



Syllabus
Gyanmanjari Science College
Semester-3 (B.Sc)

Subject: Forensic Biology and Serology-BSC1FS13309

Type of course: Major (Core)

Prerequisite:

A basic understanding of biology, including cell structure, body fluids, and human physiology, is essential. Knowledge of genetics (DNA, blood groups), biochemistry, and antigen-antibody reactions in immunology are also required. Basic laboratory skills for handling and analyzing biological samples are important.

Rationale:

Biology and serology are important for identifying and analyzing biological evidence such as blood, semen, and saliva in forensic investigations. They help in individualization through blood grouping and DNA analysis. This knowledge supports crime investigation and provides reliable scientific evidence in legal proceedings.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks		Total Marks
CI	T	P	C	SEE	CCE	
2	0	4	4	100	100	200

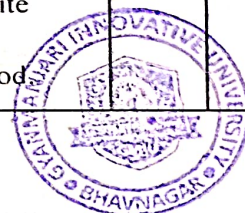
Legends: CI-Class Room Instructions; T – Tutorial; P - Practical; C – Credit; SEE - Semester End Evaluation LWA - Lab Work Assessment; V – Viva voce; CCE-Continuous and Comprehensive Evaluation; ALA- Active Learning Activities.

Course Content:

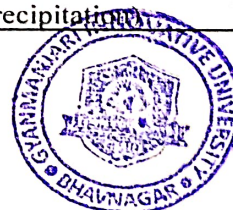
Sr. No	Course Content	Hrs.	% Weightage
1	Introduction to Forensic Biology and Blood : Fundamentals of Forensic Biology and Biological evidence, Types of biological evidence, Importance of biological evidence in forensic investigation, Procedure for Collection, Preservation, Packing, Sealing and Forwarding of biological samples, Types and identification of microbial organisms of forensic significance.	T:P 6:12	20%



	<p>The overview of blood includes its introduction, historical context, and essential characteristics. Constituents of blood, including plasma, red blood cells, white blood cells, and platelets, and their roles within the circulatory system. functions of blood in supporting bodily functions.</p> <p>Practical:</p> <ol style="list-style-type: none"> 1. Study the Nature and importance and Forensic Significances of various biological evidences. 2. Collection and preservation of blood evidence. 3. Packaging, Sealing and Forwarding of Samples. <p>Evaluation Methods</p> <table border="1" data-bbox="268 703 1145 1456"> <thead> <tr> <th>Sr. No</th> <th>Evaluation Methods</th> <th>SEE</th> <th>CCE</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Biological Evidence Identification Challenge- (blood, semen, saliva tests) from unknown sample. Students will identify the unknown biological sample and select the appropriate method for its identification.</td> <td>10</td> <td></td> </tr> <tr> <td>2</td> <td>From Scene to Laboratory: Students will demonstrate the proper collection, preservation, packing, sealing, and forwarding of forensic samples.</td> <td>10</td> <td></td> </tr> <tr> <td>3</td> <td>BioTrail: To locate, identify and analyze the biological samples retrieved from the immediate environment and upload the findings in the form of pdf on the GMIU portal.</td> <td></td> <td>10</td> </tr> <tr> <td>4</td> <td>Case Study Analysis of Biological Evidence in Forensic Investigation and upload the report on the GMIU portal.</td> <td></td> <td>10</td> </tr> <tr> <td></td> <td>Total</td> <td>20</td> <td>20</td> </tr> </tbody> </table>	Sr. No	Evaluation Methods	SEE	CCE	1	Biological Evidence Identification Challenge- (blood, semen, saliva tests) from unknown sample. Students will identify the unknown biological sample and select the appropriate method for its identification.	10		2	From Scene to Laboratory: Students will demonstrate the proper collection, preservation, packing, sealing, and forwarding of forensic samples.	10		3	BioTrail: To locate, identify and analyze the biological samples retrieved from the immediate environment and upload the findings in the form of pdf on the GMIU portal.		10	4	Case Study Analysis of Biological Evidence in Forensic Investigation and upload the report on the GMIU portal.		10		Total	20	20		
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2	<p>Blood Identification, Examination and Serogenetic Markers : Presumptive tests include the benzidine test, Phenolphthalein test, Leucomalachite test, Tetramethylbenzidine test, and Luminol test. Confirmatory tests- Haemochromogen test and Haematin test. Blood groups biochemistry and genetics of ABO, Rh. Mn Systems, Lewis antigen, Bombay Blood group.</p> <p>Practical:</p> <ol style="list-style-type: none"> 6 Phenolphthalein (Kastle–Meyer) Test and Leucomalachite Green Test for blood. 7 Tetramethylbenzidine (TMB) Test Luminol Test for blood 	T:P 6:12																									



