K.R. MANGALAM UNIVERSITY

THE COMPLETE WORLD OF EDUCATION

SCHOOL OF BASIC AND APPLIED SCIENCES

(SBAS)

Programme Handbook

(Programme Study and Evaluation Scheme)

M.Sc. in Forensic Science

Programme Code: 219

TWO YEAR POSTGRADUATE PROGRAMME

(with effect from 2025-27 session)

Approved in the 38th Meeting of Academic Council Held on 28th June 2025

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1. Preface

Introduction

The objective of any programme at Higher Education Institute is to prepare their students for the society at large. The K. R. Mangalam University visualizes all its programmes in the best interest of their students and in this endeavour; it offers a new vision to all its Under-Graduate courses.

We are committed to implementing the National Education Policy (NEP) 2020 in its entirety, and to creating a more inclusive, holistic, and relevant education system that will prepare our students for the challenges of the 21st century. With the focus on Outcome-Based Education (OBE), our university is continuously evolving an innovative, flexible, and multidisciplinary curriculum, allowing students to explore a creative combination of credit-based courses in variegated disciplines along with value-addition courses, Indian Knowledge Systems, vocational courses, projects in community engagement and service, value education, environmental education, and acquiring skill sets, thereby designing their own learning trajectory.

All academic programmes offered by the University focus on employability, entrepreneurship and skill development and their course syllabi are adequately revised to incorporate contemporary requirements based on feedback received from students, alumni, faculty, parents, employers, industry and academic experts

The School of Basic and Applied Sciences present two-year postgraduate programme master's in forensic science i.e. (M.Sc. Forensic Science) according to the New Education Policy-2020. We have designed a flexible choice-based credit system, multidisciplinary approach, and entry and exit options for the duration of 2024-2026.

We are following Curriculum and Credit Framework for Undergraduate Programmes (CCFUP)" incorporating a flexible choice-based credit system (CBCS), Learning Outcome-based Curriculum Framework (LOCF), multidisciplinary approach, and multiple entry and exit options. This will facilitate students to pursue their career path by choosing the subject/field of their interest.

The curricula are aligned with the needs of the industry and the job market and is flexible enough to adapt to changing trends and technologies. It integrates cross-cutting issues relevant to professional ethics, gender, human values, environment and Sustainable Development Goals (SDGs).

All the courses are having defined objectives and Learning Outcomes, which will help prospective students in choosing the elective courses to broaden their skills in the field of Forensic Science and interdisciplinary areas. The courses will train students with sound theoretical and experimental knowledge that suits the need of academics and industry. The courses also offer ample skills to pursue research as career in the field of Forensic Science. The K. R. Mangalam University hopes the NEP-2020 approach of this two-year postgraduate programme **M.Sc Forensic Science** will help students in making an informed decision regarding the goals that they wish to pursue in further education and life, at large.

2. **NEP-2020:** K.R. Mangalam University has adopted the National Education Policy NEP-2020 to establish a holistic and multidisciplinary undergraduate education environment, aiming to equip our students for the demands of the 21st century. Following the guidelines of NEP-2020 regarding curriculum structure and duration of the postgraduate programme, we now offer a Two-Year Undergraduate Programme with one exit option and relevant certification.

   - **PG Diploma Certificate** after completing 1 year (2 semesters with the required number of credits) of study.

M.Sc. Forensic Science program aspires to produce well-rounded post-graduates with a passion for learning and a strong foundation in Forensic Science, ready to make significant contributions to the scientific community and society at large.

Table 1: Minimum Credit Requirement for Two Year UG Program

S. No.	Broad Categories of Courses	Minimum Credit Requirement for Two Year PG Program
1	Major (Core)	50
2	Major (Practical)	6

3	Internship	6
4	Research Project/Dissertation	18
	Total	**80**

2.1 Categories of Courses

Core: The major would provide the opportunity for a student to pursue in-depth study of a particular subject or discipline.

Internship: The students are expected to complete at least 1 month internship at any Government or Private organization. A detailed report and internship certificate must be submitted by the student.

Research Project / Dissertation: The students are expected to complete the Research Project in the fourth semester. The research outcomes of their project work may be published in peer-reviewed journals or may be presented in conferences /seminars or may be patented.

3. University Vision and Mission

3.1 Vision

K.R. Mangalam University aspires to become an internationally recognized institution of higher learning through excellence in inter-disciplinary education, research, and innovation, preparing socially responsible life-long learners contributing to nation building.

3.2 Mission

- Foster employability and entrepreneurship through futuristic curriculum and progressive pedagogy with cutting-edge technology
- Instill notion of lifelong learning through stimulating research, Outcomes-based education, and innovative thinking
- Integrate global needs and expectations through collaborative programs with premier universities, research centers, industries, and professional bodies.
- Enhance leadership qualities among the youth having understanding of ethical values and environmental realities

4. About the School of Basic and Applied Sciences

The SBAS imparts both teaching and research through its four Departments of Chemistry, Physics, Mathematics, and Forensic science. SBAS imparts students' disciplinary knowledge, enhances their skills and ability, motivating them to think ingeniously, helping them to act independently and take decisions accordingly in all their scientific pursuits and other endeavors. It strives to empower its students and faculty members to contribute for the development of society and Nation. The faculty is in constant touch with various experts in the relevant fields and is willing to experiment with latest ideas in teaching and research.

5. School Vision and Mission

5.1 Vision

To be a premier school for advance learning and research in the field of basic and applied sciences.

5.2 Mission

1. Collaborations with national, international academic & research organisations and industries for knowledge creation, advancement, and application of innovative practises in sciences.
2. Create conducive environment for lifelong learning.
3. Empower students to be socially responsible and ethically strong individuals through value-based science education.

6. About the Programme (M.Sc. Forensic Science)

The Master of Science in Forensic Science (M.Sc. Forensic Science) is a postgraduate academic program designed to provide students with a comprehensive foundation in the fascinating world of Forensic Science. This program offers a rigorous and engaging curriculum that covers diverse areas such as Forensic Serology, Forensic Chemistry, Questioned Documents Examination, Fingerprint Examination, and more. Students enrolled in this program will explore the fundamental principles that govern the universe, delve into complex problem-solving, and develop strong analytical and critical thinking skills. Students will gain practical experience and a deep understanding of scientific research methodologies through hands-on laboratory work. The M.Sc. Forensic Science program prepares students for exciting career opportunities in scientific research,

technology, education, and various other fields that require a strong grasp of Forensic Science principles and applications.

6.1. Nature of M.Sc. Forensic Science Programme

Taking the NEP-2020 as an opportunity to review our existing academic programs and redesign them for a more holistic, multidisciplinary and inclusive education, SBAS, K.R. Mangalam University is transforming its academic structure in a phased manner. School of Basic and Applied Sciences is offering Two Year Postgraduate Degree programme M.Sc. Forensic Science with single Entry- Exit option from the academic session 2024-25. This course emphasized hands on practice, innovative thought process and project-based learning.

6.2. Aims of M.Sc. Forensic Science Programme

The aims of the M.Sc Forensic Science program, in accordance with the National Education Policy (NEP), are multifaceted and comprehensive. The program aims to cultivate a strong foundation in Forensic Science principles and foster a deep understanding of the subject. It seeks to promote critical thinking, analytical skills, and problem-solving abilities among students, enabling them to address real-world challenges effectively. The M.Sc Forensic Science program also encourages research-oriented thinking and provides opportunities for students to engage in scientific inquiry and exploration. By emphasizing hands-on laboratory work and practical applications, the program aims to equip students with the necessary skills for conducting experiments and analysing data. Moreover, the program seeks to foster an interdisciplinary approach, enabling students to connect Forensic Science with other scientific disciplines and societal issues. Overall, the M.Sc Forensic Science program aspires to produce well-rounded graduates with a passion for learning and a strong foundation in Forensic Science, ready to make significant contributions to the scientific community and society at large.

6.1 Definitions

- **Programme Specific Outcomes (PSOs)**

Programme Specific Outcomes are statements about the various levels of knowledge specific to the given program which the student would be acquiring during the program.

- **Programme Educational Objectives (PEOs)**

Programme Educational Objectives of a degree are the statements that describe the expected achievements of graduates in their career, and what the graduates are expected to perform, achieve and how they will conduct professionally during the first few years after graduation.

- **Credit**

Credit refers to a unit of contact hours/tutorial hours per week or 02 hours of lab/practical work per week.

6.2 Programme Educational Objectives (PEO*)*

These are deferred outcomes measured few years after completion of the programme, where the graduates of this program will:

PEO 1: Graduates will become proficient forensic science professionals, capable of working in various sectors such as law enforcement, legal consultancy, corporate security, and research institutions, while also possessing the skills to pursue entrepreneurial opportunities in forensic technology.

