nomenclature and construction of country made firearms.

**Unit 2: Ammunition**

Types of ammunition. Constructional features (Cartridge case primer propellant, Bullets, Pellets and wads). and characteristics of different types of cartridges and bullets. Primers and priming compounds. Projectiles. Headstamp markings on ammunitions. Different types of marks produced during firing process on cartridge – firing pin marks, breech face marks, chamber marks, extractor and ejector marks.

**Unit 3 Types of Ballistics**

**Internal Ballistics:** Definition, Ignition of the propellent, manner of burning, Piobett's law, Shape and Size of the propellent, pressure space curve, shot start pressure. All burnt point, Velocity, Space curve, Le Due's formula, muzzle velocity, Factors affecting muzzle velocity, theory of recoil.

**External Ballistics:** Definition-trajectory drop in the flight of the projectiles force of gravity, air resistance-base drag, Yaw, Shape of bullet (Spherical ball, Cylinder-conical, flat nose, round nose etc.) effective range, extreme range.

**Terminal Ballistics:** Definition, behavior of various types of bullets on hitting the target,remaining velocity, stopping power, Ricochet.

**Unit 4: Firearm Evidence**

**Range of Firing determination:** Visual and Chemical, instrumental methods with special reference to the applications of Neutron activation, Atomic absorptions, Scanning Electronmicroscopy and other miscellaneous methods.

**Gunshot Residue:** Mechanism of formation of GSR, modern methods of analysis of GSR from the shooting hand & target with special reference to clothings.

**Bullet and Cartridges matching:** Class and individual characteristics on bullet and cartridge case for comparing and matching with suspected firearm. Briefs of NIBIN and IBIS.

**Unit 5: Firearm injuries:**

Ballistic aspect of firearm injuries, nature, Effect of target, Velocity, constructional features and range on the wounding, significance of studying cavitations in body, Bullet Entry/Exit Hole Identification Evaluation of Firearm injuries.

**Reconstruction:** Accident, Suicide, murder and self-defense.

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## SEMESTER V

**Practicals:**

1. To describe, with the aid of diagrams, the firing mechanisms of different types of firearms.
2. To correlate the velocity of bullet with the impact it produces on the target.
3. To correlate the striking angle of the bullet with the impact on the target.
4. To estimate the range of fired bullets.
5. To carry out the comparison of fired bullets.
6. To carry out the comparison of fired cartridge cases.
7. Determination of Shot number from size and weight of shots
8. To identify gunshot residue.
9. To correlate the nature of injuries with distance from which the bullet was fired.
10. To differentiate, with the aid of diagram, contact wounds, close range wounds and distantwounds.

**Suggested Readings:**


1. B.J. Heard, Handbook of Firearms and Ballistics, Wiley and Sons, Chichester (1997).
2. W.F. Rowe, Firearms identification, Forensic Science Handbook, Vol. 2, R. Saferstein(Ed.), Prentice Hall, New Jersey (1988).
3. A.J. Schwoeble and D.L. Exline, Current Methods in Forensic Gunshot Residue Analysis,CRC Press, Boca Raton (2000).
4. J.A. Siegel, P.J. Saukko and G.C. Knupfer Elaad in Encyclopedia of Forensic Science,Volume 2, (Eds.), Academic Press, London (2000).
5. Kumar , Forensic Ballistics in Criminal Justice (1987)
6. Burrad, The Identification of Firearms and Forensic Ballistics (1951)
7. B.R. Sharma, Firearms in Criminal Investigation and Trails (1990).