	<p>8 Confirmatory Tests for Blood- Haemin Crystal Test and Haemochromogen Crystal Test .</p> <p>9 Perform ABO blood grouping .</p> <p>Evaluation Methods</p> <table border="1"> <thead> <tr> <th>Sr. No</th> <th>Evaluation Methods</th> <th>SEE</th> <th>CCE</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>confirmatory test for blood: Students will perform a confirmatory test for blood on a given sample and record their observations.</td> <td>10</td> <td></td> </tr> <tr> <td>2</td> <td>Identification of unknown stain using appropriate presumptive test: Students will examine an unknown stain and perform a suitable presumptive test to determine its possible nature.</td> <td>10</td> <td></td> </tr> <tr> <td>3</td> <td>Screen or Confirm? : Differentiation between Presumptive and Confirmatory Tests (Chart / Tabular Record Work) and upload on the GMIU portal.</td> <td></td> <td>10</td> </tr> <tr> <td>4</td> <td>CSI: Biological Evidence Challenge - Students will act as forensic investigators and examine a simulated case involving biological samples. They will research appropriate preliminary and serological tests, explain how each test helps identify the evidence, and submit a report summarizing their findings on the GMIU portal.</td> <td></td> <td>10</td> </tr> <tr> <td></td> <td>Total</td> <td>20</td> <td>20</td> </tr> </tbody> </table>	Sr. No	Evaluation Methods	SEE	CCE	1	confirmatory test for blood: Students will perform a confirmatory test for blood on a given sample and record their observations.	10		2	Identification of unknown stain using appropriate presumptive test: Students will examine an unknown stain and perform a suitable presumptive test to determine its possible nature.	10		3	Screen or Confirm? : Differentiation between Presumptive and Confirmatory Tests (Chart / Tabular Record Work) and upload on the GMIU portal.		10	4	CSI: Biological Evidence Challenge - Students will act as forensic investigators and examine a simulated case involving biological samples. They will research appropriate preliminary and serological tests, explain how each test helps identify the evidence, and submit a report summarizing their findings on the GMIU portal.		10		Total	20	20		20%
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3	<p>BPA and Immunological and Enzymatic techniques: blood stain characteristics, types, its application in forensic investigations. Blood trails. Bloodstain drying times. Documentation of bloodstain pattern evidence. Crime scene reconstruction with the aid of bloodstain pattern analysis. Antigen-antibody interaction (agglutination and precipitation)</p>	T:P 6:12	20%																								