PEO 2: Graduates will demonstrate a strong foundation in forensic science principles and practices, enabling them to critically analyze evidence and apply innovative problem-solving skills to address complex investigative challenges.

PEO 3: Graduates will uphold ethical standards in their professional practice, collaborating effectively in multidisciplinary teams to ensure justice and integrity in forensic investigations while contributing to the advancement of the field.

PEO 4: Graduates will commit to lifelong learning and continuous professional development, staying abreast with advancements in forensic science and applying their knowledge to enhance public safety and contribute positively to society.

PEO 5: Graduates will be well-prepared to pursue advanced studies and research opportunities in forensic science and related fields, furthering their expertise and contributing to the evolution of forensic methodologies.

6.3 Programme Specific Outcomes (PSO)

PSO 1: Understanding and mastering advanced forensic techniques across multiple specializations, by utilizing modern instrumentation and methodologies to solve complex forensic cases.

PSO 2: Applying interdisciplinary knowledge from various fields to enhance forensic investigations and comprehend solutions to real world forensic issues.

PSO 3: Analyzing and interpreting diverse types of forensic evidence, including physical, biological, chemical, and digital evidence, utilizing scientifically validated techniques to support investigations and legal proceedings.

PSO 3: Evaluating the efficacy of legal framework and ethical standards governing the use of forensic evidence in courts with clarity and professionalism.

PSO4: Observing and handling forensic evidence meticulously, applying technical skills to package and preserve evidence accurately, ensuring minimal contamination and maximum integrity.

PSO 5: Creating pioneering strategies to confront and resolve intricate challenges in forensic investigations, while delivering authoritative expert testimony in court.

PSO 6: Conducting independent research to develop innovative forensic solutions, contribute to scientific advancements, and address emerging challenges in criminal investigations.

6.4 Career Avenues*:* Opportunities exist in academics, forensic science laboratories and administration besides all the opportunities applicable to any other graduate like UPSC examinations, defence services and other govt. jobs. After completion of Masters and clearing UGC NET/JRF exam one can pursue career in academics and research organizations as Assistant Professor and Research Associate respectively.

6.5 Duration: We have designed a flexible CBCS, LOCF, multidisciplinary approach for the duration of 2024-2026. The minimum period required for M.Sc. degree in forensic science is two years.

6.6 Eligibility Criteria

Bachelor's degree in science / forensic science/ medicine / engineering / pharmacy/Dentistry/Ayush with at least 55% for General/OBC/EWS category candidates and 50% or equivalent for SC/ST and PwD category candidates.

6.7 Eligibility Criteria for Award of Degree

Name of Degree	Credits requirement	Completion Year
PG Diploma in Forensic Science	The student must fulfil the credit requirement as prescribed in Table 2 (Programme Study)	First Year
M.Sc. Forensic Science		Second Year

7. Student's Structured Learning Experience from Entry to Exit in the Programme

7.1 Education Philosophy and Purpose:

Learn to Earn a Living:

At KRMU we believe in equipping students with the skills, knowledge, and qualifications necessary to succeed in the job market and achieve financial stability. All the programmes are tailored to meet industry demands, preparing students to enter specific careers and contributing to economic development.

Learn to Live

The university believes in the holistic development of learners, fostering sensitivity towards society, and promoting a social and emotional understanding of the world. Our aim is to nurture well-rounded individuals who can contribute meaningfully to society, lead fulfilling lives, and engage with the complexities of the human experience.

7.2 University Education Objective: Focus on Employability and Entrepreneurship through Holistic Education using Bloom's Taxonomy

By targeting all levels of Bloom's Taxonomy—remembering, understanding, applying, analyzing, evaluating, and creating—students are equipped with the knowledge, skills, and attitudes necessary for the workforce and entrepreneurial success. At KRMU we emphasize on learners critical thinking, problem-solving, and innovation, ensuring application of

theoretical knowledge in practical settings. This approach nurtures adaptability, creativity, and ethical decision-making, enabling graduates to excel in diverse professional environments and to innovate in entrepreneurial endeavours, contributing to economic growth and societal well-being.

7.3 Importance of Structured Learning Experiences

A structured learning experience (SLE) is crucial for effective education as it provides a clear and organized framework for acquiring knowledge and skills. By following a well-defined curriculum, teaching-learning methods and assessment strategies, learners can build on prior knowledge systematically, ensuring that foundational concepts are understood before moving on to more complex topics. This approach not only enhances comprehension but also fosters critical thinking by allowing learners to connect ideas and apply them in various contexts. Moreover, a structured learning experience helps in setting clear goals and benchmarks, enabling both educators and students to track progress and make necessary adjustments. Ultimately, it creates a conducive environment for sustained intellectual growth, encouraging learners to achieve their full potential. At K.R. Mangalam University SLE is designed as rigorous activities that are integrated into the curriculum and provide students with opportunities for learning in two parts:

- **Inside the Classroom**: The approach emphasizes on cognitive outcomes through student-centred learning strategies. Methods like case studies, evidence analysis, and group investigations foster active engagement, problem-solving, and critical thinking. Students use open software tools for evidence collection and analysis for digital crimes to deepen their understanding of forensic concepts. Peer reviews, presentations, and collaborative discussions allow students to consolidate theoretical knowledge while honing analytical skills.
- **Outside the Classroom**: Activities focus on developing interpersonal and psychomotor skills through real-world forensic applications in labs, internships, and community engagements. Students participate in internships with law enforcement agencies, conduct lab-based forensic tests, and engage in community outreach projects. These experiences provide practical exposure, teamwork, and communication skills, allowing students to apply classroom knowledge in real-world forensic investigations and build essential competencies for professional practice in the field.

7.4 Educational Planning and Execution: What, when and how learning will happen

Plan – calendar, faculty, monitoring & review, correction & continuous improvement (short writeup)

The School of Basic and Applied Sciences (SBAS) emphasize a holistic approach to educational planning and execution, ensuring that both academic and personal development are seamlessly integrated into the student experience. The curriculum encompasses core subjects that establish a solid academic foundation, complemented by open electives, discipline-specific electives, Value-Added Courses (VAC), and Ability Enhancement Compulsory Courses (AECC) to expand intellectual perspectives. In addition, students are offered the opportunity to pursue a Minor in fields such as Environmental Science, Data Science, Artificial Intelligence & Machine Learning, and Nanoscience, enhancing their specialization in the four-year bachelor's degree course. The selection of these minors happens in the first semester, continuing throughout the degree program.

The learning is thoughtfully planned across the curriculum. In the early stages, foundational knowledge and skills are built through core courses. As students' progress, learning becomes more specialized, with electives and minors supporting deeper exploration of disciplines. Co-curricular activities, including sports, technical events, and cultural activities, are integrated throughout to ensure all-around growth. Leadership training, teamwork, communication skills, and discipline are emphasized through structured personality development activities. Ethical values such as truthfulness, gender sensitization, and environmental consciousness are instilled from the outset, becoming a continuous part of the student journey.

At SBAS, learning is dynamic and flexible, utilizing a variety of teaching methods including lectures, case-based learning, problem-based learning, and project-based learning, all aimed at fostering critical thinking and problem-solving abilities. Hands-on learning is reinforced through lab sessions, internships, research projects, and practical activities that connect theoretical knowledge to real-world applications. Workshops, seminars, and guest lectures from industry experts further provide practical insights and professional exposure. We have a strong students' support system in terms of differential learning (slow & fast learning), mentor-mentee system and personal counselling thereby ensuring students move up on the learning curve.

In terms of infrastructure, SBAS supports its academic planning with highly qualified faculty, smart classrooms, a well-equipped library, computer labs, and experimental research

facilities. The inclusion of Massive Open Online Courses (MOOCs) and experiential learning ensures that students are prepared for both academic success and professional excellence. This carefully executed planning ensures that students are engaged at all levels of Bloom's Taxonomy, progressing from foundational understanding to higher-order thinking, while also fostering emotional, social, and ethical development. Continuous stakeholder feedback, including input from faculty, industry experts, students, and alumni, ensures that the curriculum remains relevant, aligned with academic advancements, and tuned to industry needs.

7.5 Course Registration and Scheduling

- ✓ **Major and Minor Selection** – Every student must register at the beginning of each semester for the courses offered in the given semester. Major courses are registered centrally for the students. However, for other multidisciplinary courses (Minor, VAC, OE) the students must register by themselves through ERP.

- ✓ **Internships/ Research Project**– Students need to do summer internship after second and fourth semesters, which carries 2 credits, during the summer breaks. The same will be evaluated in the upcoming odd semester. In the eighth semester students of B.Sc. (Hons. / Hons. with Research) Forensic Science will do Research Project (Dissertation). Projects are also mapped along with the Lab/ Practical Courses and Experiential Learning Activities.