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## B.Sc. /B.Sc. +M.Sc. Forensic Science – Batch (2021-2024)
## SEMESTER V

### BSFSN502 FORENSIC TOXICOLOGY

| COURSE CODE | CATEGORY | COURSE NAME | TEACHING & EVALUATION SCHEME | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | THEORY | | | PRACTICAL | | L | T | P | CREDITS |
| | | | END SEM University Exam | Two Term Exam | Teachers Assessment* | END SEM University Exam | Teachers Assessment* | | | | |
| BSFSN502 | DC | Forensic Toxicology | 60 | 20 | 20 | 30 | 20 | 4 | 0 | 2 | 5 |

**Legends**: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;

***Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class,given that no component shall exceed more than 10 marks.**

**Course Objectives:** After studying this paper the students will know –

1. The classification of poisons and their modes of actions.
2. The absorption of poisons in body fluids.
3. The medico legal aspects of several poisons i.e. Metallic poison, Plant poison, AnimalPoison etc.
4. The classification and characteristics of the narcotics, drugs and psychotropic substances.
5. The menace of designer drugs.

**Course Outcomes:**

1. Student will be able to understand the the role of Forensic Toxicologist.
2. Student will be able to know the significance of toxicological examination.
3. Student will get the knowledge about the classification of poisons and their mode of actions.
4. Student will be able to know the lethal dose, lethal period of different types of poisons.
5. Student will be able to get information's about the poisonous plants and animal poison and their sign and symptoms.

**Unit 1: Fundamentals of Forensic Toxicology**

Introduction, Role of the toxicologist, significance of toxicological findings. Poison-definition and classification on the basis of their origin, physiological action and chemical nature. Metabolism and excretion of poisons, poisoning in India.

**Unit 2**: **Management of Toxicological cases**

Signs and symptoms of common poisons. Collection and preservation of viscera, blood and urinefor various types of poisons: Choice of preservatives, containers and storage. Extraction, Isolation, Identification, Estimation of poisons from Viscera, Blood and Urine.

**Unit 3**: **Principles of therapy and medico-legal aspects of several poisons I**
Corrosive poisons: strong mineral acids and organic acids. Metallic poisons: Lead, Arsenic, Mercury and Copper. Animal poisons: Snake and scorpion bites. Plant Poisons: Dhatura, Cannabis, Opium.

**Unit 4**: **Principles of therapy and medico-legal aspects of several poisons II**
Inebriants: Methyl and ethyl alcohol. Asphyxiant poisons: Carbon monoxide, Carbon dioxide, Methane and cyanides. Anesthetic agents. Miscellaneous: Aspirin, Paracetamol, Barbiturates, Diazepam, Antihistaminics, Antidepressants and kerosene oil.

**Unit 5: Narcotics, Drugs and Psychotropic Substances**
Definition of narcotics, drugs and psychotropic substances. Broad classification – Narcotics, stimulants, depressants and hallucinogens. General characteristics and common example of each classification. Designer drugs, Clandestine drug laboratories, Drugs and driving, Dope tests.

**Practicals**:
1. To identify biocides.
2. To identify metallic poisons.
3. To identify organic poisons.
4. To identify ethyl alcohol.
5. To identify methyl alcohol.
6. To carry out quantitative estimation of ethyl alcohol.
7. To identify drugs of abuse by spot tests.
8. To perform color tests for barbiturates.
9. To separate drugs of abuse by thin layer chromatography.

**Suggested Readings:**
1. R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004).
2. F.G. Hofmann, A Handbook on Drug and Alcohol Abuse, 2nd Edition, Oxford UniversityPress, New York (1983).
3. S.B. Karch, The Pathology of Drug Abuse, CRC Press, Boca Raton (1996).
4. A. Poklis, Forensic toxicology in, Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (Ed.), CRC Press, Boca Raton (1997).
5. A.W. Jones, Enforcement of drink-driving laws by use of per se legal alcohol limits: Blood and/or breath concentration as evidence of impairment, Alcohol, Drug and Driving,4, 99 (1988).
6. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's, Techniques of Crime Scene Investigation, CRC Press, Boca Raton (2013).
7. Modi's Medical Jurisprudence and Toxicology, 23 rd Edition, Edited by K. Mathiharan and A.K. Patnaik, Eastern Book Company, Lucknow.