	<p>Serological techniques: ELISA, RIA, Complement fixation, immunodiffusion. Electrophoresis: SDS-PAGE, Agarose gel, immune-electrophoresis, isoelectric focusing. Practical: 10 To identify different types of bloodstains. 11 To determine direction and angle of impact. 12 To reconstruct events using bloodstains. 13 To demonstrate a precipitation test for blood. 14 Agarose Gel Electrophoresis, to separate biomolecules (DNA/proteins).</p> <p>Evaluation Methods</p> <table border="1" data-bbox="284 788 1104 1653"> <thead> <tr> <th>Sr. No</th> <th>Evaluation Methods</th> <th>SEE</th> <th>CCE</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Crime Scene Reconstruction Challenge: Students will analyze bloodstain patterns to interpret events and reconstruct a simulated crime scene.</td> <td>20</td> <td></td> </tr> <tr> <td>2</td> <td>ImmunoChart : Chart preparation on immunological techniques (ELISA, RIA, complement fixation, immunodiffusion) and upload it on the GMIU portal.</td> <td></td> <td>10</td> </tr> <tr> <td>3</td> <td>Report writing - on bloodstain drying time and factors affecting it.(extrinsic and intrinsic factors) and upload the same on the GMIU portal.</td> <td></td> <td>10</td> </tr> <tr> <td></td> <td>Total</td> <td>20</td> <td>20</td> </tr> </tbody> </table>	Sr. No	Evaluation Methods	SEE	CCE	1	Crime Scene Reconstruction Challenge: Students will analyze bloodstain patterns to interpret events and reconstruct a simulated crime scene.	20		2	ImmunoChart : Chart preparation on immunological techniques (ELISA, RIA, complement fixation, immunodiffusion) and upload it on the GMIU portal.		10	3	Report writing - on bloodstain drying time and factors affecting it.(extrinsic and intrinsic factors) and upload the same on the GMIU portal.		10		Total	20	20		
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4	<p>Hair examination– Hair Analysis: Morphological, anatomical and microscopic examination of hair. Characteristics of hair to determine the species, origin, race and sex. Mitochondrial DNA in Hair Analysis. Practical:</p>	T: P 6:12																					



	<p>15 Microscopic examination of hair. 16 Examination of hair of different animals as cat, dog, cow, horse and goat. 17 To examine and differentiate hair from various body parts (scalp, beard, moustache, axillary, pubic, limb). 18 To compare questioned and known samples. 19 To determine origin (human/animal).</p> <p>Evaluation Methods</p> <table border="1" data-bbox="287 649 1141 1377"> <thead> <tr> <th>Sr. No</th> <th>Evaluation Methods</th> <th>SEE</th> <th>CCE</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Preserve the Proof: Students will demonstrate the proper collection, packaging, and preservation of forensic evidence to maintain its integrity and evidentiary value.</td> <td>10</td> <td></td> </tr> <tr> <td>2</td> <td>Comparison of questioned and known hair samples.</td> <td>10</td> <td></td> </tr> <tr> <td>3</td> <td>HairScope: Comparative Animal Hair Analysis (cat, dog, cow, horse, goat).</td> <td></td> <td>10</td> </tr> <tr> <td>4</td> <td>Body Hair Detective: Source Identification Lab: Identification of hair from different body parts (scalp, beard, axillary, pubic, limb)</td> <td></td> <td>10</td> </tr> <tr> <td colspan="2">Total</td> <td>20</td> <td>20</td> </tr> </tbody> </table>	Sr. No	Evaluation Methods	SEE	CCE	1	Preserve the Proof: Students will demonstrate the proper collection, packaging, and preservation of forensic evidence to maintain its integrity and evidentiary value.	10		2	Comparison of questioned and known hair samples.	10		3	HairScope: Comparative Animal Hair Analysis (cat, dog, cow, horse, goat).		10	4	Body Hair Detective: Source Identification Lab: Identification of hair from different body parts (scalp, beard, axillary, pubic, limb)		10	Total		20	20		<p>20%</p>
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<p>5</p>	<p>Semen and Other Biological Fluids Forensic significance of semen. Composition, functions, and morphology of spermatozoa. Collection, evaluation, and tests for identification of semen. examination. Individualization based on semen. Composition, functions, and Forensic significance of saliva, sweat, urine, nails, tears, fecal stains, milk, and vomit. and their test.</p> <p>Practical:</p> <p>20 Microscopic Examination of Spermatozoa. 21 To perform preliminary and confirmatory examination of Semen. 22 Collection and Preservation of Semen and other biological Evidence 23 Analyze saliva as a biological fluid.</p>	<p>T:P 6:12</p>	<p>20%</p>																								



24 To identify seminal stains by chemical tests. 25 To identify the given stain as sweat.					
Evaluation Methods					
Sr. No	Evaluation Methods	SEE	CCE		
1	Semen Evidence Screening & Confirmation Lab: Students perform and compare preliminary and confirmatory tests used for the forensic identification of semen samples.		10		
2	confirmatory tests for (semen/saliva/sweat).	10			
3	Identification of unknown stain (semen/saliva/sweat).	10			
4	BioFluid Forensics Chart Challenge Students prepare a comparative chart of different biological fluids and the forensic tests used for their identification.		10		
	Total	20	20		

Distribution of Marks (Revised Bloom's Taxonomy)						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage %	10%	30%	30%	30%	-	-

Course Outcome

After learning the course the students should be able to:	
CO1	Define bloodstain patterns and biological evidence in crime scene reconstruction.
CO2	Recognize blood and serological evidence for forensic identification and interpretation.