- ✓ **Cocurricular Activities Credit Choices: Participation in Co/ Extracurricular activities is part of outside classroom learning.**

  Students must earn 2 credits from co/ extracurricular activities. One credit from participation in co-curricular activities like Club/Society activities and another credit from Community Service (1 credit each) through participation in NSS/ Redcross activities or NGOs that contribute to their personal development, leadership skills, and community engagement.

  - Under the category of **Club/Society**, 1 credit can be earned by registration in one of the Club/Societies of university and active participation in the events organized by the club/society OR
  - 15 hours of active engagement in any of the recreational/sports activities

Under the category of **Community Service**, 1 credit can be earned by

- 15 hours active engagement in community service through NGO/NSS/Redcross or any other society approved/ empanelled by the university.
- At the end of the semester, students are required to submit a log of hours, a report, and a certificate of participation/ completion summarizing their activities followed by a presentation.

7.6 Academic Support Services: (Differential learning needs)

The School of Basic and Applied Sciences offer a variety of academic support services tailored to meet the diverse learning needs of its students, ensuring success for all. These services include:

- **Personalized Tutoring**: One-on-one sessions with experienced tutors focus on specific areas such as laboratory techniques, experimental design, research projects, data analysis, and theoretical understanding. Tutoring is customized to each student's level, allowing for targeted support in areas like crystal structure analysis, magnetic properties, and dielectric behaviour.
- **Workshops and Seminars**: Regular workshops on topics such as advanced scientific research methods, materials characterization techniques, and the latest advancements in nanotechnology and superconductivity. These workshops, alongside industry connections, help students enhance both practical skills and theoretical knowledge.
- **Peer Mentoring Programs**: Advanced learners' mentor fellow students by leading study groups, assisting with assignments, and guiding practical projects, fostering a collaborative and supportive academic environment.
- **Accessible Learning Resources**: A variety of online platforms provide access to resources such as recorded lectures, research papers, interactive simulations, and experimental procedure guides, catering to different learning styles and enhancing independent study.
- **Outcome-Based Activities**: Students are encouraged to engage in hands-on practical, such as conducting experiments on material properties, to produce meaningful results. These outcomes are then showcased and celebrated, motivating students to further develop their skills.

- **Diversity and Inclusion Initiatives**: Programs promoting diversity and inclusion ensure that all students, regardless of background, feel valued and can contribute to a rich, collaborative learning environment.
- **Feedback and Assessment**: Continuous feedback mechanisms provide students with constructive evaluations of their work, allowing them to refine their techniques, improve their understanding, and achieve academic excellence.

7.7 Student Career & personal Support Services

- **Mentor Mentee Relationship**

Every student enrolled in the school is considered a mentee and will be assigned a faculty member as their mentor. The mentor's role is to guide and support the mentee, helping them grow both personally and professionally. Mentors act as coaches by giving feedback, sharing advice, and offering insights from their own experiences. They also challenge the mentee's thinking, help them make important decisions, and connect them to valuable resources and networks. Additionally, mentors provide emotional support, celebrating successes and offering encouragement during tough times. On the other hand, the mentee's role is to actively participate in the learning process by planning meetings, setting goals, and communicating openly with their mentor. Mentees should also apply what they learn, continue growing outside the mentor-mentee relationship, and stay proactive in seeking new opportunities. By staying committed and enthusiastic, mentees can make the most of this relationship and achieve their goals.

- **Counselling and Wellness Services**

Counselling and wellness services typically encompass a range of resources to support students' mental health, emotional well-being, and overall quality of life. The school has various counselling programs such as individual Counselling where one-on-one sessions with licensed counsellors or psychologists are held to address personal issues, stress, and mental health concerns, **Group Counselling** which support groups for shared experiences like anxiety, depression, or adjustment challenges, **Crisis Counselling** for Immediate support for students in urgent situations or experiencing severe emotional distress, **Career Counselling** for guidance on career planning, job search strategies, and professional development and **Academic Counselling** for managing academic stress, time management, and study strategies. School also has various Wellness Services like On-campus clinics which provides

medical care, including physical exams, vaccinations, and treatment for minor illnesses. Various mental health workshops on topics like stress management, mindfulness, and coping strategies are organized**.** All the students have access to gyms, fitness classes to promote physical health. These services aim to support students in maintaining a balanced and healthy lifestyle while managing the demands of university life.

- **Career Services and Training**

Career services and training programs are designed to support students in their professional development and job search. School provides personalized advice on career paths, goal setting, and job search strategies to students. They are given proper guidance on creating and refining job application materials. Mock interviews are also held. They are given opportunities to connect with alumni, professionals, and potential employers. Students are given professional training in areas like communication, leadership, and time management. These services and programs aim to prepare students for successful careers by enhancing their skills, providing practical experience, and connecting them with potential employers.

8. Assessment and Evaluation

8.1. Evaluation scheme for theory courses

Evaluation Component	**Weightage**
Internal Marks (Theory): - **I) Continuous Assessment (40 Marks)** **(All the components to be evenly spaced)** Projects/ Quizzes/ Assignments and Essays/ Presentations/ lab work/design sprints/case write up/studio critiques/reflective blogs/peer reviews (minimum of five components to be covered)	40 Marks
Mid Term Exam	20 Marks
External Marks (Theory): – End Term Examination	40 Marks

Overview of Internal Evaluation (40 Marks) –

Internal evaluation is designed to assess students' ongoing learning and application of course materials through diverse assessment methods. Instructors have full autonomy within the 40 marks to employ assessment strategies that best align with the course's learning objectives.

Recommended Assessment Types: -

Projects: - Individual or group projects focusing on research, analysis, and practical application of concepts.

Quizzes: - Regular, short assessments to evaluate understanding of the material.

Assignments and Essays: - In-depth tasks to assess critical thinking and problem-solving skills.

Presentations: - Assessing knowledge dissemination and communication skills.

Participation: - Evaluation of engagement and contributions to class activities.

Case Studies: - Application of theoretical knowledge to real-world scenarios.

8.2. Evaluation scheme for practical courses

Evaluation components	**Weightage**
Internal marks (Practical)	
I. Conduct of experiment	10 Marks
II. Lab Record	10 Marks
III. Viva Voice	20 Marks
IV. Attendance	10 Marks
II. External Marks (practical): End Term Examination	50 Marks

8.3. Evaluation scheme for research project

Particular	**Weightage**
Internal Marks: - (Punctuality, Performance, Work Ethics, Efforts and Research Output)	50 Marks
External Marks (Practical): -	50 Marks
Presentation	20
Report Writing	10
Viva Voce	20

***(It is compulsory for the student to provide an internship certificate issued by**

the relevant institution or organization where they completed their internship during the evaluation process.)

8.4. Evaluation scheme for internship/research project

Particular	Weightage
Internal Marks: - Internship completion certificate obtained from supervisor from host institute.	30 Marks
External Marks (Practical): - Presentation Report Writing Viva Voce	70 Marks 25 25 20

8.5 GRADING SYSTEM

Based on the performance in all evaluation components of a Course, each student will be awarded a final grade in the Course registered, at the end of the semester. The total marks obtained by a student in the Course will be converted to a corresponding letter grade as described below.

Marks Range (%)	Letter Grade	Grade Points	Description of the Grade
%marks > 90%	O	10.0	Outstanding
80 < %marks ≤ 90	A+	9.0	Excellent
70 < %marks ≤ 80	A	8.0	Very Good
60 < %marks ≤ 70	B+	7.0	Good
55 < %marks ≤ 60	B	6.0	Above Average
50 < %marks ≤ 55	C	5.5	Average
40 ≤ %marks ≤ 50	P	5.0	Pass
%marks < 40	F	0	Fail
-	AB	0	Absent
%marks ≥ 50	S	-	Satisfactory
%marks < 50	U	-	Unsatisfactory

-	W	0	Withdrawal

1. Feedback and Continuous Improvement Mechanisms

Teaching-learning is driven by outcomes. Assessment strategies and andragogy are aligned to course outcomes. Every CO is assessed using multiple components. The attainment of COs is calculated for every course to know the gaps between the desired and actual outcomes. These gaps are analysed to understand where does the student lags in terms of learning levels. Thereafter each student's learning levels are ascertained, if found below desirable level, and intervention strategy is affected in the following semester to make necessary corrections. To cater to the diverse learning needs of its student body, K.R. Mangalam University employs a comprehensive assessment framework to identify both slow and advanced learners. Students' learning levels are continually assessed based on their performance at various stages. If a student's performance in internal assessments falls below or equal to 55%, they are categorized as slow learners. Conversely, if a student's performance score in internal assessments is greater than or equal to 80%, they are identified as advanced learners. Such students are encouraged to participate in advanced learning activities. Through periodic evaluations and the utilization of modern management systems, the institution adeptly tracks students' performance across various courses, allowing for targeted interventions and support mechanisms.