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## SEMESTER V

### BSFSN5031 FORENSIC SEROLOGY

| COURSE CODE | CATEGORY | COURSE NAME | TEACHING & EVALUATION SCHEME | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | THEORY | | | PRACTICAL | | L | T | P | CREDITS |
| | | | END SEM University Exam | Two Term Exam | Teachers Assessment* | END SEM University Exam | Teachers Assessment* | | | | |
| BSFSN5031 | DC | Forensic Serology | 60 | 20 | 20 | 30 | 20 | 3 | 0 | 2 | 4 |

**Legends**: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class,given that no component shall exceed more than 10 marks**

**Course Objectives**: After studying this paper the students will know-

1. The significance of micro and macro molecules i.e amino acid, Protein, Carboliydrate.
2. The importance of biological fluids blood, urine, semen, saliva, sweat and milk-in crime investigations.
3. The usefulness of genetic markers in forensic investigations.
4. The forensic importance of bloodstain patterns.

**Course Outcomes**

1. The student will understand the importance of biological fluids in criminal investigation.
2. To understand & apply the knowledge regarding several tests used in Blood Analysis and Grouping of blood stains.
3. To acquire, understand and apply the basic knowledge of Instrumental Techniques and Methods used in Blood Analysis.
4. To understand the importance of genetic markers .
5. The importance of blood pattern in crime detection.
6. Discuss the importance of DNA Fingerprinting in Forensic science and explain the genetic basis of DNA Fingerprinting

**Unit 1: Biochemistry:**

**Amino Acids**: Definition, classification, general properties and reaction. Proteins: Definition, classification, General properties and reaction/ detection. **Carbohydrates**: Definition, classification and detection.

**Unit 2: Forensic Importance of Body fluids**

**Blood:** Composition and functions of blood. Collection and preservation of blood evidence. Distinction between human and non-human blood. Determination of blood groups. Antigens and antibodies. Forensic characterization of bloodstains. Typing of dried stains. Blood enzymes and proteins.

**Semen:** Forensic significance of semen. Composition, functions and morphology of spermatozoa. Collection, evaluation and tests for identification of semen. Individualization on the basis of semen examination.

**Other Body Fluids:** Composition, functions and forensic significance of saliva, sweat, milk and urine. Tests for their identifications.

**Unit 3: Serogenetic Markers Analysis:**

**Blood group**: History, Biochemistry and genetics of ABO, Rh, Mn and other systems. Determination of secretors/non secretor status, Lewis antigen, Bombay blood group, Polymorphic enzymes typing- PGM, ESD, EAP, AK, etc., and their forensic significance, HLA typing, role of serogenetic markers in individualization, paternity disputes etc.

**Unit 4: Bloodstain Pattern Analysis Bloodstain characteristics**.

Impact bloodstain patterns. Cast-off bloodstain patterns. Projected .oodstain patterns. Contact bloodstain patterns. Blood trails. Bloodstain drying times. Documentation of bloodstain pattern evidence. Crime scene reconstruction with the aid of bloodstain pattern analysis.

**Unit 5:DNA Profiling**

Structure of DNA. Damage to DNA, variation in DNA, DNA as excellent polymorphic markers, Basis of DNA typing.

**DNA Typing Technique** - RFLP, PCR, Amplification, PCR based typing methods such as HLA (R) DQ AT Amply- type PM Polymarkers, D 1580, STR, Gender ID, mt- DNA methods with their merits and demerits. Comparison of RFLP and PCR based method.

**Practicals:**

1. To determine blood group from fresh blood samples.
2. To determine blood group from dried blood sample.
3. To carry out the crystal test on a blood sample.
4. To identify blood samples by chemical tests.
5. To identify the given stain as saliva.
6. To identify the given stain as urine.
7. To carry out cross-over electrophoresis.
8. To study the correlation between impact angle and shape of bloodstain.
9. To identify the point of convergence from the bloodstain patterns.