CO3	Understand bloodstain patterns and biological evidence for crime scene reconstruction.
CO4	Employ hair examination for identification, comparison, and origin determination.
CO5	Analyze hair examination techniques for identification and comparison.

Instructional Method:

The course delivery method will depend upon the requirement of content and needs of students. The teacher, in addition to conventional teaching methods by black board, may also use any tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

From the content 10% topics are suggested for flipped mode instruction.

Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses, Virtual Laboratory.

The internal evaluation will be done on the basis of the Active Learning Assignment.

Practical/Viva examination will be conducted at the end of semester for evaluation of performance of students in the laboratory.

Reference Books:

- [1] B.R.Sharma: Forensic science in criminal Investigation & Trails
- [2] S.H. James and J.J. Nordby, Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton
- [3] B.B. Nanda and R.K. Tiwari, Forensic Science in India A Vision for the Twenty First Century, Select Publishers, New Delhi.
- [4] Forensic Serology: A Laboratory Manual by Beverly A. K. Duval.
- [5] Forensic Biology by Richard Li.

Rubrics:

MODULE 1-

Biological Evidence Identification Challenge –

Identification of the unknown biological sample (blood, semen, or saliva) using appropriate tests – 4 Marks

Selection and correct application of suitable identification methods – 3 Marks

Recording observations, interpretation of results, and conclusion – 3 Marks



Students Should Do:

- Examine the unknown biological sample carefully.
- Select the appropriate presumptive or confirmatory test for identification.
- Perform the test following proper procedure and safety precautions.
- Record observations and interpret the findings.
- Submit the observation sheet with conclusions.

From Scene to Laboratory –

Proper collection and preservation of forensic samples following standard procedures – 4 Marks

Correct packing, sealing, and labeling of evidence for safe transport – 3 Marks

Understanding of chain of custody and forwarding procedure – 3 Marks

Students Should Do:

- Collect the given forensic samples using proper methods.
- Preserve the samples to prevent contamination or degradation.
- Pack, seal, and label the evidence correctly.
- Prepare the forwarding details while maintaining chain of custody.
- Submit the documented evidence package for evaluation.

BioTrail –

Location and identification of biological samples from the immediate environment – 4 Marks

Analysis and interpretation of the collected biological evidence – 3 Marks

Preparation of findings in PDF format and timely upload on the GMIU portal – 3 Marks

Students Should Do:

- Search and locate biological samples from the given environment.
- Identify the type of biological evidence collected.
- Analyze the samples using suitable forensic methods.
- Record observations and summarize findings in a PDF report.
- Upload the report on the GMIU portal.

Case Study Analysis of Biological Evidence in Forensic Investigation –

Analysis of the case and identification of relevant biological evidence – 4 Marks

Interpretation of forensic significance and application in investigation – 3 Marks

Preparation of report and timely upload on the GMIU portal – 3 Marks

Students Should Do:

- Study the given forensic case involving biological evidence.
- Identify the types of biological samples and their relevance to the investigation.
- Analyze how the evidence supports crime reconstruction or suspect identification.
- Prepare a concise report with observations and conclusions.
- Upload the report on the GMIU portal.

Module - 2

Confirmatory Test for Blood –

Correct execution of the confirmatory test on the given blood sample – 4 Marks



Accurate observation and recording of the test results – 3 Marks

Interpretation of results and explanation of forensic significance – 3 Marks

Students Should Do:

- Perform the confirmatory test for blood using the given sample.
- Follow the proper procedure and laboratory safety precautions.
- Observe the reaction/results carefully and record them accurately.
- Interpret the findings and explain their importance in forensic investigation.
- Submit the observation sheet with conclusions.