10. Academic Integrity and Ethics

The School of Basic and Applied Sciences (SBAS) is committed to promoting safety and academic integrity by enforcing rigorous behavioural standards. Alcohol consumption and substance abuse are strictly prohibited, with escalating penalties for repeat offenders, which may include rustication. Ragging is also banned, adhering to UGC regulations and Supreme Court directives, and is managed through a comprehensive anti-ragging policy. The Anti-Ragging Committee, led by student affairs advisors and comprising diverse members, is tasked with handling ragging complaints and making recommendations. The Anti-Ragging Squad plays a proactive role by monitoring the campus, patrolling potential ragging hotspots, and investigating incidents. Penalties for violations can range from suspension and withholding benefits to expulsion and filing an FIR, in line with UGC regulations.

Sexual harassment in any form is taken very seriously and will be addressed by the Internal Committee Against Sexual Harassment in accordance with the Institute’s policies.

The school also enforces strict penalties for other forms of misconduct, including possession of weapons, theft, and misuse of Institute property or facilities. These actions are subject to severe disciplinary measures.

Academic integrity is a cornerstone of SBAS's research and educational missions. It encompasses honesty, responsibility, and the proper acknowledgment of others' contributions. Violations such as plagiarism and cheating are treated as serious offenses. Students are required to follow principles of academic integrity, including proper citation, ethical data collection, and respect for others' work. Examples of misconduct include copying, falsifying data, and submitting purchased materials. The Institute provides guidelines for accurate record-keeping, truthful reporting, and proper attribution to uphold high academic standards.

Both individual and collective responsibility are emphasized in maintaining academic integrity. Students must ensure their theses are free from plagiarism and original before submission and are encouraged to report any violations. Faculty members are responsible for guiding students in proper research methods, ensuring accurate data recording, and reviewing student work. Additionally, faculty must educate students on academic integrity and address any breaches.

Reporting academic violations involves several steps. Faculty members should report breaches to the School Dean, and any student-faculty conflicts are managed by the Dean with committee support. The Director may appoint a committee to investigate scientific misconduct. Penalties for academic breaches are severe, with initial offenses resulting in warnings or an “F” grade, and repeat offenses potentially leading to expulsion.

Students must also seek permission before engaging with media on behalf of the Institute or recording classroom activities. Unauthorized sharing of audio/video clippings or posting derogatory comments on social media is prohibited. Misconduct can be reported by students, staff, or faculty, and penalties may include warnings, community service, restrictions, fines, withholding grades, suspension, expulsion, or a ban on reapplying for admission. The disciplinary process involves a hearing, documentation, and recommendations by a committee, with final actions decided by the Dean and enforced by the academic office. Repeat offenders face harsher penalties.

11. Programme Structure

Semester-I							
S. No.	**Category of Course**	**Course Code**	**Course**	**L**	**T**	**P**	**C**
1	**Core Course 1**	**BSMFIF171**	Introduction to forensic science and Law	4	0	0	4
2	**Core Course-2**	**BSMFFC172**	Forensic Chemistry and Toxicology	4	0	0	4
3	**Core Course-3**	**BSMFCS173**	Crime Scene Management and Forensic Physics	3	0	0	3
4	**Core Course -4**	**BSMFIN174**	Instrumentation	4	0	0	4
5	**Core Course -5**	**BSMFDR175**	Dermatoglyphics and Impressions	3	0	0	3
6	**Core Practical I**	**BSMFFP186**	Forensic Practical-I	0	0	6	3
Total							**21**
Semester II							
S. No.	**Category of Course**	**Course Code**	**Course**	**L**	**T**	**P**	**C**
1	**Core Course -6**	**BSMFBS271**	Forensic Biology and Serology	4	0	0	4
2	**Core Course -7**	**BSMFFM272**	Forensic Medicine & Psychology	3	0	0	3
3	**Core Course -8**	**BSMFNC273**	Network security and cyber defense	3	0	0	3
4	**Core Course -9**	**BSMFQD274**	Questioned Document	4	0	0	4
5	**Core Course 10**	**BSMFQDP275**	Forensic Ballistics and Explosives	4	0	0	4
6	**Core (Practical) II**	**BSMFFP286**	Forensic Practical II	0	0	6	3

Total	21

After completion of 1 year of course, student will be given post graduate diploma. Students will be offered Five specialization subjects from 3rd semester onwards. The specializations in M.Sc. Forensic Science that will be run will be dependent on the strength enrolling these specializations. Minimum strength of 5 students is needed to run any specialization subject.

Semester III							
Specialization-A: Forensic Physics and Ballistics							
S. No.	**Category of Course**	**Course Code**	**Course**	**L**	**T**	**P**	**C**
1	**Core Course 11**	**BSMFLS371**	**Lasers & Spectroscopy**	**3**	**0**	**0**	**3**
2	**Core Practical III**	**BSMFLS386**	**Lasers & Spectroscopy-PRACTICAL**	**0**	**0**	**2**	**1**
3	**Core Course 12**	**BSMFBA372**	**Advancement in Forensic Ballistics and Armour Material**	**3**	**0**	**0**	**3**
4	**Core Practical IV**	**BSMFBA387**	**Advancement in Forensic Ballistics and Armour Material-PRACICAL**	**0**	**0**	**2**	**1**
5	**Core Course 13**	**BSMFAV373**	**Audio and Video Analysis**	**3**	**0**	**0**	**3**
6	**Core Practical V**	**BSMFAV388**	**Audio and Video Analysis-PRACTICAL**	**0**	**0**	**2**	**1**
7	**Core Course 14**	**BSMFTT374**	**Statistical Tools and techniques**	**2**	**0**	**0**	**2**
8	**Core Course 15**	**BSMFRW375**	**Forensic Research Methods and Analytical Report Writing**	**2**	**0**	**0**	**2**

9	Dissertation	BSMFDR376	Dissertation -I	0	0	0	4
TOTAL							20

Specialization-B: Forensic Biology and serology							
S. No.	Category of Course	Course Code	Course	L	T	P	C
1	Core Course 11	BSMFAS371	Advanced Concepts in Forensic Biology and Serology	3	0	0	3
2	Core Practical III	BSMFAS386	Advanced Concepts in Forensic Biology and Serology-PRACTICAL	0	0	2	1
3	Core Course 12	BSMFMA372	Fundamentals of Molecular Biology	3	0	0	3
4	Core Practical IV	BSMFMA387	Fundamentals of Molecular Biology-PRACTICAL	0	0	2	1
5	Core Course 13	BSMFFG373	Forensics Genomics and DNA Analysis	3	0	0	3
6	Core Practical V	BSMFFG388	Forensics Genomics and DNA Analysis-PRACTICAL	0	0	2	1
7	Core Course 14	BSMFTT374	Statistical Tools and techniques	2	0	0	2
8	Core Course 15	BSMFRW375	Forensic Research Methods and Analytical Report Writing	2	0	0	2
9	Dissertation	BSMFDR376	Dissertation -I	0	0	0	4
TOTAL							20

Specialization-C: Fingerprints and Questioned Documents

S. No.	Category of Course	Course Code	Course	L	T	P	C
1	Core Course 11	BSMFFT371	Advanced Fingerprint Technologies	3	0	0	3
2	Core Practical III	BSMFFT386	Advanced Fingerprint Technologies-PRACTICAL	0	0	2	1
3	Core Course 12	BSMFDE372	Advances in Forensic Documents Examination	3	0	0	3
4	Core Practical IV	BSMFDE387	Advances in Forensic Documents Examination-PRACTICAL	0	0	2	1
5	Core Course 13	BSMFAA373	Forensic Accounting and Auditing	3	0	0	3
6	Core Practical V	BSMFAA388	Forensic Accounting and Auditing-PRACTICAL	0	0	2	1
7	Core Course 14	BSMFTT374	Statistical Tools and techniques	2	0	0	2
8	Core Course 15	BSMFRW375	Forensic Research Methods and Analytical Report Writing	2	0	0	2
9	Dissertation	BSMFDR376	Dissertation -I	0	0	0	4
TOTAL							20

Specialization-D: Forensic Chemistry and Toxicology							
S. No.	Category of Course	Course Code	Course	L	T	P	C

1	Core Course 11	BSMFPH371	Forensic Pharmacy and Pharmacology of Controlled Drugs	3	0	0	3
2	Core Practical III	BSMFPH386	Forensic Pharmacy and Pharmacology of Controlled Drugs-PRACTICAL	0	0	2	1
3	Core Course 12	BSMFAF372	Advanced Forensic Toxicology	3	0	0	3
4	Core Practical IV	BSMFAF387	Advanced Forensic Toxicology-PRACTICAL	0	0	2	1
5	Core Course 13	BSMFMA373	Modern and Applied Analytical Forensic Chemistry	3	0	0	3
6	Core Practical V	BSMFMA388	Modern and Applied Analytical Forensic Chemistry-PRACTICAL	0	0	2	1
7	Core Course 14	BSMFTT374	Statistical Tools and techniques	2	0	0	2
8	Core Course 15	BSMFRW375	Forensic Research Methods and Analytical Report Writing	2	0	0	2
9	Dissertation	BSMFDR376	Dissertation -I	0	0	0	4
TOTAL							20