**Suggested Readings:**

1. Analytical Biochemistry: Holme
2. W.G. Eckert and S.H. James, Interpretation of Bloodstain Evidence at Crime Scenes, CRC Press, Boca Raton (1989).
3. G.T. Duncan and M.I. Tracey in Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (Ed.), CRC Press, Boca Raton (1997).
4. R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004).
5. T. Bevel and R.M. Gardner, Bloodstain Pattern Analysis, 3rd Edition, CRC Press, Boca Raton (2008).
6. Genetic Markers in Human Blood,(1969): Giblett, Eloise R. Blackwell Scientific Publications
7. Race, R.R, and Sanger, R. (1975): Blood Groups in Man. Blackwell Scientific, Oxford.
8. Human blood groups-Chemical and biochemical basis of antigen specificity (Second edition): Helmut Schenkel-Brunner, Springer Wein New York
9. Forensic DNA Typing: Biology, Technology, and Genes behind STR Markers by John M. Butler

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## SEMESTER V

### BSFSN5032 ACCIDENT INVESTIGATION

| COURSE CODE | CATEGORY | COURSE NAME | TEACHING & EVALUATION SCHEME | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | THEORY | | | PRACTICAL | | L | T | P | CREDITS |
| | | | END SEM University Exam | Two Term | Teachers | END SEM University Exam | Teachers | | | | |
| BSFSN5032 | DC | Accident Investigation | 60 | 20 | 20 | 30 | 20 | 3 | 0 | 2 | 4 |

**Legends**: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class,given that no component shall exceed more than 10 marks**

**Course Objectives**: After studying this paper the students will know-

1. Different elements of motor vehicle accidents
2. Analysis of accidental cases
3. Different types of injuries in accidents
4. Mass disasters and their types

**Course Outcomes:**

1. The significance of photographs in accident cases.
2. The importance of trace evidences
3. The consequences of Accident analysis
4. Significance of Tachographs

**Unit 1: Motor Vehicle Accidents**

Accident scene, Sources of information, Eyewitness accounts, Extent of vehicle damage. Visibility conditions. Photographs of accident site. Estimation of speed. Tire marks, skid marks, scuff marks. Maintenance of vehicles. Abandoned vehicles. Importance of air bags.

**Unit 2: Accident Analysis**

Pre-crash movement. Post-crash movement. Collision model. Gauging driver's reaction. Occupant's kinematics. Hit and investigations, Trace evidence at accident sites.

**Unit 3 Injuries in Accidents**

Types of injuries resulting from accident. Biomechanics of injuries, Psychological impact of severe injury. Patterns of injury in motor vehicle accident-Head injury, Spinal injury. Blunt cervical vascular injuries. Thoracic injury, Aortic injuries, Blunt cardiac injury. Blunt tracheobronchial injuries. Diaphragmatic injuries. Abdominal injury, Extremity injury, Pedestrian injury .

**Unit 4: Tachographs**

Forensic significance of tachograph data. Tachograph charts. Principles of chart analysis. Accuracy of speed record. Tire slip effects. Falsification and diagnostic signals. Route tracing.

**Unit 5: Mass Disasters**

Introduction to mass disasters, types of mass disasters- natural and accidental, Investigation in cases of mass disasters, Disaster Victim Identification (DVI) in such cases, different types of accidental mass disasters- aircraft crash, railway accident, leakage of toxic gases, bridge collapse, building collapse etc.

**Practicals:**

1. Examination of Skid marks.
2. Examination of Scuff marks.
3. Examination of head lamp (tungsten filament)
4. Analysis of glass fractures in hit and run cases
5. Examination of Tyres and tread marks
6. Examination of paint chips

**Suggested Readings:**

1. T.S. Ferry, Modern Accident and Analysis, Wiley, New York (1988).
2. D. Lowe, The Tachograph, 2nd Edition, Kogan Page, London (1989).
3. T.L. Bohan and A.C. Damask, Forensic Accident Investigation: Motor Vehicles, Michie Butterworth, Charlottesville (1995).
4. S.C. Batterman and S.D. Batterman in Encyclopedia of Forensic Sciences. Volume 1, J.A. Siegel, P.J. Saukko and G.C. Knupfer (Eds.), Academic Press, London (2000).