Identification of Unknown Stain using Appropriate Presumptive Test –

Selection and performance of the suitable presumptive test for the unknown stain – 4 Marks

Observation and recording of test reactions accurately – 3 Marks

Interpretation of results and identification of the possible nature of the stain – 3 Marks

Students Should Do:

- Examine the unknown stain carefully.
- Select the appropriate presumptive test based on the sample type.
- Perform the test following proper procedure and safety measures.
- Record the observations and reactions accurately.
- Interpret the findings and submit the observation sheet.

Screen or Confirm? – Differentiation between Presumptive and Confirmatory Tests

Preparation of a clear chart/tabular record showing differences between presumptive and confirmatory tests – 4 Marks

Accuracy of information with suitable examples of biological tests – 3 Marks

Presentation quality and timely upload on the GMIU portal – 3 Marks

Students Should Do:

- Prepare a chart or table comparing presumptive and confirmatory tests.
- Include differences in purpose, principle, reliability, and examples.
- Mention biological evidence such as blood, semen, saliva, etc.
- Present the information in an organized and easy-to-understand format.
- Upload the completed work on the GMIU portal.

CSI: Biological Evidence Challenge –

Analysis of the simulated case and identification of relevant biological samples – 4 Marks

Research and explanation of appropriate preliminary and serological tests for evidence identification – 3 Marks

Preparation of a structured report with findings and timely upload on the GMIU portal – 3 Marks

Students Should Do:

- Study the simulated forensic case carefully.
- Identify the biological evidence present in the case.
- Research suitable preliminary and serological tests for each sample.



- Explain the significance of each test in evidence identification.
- Prepare and upload the report on the GMIU portal.

Module -3

Crime Scene Reconstruction Challenge –

Analysis and identification of bloodstain patterns from the simulated crime scene –8 Marks

Interpretation of events based on bloodstain evidence and logical reconstruction – 8 Marks

Presentation of findings and explanation of the reconstructed sequence of events – 4 Marks

Students Should Do:

- Observe and analyze the given bloodstain patterns carefully.
- Identify the type and characteristics of the bloodstains.
- Interpret how the stains were formed and what events may have occurred.
- Reconstruct the possible sequence of events at the crime scene.
- Submit the analysis report with conclusions.

ImmunoChart –

Preparation of a chart explaining immunological techniques such as Enzyme-Linked Immunosorbent Assay (ELISA), Radioimmunoassay (RIA), Complement Fixation, and Immunodiffusion – 4 Marks

Accuracy of content, principles, and forensic applications of each technique – 3 Marks

Presentation quality and timely upload on the GMIU portal – 3 Marks

Students Should Do:

- Prepare a chart showing different immunological techniques used in forensic biology.
- Include the principle, procedure, and applications of ELISA, RIA, complement fixation, and immunodiffusion.
- Compare the techniques in a clear and organized manner.
- Highlight their significance in forensic investigations.
- Upload the completed chart on the GMIU portal.

Report Writing: Bloodstain Drying Time and Factors Affecting It –

Research and explanation of bloodstain drying time and its forensic significance – 4 Marks

Analysis of intrinsic and extrinsic factors affecting drying time – 3 Marks

Quality of report preparation and timely upload on the GMIU portal – 3 Marks

Students Should Do:

- Study the concept of bloodstain drying time in forensic investigation.
- Explain the importance of drying time in crime scene reconstruction.
- Identify and discuss intrinsic factors (volume, composition, surface type) and extrinsic factors (temperature, humidity, airflow).
- Prepare a structured report with examples and observations.
- Upload the report on the GMIU portal.

Module - 4

Preserve the Proof –

Proper collection of forensic evidence using standard procedures – 4 Marks



Correct packaging, labeling, and preservation to prevent contamination or damage – 3 Marks
 Understanding of evidence integrity, chain of custody, and evidentiary value – 3 Marks

Students Should Do:

- Collect the given forensic evidence carefully using proper techniques.
- Package and label the evidence according to forensic standards.
- Preserve the evidence to maintain its integrity and prevent contamination.
- Follow the chain of custody procedures during handling.
- Submit the preserved evidence with proper documentation.