Specialization-E: Digital Forensics								
S. No.	Category of Course	Course Code	Course	L	T	P	C	Hours/week
1	Core Course 11	BSMFAD371	Advanced Digital Forensics	3	0	0	3	3
2	Core Practical III	BSMFAD386	Advanced Digital Forensics-PRACTICAL	0	0	0	1	2
3	Core	BSMFMN37	Mobile and Network	3	0	0	3	3

	Course 12	2	Forensics					
4	Core Practical IV	BSMFMN387	Mobile and Network Forensics-PRACTICAL	0	0	0	1	2
5	Core Course 13	BSMFVA373	Vulnerability Assessment and Penetration Testing	3	0	0	3	3
6	Core Practical V	BSMFVA388	Vulnerability Assessment and Penetration Testing-PRACTICAL	0	0	2	1	2
	Core Course 14	BSMFTT374	Statistical Tools and techniques	2	0	0	2	2
7	Core Course 15	BSMFRW375	Forensic Research Methods and Analytical Report Writing	2	0	0	2	2
8	Dissertation	BSMFDR376	Dissertation -I	0	0	0	4	0
							20	19

Semester IV							
S. No.	Category of Course	Course Code	Course	L	T	P	C
1	Dissertation	BSMFDR471	Dissertation- II	0	0	0	12
2	Core (Internship)	BSMFFS472	Internship at Forensic Science Laboratory	0	0	0	6
TOTAL							18

TOTAL CREDITS-80

12.Syllabi

FIRST SEMESTER

SEMESTER I					
BSMFIF171	**Introduction to Forensic Science and Law**	**L**	**T**	**P**	**C**
Version	2	4	0	0	4
Category of	Core course 1				

Course	
Total Contact Hours	60 Hours
Pre-Requisites/ Co-Requisites	Nil

Course Perspective: Introduction to Forensic Science is a foundational course that provides a broad overview of the field. It covers key concepts, forensic disciplines, legal considerations, and practical applications. The students will learn about crime scene investigation, evidence analysis, courtroom procedures, and ethical responsibilities.

Course Outcome:

Upon completion of the course, the students will be able to:

1. **Remember** and recall different types of evidences, including physical, biological, trace, digital evidences during crime scene investigation.
2. **Understand** forensic science, its multidisciplinary nature, and its role in criminal investigations and the justice system.
3. **Apply** the understanding about the organizational structure of forensic science laboratory, process of report writing and submission to court for real world cases.
4. **Analyse** different types of evidences and their admissibility in the court of law.
5. **Evaluate** modern legal reforms such as Bharatiya Nyaya Sanhita (BNS), Bharatiya Sakshya Adhiniyam (BSA), and Bharatiya Nagarik Suraksha Sanhita (BNSS), and compare them with older criminal was to assess their impact on crime prevention and justice delivery

Course Contents
Unit I: Basics of forensic science Introduction of Forensic science, classification & its significance in forensic science, basic principle and law of forensic science. Branches of forensic science – Introduction to Forensic Toxicology, Forensic Biology & Serology, Forensic Ballistics, Questioned documents & Fingerprints and Cyber Forensics. Hierarchical set up of Forensic Science Laboratories National Crime Records Bureau, Police & Detective Training Schools, Bureau of Police Research & Development, Mobile Forensic Units, Police Academies.

Unit II: Crime Scene Investigation and Management Crime Scene & its various Types including – size, nature, location. Processing of Crime scene. Securing and isolating the crime scene. Crime scene search methods, Elements, nature, causes and consequences of crime. Documentation of crime scenes – photography, videography, sketching and recording notes. Forwarding Letter. Duties of first responders at crime scenes. Coordination between police personnel and forensic scientists at crime scenes, Chain of custody, Reconstruction of crime scene.
Unit III: Physical Evidences and Expert testimony Physical evidences and its types (Fingerprints, glass, fiber, blood, saliva, weapon of crime etc.), Blood spatter analysis, Characteristic blood patterns, testimonial and real evidence, admissibility of scientific evidence and importance of physical evidences, Collection, preservation, packing and forwarding of different types of evidences to the laboratories. Trace evidences & Druggist fold method for packaging. Expert Testimony: The role of the expert-witness; acceptance of evidence in the court; Direct examination, re-examination and cross – examination of prosecution lawyer and defense lawyer.
Unit IV: Modern Legal Reforms, Punishment, and Crime Prevention Introduction to Bharatiya Nyaya Sanhita (BNS), Bharatiya Sakshya Adhiniyam (BSA), and Bharatiya Nagarik Suraksha Sanhita (BNSS); comparative analysis of old and new criminal laws; key sections and punishments; crime prevention strategies and forensic interventions; role of the Law Commission of India and global agencies; and challenges of cybercrime and other emerging global crimes. Crime Statistics and Current Trends - Meaning and Importance, NCRB, SCRB, DCRB functions, Crime/Victim Surveys: International Crime Comparisons, Unreported Crimes

Learning Experience: The learning experience in Introduction to Forensic Science course is highly engaging and interdisciplinary, offering insights into how science is applied to solve criminal cases. Students are introduced to various branches of forensic science, including crime scene investigation, evidence collection, and analysis of biological, chemical, and physical evidence. The course often combines lectures with hands-on activities, such as mock crime scene investigations and laboratory exercises, where students apply techniques like fingerprint analysis, DNA profiling, and trace evidence examination.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination scheme:

Evaluation Component	**Weightage**
Internal Marks (Theory): - **I) Continuous Assessment (40 Marks)**	

(All the components to be evenly spaced) Projects/ Quizzes/ Assignments and Essays/ Presentations/ lab work/design sprints/case write up/studio critiques/reflective blogs/peer reviews (minimum of five components to be covered)	40 Marks
Mid Term Exam	20 Marks
External Marks (Theory): – End Term Examination	40 Marks

Textbooks:

1. Sharma B.R. Forensic Science In Criminal Investigation And Trials 6Th Edition 2020

Reference Books:

1. E.H. Sutherland & D.R. Cressey – Principles of Criminology, 6th Edition, Lippincott, 1960.
2. Larry J. Siegel – Criminology: Theories, Patterns and Typologies, 13th Edition, Cengage Learning.

Open Educational Resources (OER)

1. National Crime Records Bureau (NCRB) **Official Website**: https://ncrb.gov.in
2. State Crime Record Bureau (SCRB) **Bihar SCRB**: https://scrb.bihar.gov.in
3. https://www.mha.gov.in/en/commoncontent/new-criminal-laws
4. https://www.data.gov.in/dataset-group-name/Crime%20Statistics
5. https://www.mospi.gov.in/statistical-year-book-india/2018/206
6. https://www.open.edu/openlearn/society-politics-law/an-introduction-crime-and-criminology/content-section-0
7. https://www.edx.org/learn/justice/harvard-university-justice
8. https://www.coursera.org/courses?query=criminology
9. https://bjs.ojp.gov/
10. https://www.interpol.int/en

SEMESTER I					
BSMFFC172	**Forensic Chemistry and Toxicology**	**L**	**T**	**P**	**C**
Version	1	4	0	0	4
Category of Course	Core course 2				
Total Contact Hours	60 Hours				
Pre-Requisites/ Co-Requisites	Nil				

Course Perspective: Forensic chemistry and toxicology offer a comprehensive blend of theoretical knowledge and practical skills essential for analyzing chemical and toxicological evidence in forensic investigations. Students will learn various techniques and toxicological analysis, applying them to real-world cases involving drugs, poisons, and hazardous substances. The course emphasizes critical thinking, problem-solving, and the ethical responsibilities of forensic scientists, preparing students for careers in forensic labs, law enforcement, and medical fields by providing a deep understanding of scientific principles and their legal implications.

Course Outcome:

Upon completion of the course, the students will be able to:

1. **Remember** and recall the fundamentals of drugs, poisons and toxins, their collection and preservations
2. **Understand** the scope, role & significance of various types of drugs, commonly abused along with their presumptive & instrumental analysis
3. **Apply** the concepts in solving real world issues and legal provisions for forensic

investigation of drugs, cosmetics, fire and arson evidences

4. **Analyse** the chemical substances found at crime scenes or in biological samples.
5. **Evaluate** the medicolegal aspect of poisons and the management of toxicological cases

Course Contents
Unit I: Forensic Chemistry - 15 Hours Introduction, Role of Forensic Chemist, Types of Cases which require Chemical Analysis, Sampling of Evidences, Presumptive Tests (Colour/Spot Tests), Microcrystal Tests, Limitations of Forensic Samples, Elemental Analysis (Organic and Inorganic), Instrumental Methods and Equipments. Examination of Contact Traces: Introduction to Cosmetics and Detective Dyes, Collection, Sampling, Analysis and Forensic Importance. Analysis of Illicit Liquors including Methyl and Ethyl Alcohol.
Unit II: Drugs of Abuse - 15 Hours Introduction, Drug Addiction and its Problems. Classification of Drugs of Abuse, Analgesics, Depressants, Stimulants, Hallucinogens and Narcotics, Designer Drugs. Drug Abuse in Sports: Introduction, Common Prohibited Substances, Analytical Approach.
Unit III: Forensic Toxicology - 15 Hours Introduction, Role of the Toxicologist, Significance of Toxicological Findings, Poisons, Definition, Classification on the Basis of their Origin, Physiological Action and Chemical Nature, Absorption, Distribution, Metabolism and Excretion of Poisons, Factors Affecting Poisoning in India.
Unit IV: Management of Toxicological Cases - 15 Hours Introduction, Principles of Management of Poisoning Cases, Duties of a Doctor in Poisoning Cases, Signs and Symptoms of Common Poisons, Types of Antidotes, Detection of Poisoning in the Dead. Selection, Collection and Preservation of Viscera for Various Types of Poisons: Choice of Preservatives, Containers and Storage. Different Methods of Extraction, Isolation, Identification, Estimation of Poisons from Biological Specimens.

Learning Experience: In this forensic chemistry and toxicology course, learning is dynamic and hands-on, blending lectures with practical lab work and real-world case studies. Students will explore forensic applications through group projects, peer collaboration, and the use of specialized lab equipment. Interactive technology, including online platforms and simulation tools, will support learning through practical exercises. Continuous evaluation will be conducted through quizzes, lab reports, and presentations. The course instructor will provide regular feedback and guidance, encouraging students to seek help when necessary. Group activities will promote teamwork and critical thinking, allowing students to apply and deepen their knowledge of forensic science concepts.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Evaluation Component	**Weightage**
Internal Marks (Theory): - **I) Continuous Assessment (40 Marks)** **(All the components to be evenly spaced)** Projects/ Quizzes/ Assignments and Essays/ Presentations/ lab work/design sprints/case write up/studio critiques/reflective blogs/peer reviews (minimum of five components to be covered)	40 Marks
Mid Term Exam	20 Marks
External Marks (Theory): – End Term Examination	40 Marks

Textbooks:

1. Parikh CK. Text Book of Medical Jurisprudence, Forensic Medicine and Toxicology. CBS Publ. New Delhi, 1999.
2. Modi JP. Textbook of Medical Jurisprudence and Toxicology. MM Tripathy Publications, 2001.
3. Saferstein R. Forensic Science Hand Book, Vol I, II and III, Pretince Hall, NI., 1982

Reference Books:

1. Suzanne Bell. Drugs, Poisons, and Chemistry, 2009

2. James, S.H., Nordby, J.J. – *Forensic Science: An Introduction to Scientific and Investigative Techniques*
3. Carvey RH, Baselt RC. Introduction to Forensic Toxicology and Biochemicals. Publ. Davis CA, 1981.
4. Chadha PV. Handbook of Forensic Medicine and Toxicology. Jaypee Brothers, New Delhi, 2004.

Open Educational Resources (OER)

Websites:

1. **NIJ (National Institute of Justice, USA)** Forensic Resources: https://nij.ojp.gov/topics/forensics
2. https://www.open.edu/openlearn/history-the-arts/history/social-economic-history/19th-century-autopsy-unmasks-poisoner

SEMESTER I					
BSMFCS173	**Crime Scene Management and Forensic Physics**	**L**	**T**	**P**	**C**
Version	1	3	0	0	3
Category of Course	Core Course 3				
Total Contact Hours	60 Hours				
Pre-Requisites/ Co-Requisites	Nil				

Course Perspective

The Crime Scene Management and Forensic Physics course immerses students in practical and theoretical aspects of crime scene handling and evidence analysis. Students will engage in activities that teach them to secure, document, and preserve crime scenes, while also exploring the collection and examination of physical and impression evidence, such as glass, paint, footprints, and tire marks. Through hands-on practice, lab work, and case studies, the course emphasizes the application of scientific principles to ensure accurate evidence analysis and effective crime scene management.

1.Remember and recall the fundamental concepts of crime scene management, types of evidence, and standard procedures for securing, documenting, and preserving a crime scene.

2. Understand the scientific principles and forensic relevance of material evidence such as glass, paint, soil, lip/ear prints, fibers, and tool marks.

3. Apply appropriate methods for the collection, preservation, and examination of physical, impression, and material evidence in simulated casework.

4. Analyze difference between various types of forensic evidence by interpreting their physical and chemical characteristics, and analyze their significance in crime reconstruction.

5.Evaluate the evidentiary value and reliability of forensic findings to support investigative and judicial through critical evaluation of case studies.

Course Contents
Unit I: Crime Scene Management and Physical Evidence Handling Introduction to Crime Scene: Types of crime scenes, securing the crime scene, evaluation, and processing of evidence, Documentation: Note making, sketching, photography, videography of the crime scene, and the role of the first responder, Crime Scene Search Techniques: Physical evidence discovery, recognition, collection, and maintaining chain of custody, Reconstruction and Physical Evidence: Types, classification, and role in criminal investigations and trials.
Unit II: Forensic Physics and Material Evidence

Glass Examination: Types of glass, forensic fracture analysis, impact direction, physical and chemical properties, refractive index, and elemental analysis, Paint Analysis: Composition and types of paint, forensic examination using physical, chemical, and instrumental techniques, case studies, Soil Evidence: Soil composition, classification, forensic analysis methods, interpretation of soil evidence, case studies, Lip and Ear Prints: Lip Prints: Cheiloscopy, classification, collection, and forensic comparison, Ear Prints: Morphology, collection, identification, and comparison.

Unit III: Tool Marks, Bite Marks, and Impressions

Tool Mark Evidence: Types, class and individual characteristics, forensic collection, examination, and case studies, Impression Evidence: Tire Impressions: Forensic significance, collection, and examination of skid marks, Footprints and Shoe Impressions: Evidence collection, gait pattern analysis, identification, and case studies.

Unit IV: Fiber, Textile, and Material Evidence

Fiber and Textile Analysis: Classification, forensic examination of fibers, ropes, wires, and counterfeit coins using microscopy and chemical methods, Restoration of Erased Marks: Techniques for restoring erased or obliterated markings, forensic assessment, photography, and case studies.

Learning Experience: The Crime Scene Management and Forensic Physics course immerses students in practical and theoretical aspects of crime scene handling and evidence analysis. Students will engage in activities that teach them to secure, document, and preserve crime scenes, while also exploring the collection and examination of physical and impression evidence, such as glass, paint, footprints, and tire marks. Through hands-on practice, lab work, and case studies, the course emphasizes the application of scientific principles to ensure accurate evidence analysis and effective crime scene management.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Evaluation Component	**Weightage**
Internal Marks (Theory): - **I) Continuous Assessment (40 Marks)**	

(All the components to be evenly spaced) Projects/ Quizzes/ Assignments and Essays/ Presentations/ lab work/design sprints/case write up/studio critiques/reflective blogs/peer reviews (minimum of five components to be covered)	40 Marks
Mid Term Exam	20 Marks
External Marks (Theory): – End Term Examination	40 Marks

Textbooks:

1. Sharma BR. Forensic Science in Criminal Investigation and Trials, Central Law Agency, Allahabad, 1974.
2. Saferstein: Forensic Science Handbook, Vol I, II & III, Prentice Hall Inc. USA.
3. Sharma BR. Footprints, Tracks and Trials. Central Law Agency. Allahabad, 1980.
4. Robertson J, Roux C, Wiggin GK, Grieve M Forensic Examination of Fibres (2nd Edn). CRC Press, 1999.
5. Noon RK. Forensic Engineering Investigation (2nd Edn). CRC Press, 2000.

Reference Books:

1. H. James, Wouldiam G. EcSettle FA. Handbook of Instrumental Techniques for Analytical Chemistry, Prentice Hall, 1997.
2. Saferstein R. Criminalistics, Prentice Hall Inc. USA., 1976.
3. Kirk. Criminal Investigation Interscience Publisher Inc. New York, 1953.
4. Van Kirk DJ. Vehicular Accident investigation and reconstruction. CRC Press, 2000.