Comparison of Questioned and Known Hair Samples –

Examination and comparison of questioned and known hair samples based on microscopic characteristics – 4 Marks

Identification of similarities and differences in structure, color, and texture – 3 Marks

Recording observations and drawing forensic conclusions – 3 Marks

Students Should Do:

- Observe the questioned and known hair samples carefully.
- Compare characteristics such as color, length, medulla, cortex, and cuticle pattern.
- Identify similarities and differences between the samples.
- Record observations systematically.
- Submit the comparison report with conclusions.

HairScope: Comparative Animal Hair Analysis –

Identification and examination of animal hair samples (cat, dog, cow, horse, goat) based on microscopic features – 4 Marks

Comparison of structural characteristics such as cuticle, cortex, and medulla patterns – 3 Marks

Recording observations and interpretation of species-specific differences – 3 Marks

Students Should Do:

- Observe the given animal hair samples under a microscope.
- Identify species-specific characteristics of cat, dog, cow, horse, and goat hair.
- Compare the cuticle, cortex, medulla, and pigmentation patterns.
- Record findings in a structured format.
- Submit the comparative analysis report.

Body Hair Detective: Source Identification Lab –

Identification of hair samples from different body parts (scalp, beard, axillary, pubic, limb) based on microscopic characteristics – 4 Marks

Comparison and differentiation of structural features such as length, texture, medulla, and pigmentation – 3 Marks

Recording observations and drawing conclusions about the source of hair – 3 Marks

Students Should Do:

- Observe the given hair samples under a microscope.
- Identify the body part of origin based on morphological features.
- Compare characteristics like length, texture, medulla pattern, and pigmentation.
- Record observations systematically.



- Submit the source identification report.

Module - 5

Semen Evidence Screening & Confirmation Lab –

Performance of preliminary and confirmatory tests for identification of semen samples – 4 Marks

Comparison and differentiation between screening and confirmatory test results – 3 Marks

Recording observations, interpretation of findings, and forensic significance – 3 Marks

Students Should Do:

- Perform the preliminary test for semen on the given sample.
- Conduct the confirmatory test using proper laboratory procedures.
- Compare the results of both tests and note the differences.
- Record observations accurately and interpret the findings.
- Submit the observation sheet with conclusions.

Confirmatory Tests for Semen / Saliva / Sweat –

Correct performance of confirmatory tests for the given biological sample – 4 Marks

Accurate observation and recording of test results – 3 Marks

Interpretation of findings and explanation of forensic significance – 3 Marks

Students Should Do:

- Perform the confirmatory test for the given sample (semen, saliva, or sweat).
- Follow the correct procedure and laboratory safety precautions.
- Observe and record the test reactions carefully.
- Interpret the results and identify the biological fluid.
- Submit the observation sheet with conclusions.

Identification of Unknown Stain (Semen / Saliva / Sweat) –

Selection and application of the appropriate test for identifying the unknown stain – 4 Marks

Accurate observation and recording of test reactions – 3 Marks

Interpretation of results and identification of the biological sample – 3 Marks

Students Should Do:

- Examine the unknown stain carefully.
- Select the suitable preliminary or confirmatory test for identification.
- Perform the test using proper procedure and safety measures.
- Record the observations and analyze the results.
- Submit the observation sheet with conclusions.

BioFluid Forensics Chart Challenge –

Preparation of a comparative chart on different biological fluids and the forensic tests used for their identification – 4 Marks

Accuracy of information, test principles, and proper comparison of biological fluids – 3 Marks

Presentation quality, organization, and clarity of the chart – 3 Marks

Students Should Do:

- Prepare a comparative chart of biological fluids such as blood, semen, saliva, sweat, and urine.



- Mention the preliminary and confirmatory tests used for each fluid.
- Compare their forensic significance and identification methods.
- Present the chart in a clear, organized, and visually understandable format.
- Submit the completed chart for evaluation.