Open Educational Resources (OER)

1. https://www.udemy.com/course/effective-accident-investigation-and-reporting-in-ehs/?couponCode=ST8MT101424
2. https://www.umgc.edu/online-degrees/undergraduate-certificates/crime-scene-investigation

SEMESTER I					
BSMFIN174	**Instrumentation**	**L**	**T**	**P**	**C**
Version		4	0	0	4
Category of Course	Core Course 4				
Total Contact Hours	60 Hours				
Pre-Requisites/ Co-Requisites	Nil				

Course Perspective: The Instrumental Analysis course offers an in-depth understanding of various instrumental techniques used in forensic investigations. It focuses on the principles, operation, and applications of instruments like chromatography, spectroscopy, and mass spectrometry to analyze physical evidence. Students learn to interpret analytical data, ensuring accuracy in identifying substances, trace elements, and chemicals in forensic samples. By integrating theory with practical lab work, the course hones skills necessary for crime scene investigations, toxicology analysis, and legal case presentations**,** enhancing both scientific expertise and critical thinking in forensic contexts.

Course Outcome: Students will be able to:

1. **Remember** and recall the fundamental principles of various instrumental techniques used in chemical analysis, such as spectroscopy, chromatography, and electrochemical methods.
2. **Understand** the scope, working, and application of analytical instruments in both qualitative and quantitative analysis of chemical substances.
3. **Apply** knowledge of instrumental techniques to solve real-world analytical problems, choosing the appropriate method for the analysis of different types of samples.
4. **Analyze** complex data obtained from instrumental techniques and interpret the results with a focus on accuracy and precision.
5. **Evaluate** the performance, limitations, and troubleshooting of instruments used in analytical laboratories to ensure optimal functioning and reliable results.

Course Contents
Unit I: Concepts of Atomic and molecular Spectroscopy What is Spectroscopy, Electromagnetic Spectrum, Sources of Radiations, their Utility and Limitations, Conventional Sources for UV, Visible and Infrared Rays, Sources for Shorter Wavelength Radiations (X-Ray Tubes) Radioactivity, Gamma Rays and Beta Rays. Laser (He, Ne, Argon Ion, Dye Lasers, Semi-Conductor Lasers) as Source of Radiation. Interaction of Radiation with Matter: Reflection, Absorption, Transmission, Fluorescence, Phosphorescence and their Forensic Application Molecular Spectra: Introduction, Molecular Orbital, Types of Molecular Energies, Vibrational and Electronic Spectra, Atomic Spectra, Energy Levels, Quantum Numbers and Designation of States, Selection Rules, Augur Effect. Detection of Radiations, Photographic Detectors, Thermal Detectors, Photoelectric Detectors, Radiation Filters, etc.
Unit II: Absorption Spectroscopy Ultra Violet and Visible Spectrophotometry: Types of Sources and Stability, Wavelength Selection, Filters-Cells and Sampling Devices, Detectors, Resolution, Applications of UV- Visible Spectroscopy, Difference/ Derivative Spectroscopy. Fluorescence and Phosphorescence Spectrophotometry: Types of Sources, Structural Factors, Instrumentation and its Applications. Atomic Absorption Spectrometry: Introduction, Instrumentation and Techniques, Interference in AAS, Background Correction Methods, (GFAAS) Quantitative Analysis. It's Applications In Forensic Science. Infrared Spectrophotometry: Instrumentation of Dispersive and Fourier Transform Spectrophotometry, Sample Handling, Quantitative Analysis and Interpretation of IR Spectra.
Unit III: Chromatographic Techniques Definition and Concept of Chromatography, Classification of Chromatography. Basic principle, theory, Instrumentation and Forensic Applications of Paper chromatography, Thin layerchromatography and HPTLC. Types of column, Column efficiency, Pumps, Various types of detector, Development of HPLC and UPLC method, Choice of stationary and mobile phase, Difference between HPLC and UPLC, Applications, Instrumentation and Forensic Applications of Gas chromatography

Unit IV: Immunological techniques: Types of Immunological Techniques Radioimmunoassay (RIA): Basic Principle, Procedure, Labelling of Antigen and Technique of Assay & Applications. Enzyme Linked Immuno Sorbent Assay (ELISA): Introduction, Procedure, Competitive Method, Sandwich Method, Indirect Method & Applications. Polymerase chain reaction: Overview, History, Basic Principles, significance, and forensic applications. Types of PCR: Conventional PCR, Real-time PCR (qPCR), Reverse Transcription PCR (RT-PCR), Digital PCR, Multiplex PCR, Nested PCR, Thermal cycler

Learning Experience: The learning experience in forensic instrumental analysis blends theoretical knowledge with extensive hands-on practice. Students learn the underlying principles of key analytical instruments like gas chromatography, high-performance liquid chromatography, and mass spectrometry, and how these tools are applied to forensic investigations. Practical lab sessions are crucial, allowing learners to analyze real forensic samples, troubleshoot instrument issues, and interpret complex data. By applying these techniques to real-world scenarios like drug analysis and toxicology, students gain essential skills for crime scene investigations, ensuring they are prepared for the challenges of forensic science.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Evaluation Component	**Weightage**
Internal Marks (Theory): - **I) Continuous Assessment (40 Marks)** **(All the components to be evenly spaced)** Projects/ Quizzes/ Assignments and Essays/ Presentations/ lab work/design sprints/case write up/studio critiques/reflective blogs/peer reviews (minimum of five components to be covered)	40 Marks
Mid Term Exam	20 Marks
External Marks (Theory): – End Term Examination	40 Marks

Textbooks:

1. Robinson JW. Atomic Spectroscopy (2nd Edn). Marcel Dekkar, Inc, New York, 1996.
2. Willard HH, Lynne L. Merrett, J. Dean, A. Frank, A. Settle. Instrumental Methods of Analysis (7th Edn). CBS pub. & Distributors, New Delhi, 1988.
3. Khandpur RS. Handbook of Analytical Instruments, Tata McGraw Hill Pub. Co. New Delhi, 2004.
4. Dudley H. Williams, Fleming I. Spectroscopic Methods in Organic Chemistry (4th Edn). Tata McGraw- Hill Publishing Company, New Delhi, 1994.
5. Douglas Skoog, James Holler, Stanley Crouch. Principles of Instrumental Analysis (7th Edn). Cengage Learning, 2017.
6. G.R Chatwal, S.K Anand. Instrumental Methods of Chemical Analysis. Himalaya Publ. House, 2004.

Reference Books:

1. James W. Robinson, Eileen Skelly Frame, George M. Frame II. Undergraduate Instrumental Analysis (7th Edn). CRC Press, 2014.
2. Settle FA. Handbook of Instrumental Techniques for Analytical Chemistry, Prentice Hall, 1997.
3. Sue Jickells, Adam Negrusz. Clarke's Analytical Forensic Toxicology. Pharmaceutical Press, 2008.
4. Thomson KC, Renolds RJ. Atomic Absorption Fluorescence & Flame Emission Spectroscopy: A Practical Approach (2nd Edn). Charles Griffith & Company, New South Wales, 1978.
5. Silverstein RM, Webster FX. Spectrometric Identification of Organic Compounds (6th Edn). John Wiley & Sons, Inc. 1997.

Open Educational Resources (OER)

3. https://www.bcit.ca/courses/instrumental-analysis-for-forensic-chemistry-fsct-8156/
4. https://onlinecourses.nptel.ac.in/noc20_cy08/preview
5. https://www.udemy.com/course/chromatography-techniques/

SEMESTER I					
BSMFDR175	**Dermatoglyphics and Impressions**	**L**	**T**	**P**	**C**
Version		3	0	0	3
Category of Course	Core Course 5				
Total Contact Hours	45 Hours				
Pre-Requisites/ Co-Requisites	Nil				

Course Perspective: The Dermatoglyphics and Impressions course explores the scientific study of fingerprints, palm prints, and footprints, which are crucial in forensic identification. It covers the biological formation of ridges on the skin, the classification of fingerprint patterns, and the methodologies used to capture and analyze these impressions at crime scenes. The course emphasizes both theoretical aspects of dermatoglyphics and practical applications, such as latent print collection, comparison techniques, and digital analysis. Students also study the relevance of pores and edges in forensic investigations, preparing them to use these techniques for crime scene analysis and individual identification in forensic contexts.

Course Outcome: Students will be able to:

1. **Remember** and recall the fundamental principles and patterns of dermatoglyphics, including the structure and formation of fingerprints and palm prints.
2. **Understand** the importance and application of dermatoglyphics in forensic identification, personal identification, and medical research.
3. **Apply** knowledge of impression evidence, such as fingerprints, poroscopy and edgeoscopy in forensic investigations and criminal cases.
4. **Analyse** various types of impressions, including latent, visible, and plastic prints, and use appropriate techniques for their collection, preservation, and comparison.
5. **Evaluate t**he significance of ridge patterns, minutiae points, and other identifying features in personal identification and forensic analysis in crime scene.

Course Contents
Unit I: Fingerprints in Personal Identification History of fingerprints, Significance of fingerprints in personal identification, Fingerprint ridge characteristics: class and individual, ridge counting and ridge tracing, Comparison of fingerprints on the basis of ridge characteristics and details.
Unit II: Fingerprint Classification & Case representation Fingerprint handling, collection and preservation, significance of fingerprint as evidence, Classification systems for fingerprints Henry's system, Batley's system and Extension of Henry's system, recording of fingerprints, report writing and appearing as an expert in court of law - Moot court.
Unit III: Introduction to Poroscopy & Edgeoscopy Introduction: Poroscopy and edgeoscopy, Fingerprints Examination on the basis of poroscopy and its significance, evaluation of fingerprints on the basis of edgeoscopy and its significance in fingerprint field.
Unit IV: Advanced Methods of Recording & examination of Fingerprints Chemical and physical methods and procedure adopted for development of fingerprints, photography of fingerprints, Digital imaging and enhancement, Automatic fingerprint identification system, application of radiations to examine latent fingerprints on various surfaces including skin.

Learning Experience: The learning experience in Dermatoglyphics and Impressions is hands-on and analytical, focusing on both biological and forensic aspects. Students explore the formation and classification of ridge patterns found in fingerprints, palms, and soles. Learners collect and analyze latent prints using methods like dusting, chemical development, and digital imaging techniques. They also engage with comparison techniques to match prints found at crime scenes to potential suspects. Additionally, the study of pores and fingerprint edges deepens the forensic application, giving students real-world experience in identifying and linking evidence through pattern recognition and comparison techniques. This comprehensive approach helps students understand the role of dermatoglyphics in criminal investigations.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Evaluation Component	Weightage
Internal Marks (Theory): - **I) Continuous Assessment (40 Marks)** **(All the components to be evenly spaced)** Projects/ Quizzes/ Assignments and Essays/ Presentations/ lab work/design sprints/case write up/studio critiques/reflective blogs/peer reviews (minimum of five components to be covered)	40 Marks
Mid Term Exam	20 Marks
External Marks (Theory): – End Term Examination	40 Marks

Textbooks:

1. Nath, S., Fingerprint Identification, CRC Press, 2nd edition, 2002.
2. James, S. H. and Nordby, J. J. (Eds), Forensic Science - An Introduction to Scientific and Investigation Techniques, CRC Press, London, 2003.
3. Sharma, B. R., Forensic Science in Criminal Investigation and Trials (3rd Edn) Universal Law Publishing Co. Ltd. New Delhi, 2001.

Reference Books:

1. Cossidy, M.J., Footwear Identification, Royal Canadian Mounted Police, Ontario, Canada, 1980.
2. Nanda, B. B., and Tewari, R. K., Forensic Science in India. Select Publishers, New Delhi, 2001. Saferstein, Richard, Criminalistics, an Introduction to Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998.
3. Bridges, B. C., Vollmar, A. Monir, M., Criminal Investigation, Practical Fingerprinting, Thumb Impression, Handwriting, Expert Testimony Opinion Evidence, The University Book Agency, Allahabad, 2000.

Open Educational Resources (OER)

1. https://www.open.edu/openlearn/health-sports-psychology/health/forensic-science-and-fingerprints/content-section-0?active-tab=description-tab
2. https://www.udemy.com/course/fingerprints-forensic-science-certification-accredited

SEMESTER I					
BSMFFP186	**Forensic Practical-I**	**L**	**T**	**P**	**C**
Version		0	0	6	3
Category of Course	**Core (Practical) I**				
Total Contact Hours	**45 Hours**				
Pre-Requisites/ Co-Requisites	**Nil**				

Course Perspective: The Forensic Practical I course focuses on providing hands-on skills required for effectively managing and analyzing crime scenes. It covers the systematic processes involved in securing crime scenes, collecting and preserving physical evidence, and documenting the scene through sketches, photographs, and notes. Students learn to apply various forensic techniques such as fingerprint lifting, blood spatter analysis, and trace evidence collection. Emphasis is placed on maintaining the chain of custody and ensuring the integrity of evidence for courtroom presentations. Through real-world simulations, students gain practical experience in handling different crime scene scenarios, preparing them for the complexities of forensic investigations.

Course Outcome: Students will be able to:

1. **Observe** and document crime scenes (both indoor and outdoor) through accurate sketching and photography, ensuring proper evidence preservation.
2. **Imitate** the process of collection and preservation of physical evidence from crime scenes using standardized techniques to maintain integrity for forensic analysis.
3. **Perform** preliminary forensic tests, including presumptive tests, microcrystal tests, and fire scene analysis, to identify substances and determine causes.
4. **Adapt** the experimental methods or procedures based on observations and results, addressing challenges and improving outcomes through iterative problem-solving.

Course Contents

1. Investigation and sketching of indoor scene of crime.
2. Investigation and sketching of outdoor scene of crime.
3. Crime Scene Photography: indoor, outdoor.
4. Collection and preservation methods of crime scene
5. Presumptive Tests (Colour/Spot Tests), Microcrystal Tests
6. Analysis of Fire Scene Evidences
7. Extraction, Isolation, Identification, Estimation procedures of Poisons from Biological Specimens
8. Prepare fingerprint card and identify the patterns.
9. Tape lifting of fingerprint.
10. Chemical methods for fingerprint development.

Learning Experience: The learning experience in the Forensic Practical I course provides students with immersive, hands-on practice in crime scene management and evidence analysis. Students engage in real-world simulations to secure crime scenes, collect physical evidence, and document scenes using sketches, photographs, and notes. They apply forensic techniques like fingerprint lifting, blood spatter analysis, and trace evidence collection while emphasizing the chain of custody and evidence integrity for courtroom use. This practical experience prepares students to handle complex forensic investigations with professionalism and precision.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination.

Examination Scheme:

Evaluation components	Weightage
Internal marks (Practical)	
I. Conduct of experiment	10 Marks
II. Lab Record	10 Marks
III. Viva Voice	20 Marks
IV. Attendance	10 Marks
II. External Marks (practical): End Term Examination	50 Marks

Textbooks:

1. A Glencoe Program Physics principles and problems: Forensic Laboratory Manual Studentedition.

2. Thomas Kubic, Nicholas Petraco Forensic Science Laboratory Manual and Workbook, ThirdEdition 2009.
3. DFSS manual, Govt. of India

Reference Books:

1. Kathy Mirakovits, Gina Londino, The Basics of Investigating Forensic Science: A LaboratoryManual 2015.
2. Washington state patrol Forensic Laboratory services: Crime Laboratory: Technical & TrainingManuals.

Open Educational Resources (OER)

1. https://www.udemy.com/course/crime-scene-investigation-reality/?
2. https://www.sifs.in/course-details/online-course-crime-scene-investigation

SYLLABUS SEMESTER 2

SEMESTER II					
BSMFBS271	**Forensic Biology and Serology**	**L**	**T**	**P**	**C**
Version		4	0	0	4
Category of Course	Core Course 6				
Total Contact Hours	60 Hours				
Pre-Requisites/ Co-Requisites	Nil				

Course Perspective: Forensic Biology and Serology explores the scientific analysis of biological evidence, including hair, body fluids, and tissues, which are fundamental in forensic investigations. The course covers the identification and examination of various biological materials, such as blood, semen, saliva, and urine, as well as techniques for determining species origin and individualization. It emphasizes the integration of serological methods and molecular techniques to analyze biological samples for crime scene reconstruction. Students will learn both theoretical concepts and practical applications, including the collection, preservation, and analysis of biological evidence, bloodstain pattern analysis, and the forensic significance of body fluids in legal investigations. The course prepares students to apply these techniques in solving criminal cases and ensuring accurate forensic interpretations.

Course Outcome: Students will be able to:

1. **Remember** and recall the fundamental principles of forensic biology, including the structure and composition of biological evidence such as hair, blood, and body fluids.
2. **Understand** the importance and application of forensic biology and serology in crime scene analysis, personal identification, and legal investigations.
3. **Apply** knowledge of biological evidence collection techniques, such as sampling of body fluids and DNA extraction, in forensic investigations and criminal cases.
4. **Analyze** various biological samples, including blood, saliva, semen, and urine, and use appropriate techniques for their identification, preservation, and forensic interpretation.

5. **Evaluate** the significance of serological techniques, bloodstain pattern analysis, and DNA profiling in personal identification and forensic casework, ensuring accurate analysis and reporting in criminal investigations.

Course Content
Unit I: Biological Evidences: Introduction, Identification and Examination of Hair: Nature, Development, Structure, Species Origin, Individualization and Examination, Variation in different major population groups, Somatic Origin. Body Fluids: Brief Introduction, Types, Location, Collection and Forensic significance.
Unit II: Bloodstain Pattern Analysis Principles and methods for analyzing bloodstain patterns Applications in crime scene reconstruction and interpretation Identification of Body Fluids: Methods for identifying saliva, semen, urine, and other body fluids, Interpretation of results in forensic contexts
Unit III: Forensic Entomology Definition, Nature and Arthropod Biology, Insects of Forensic Importance, Collection of Entomological Evidences during Death Investigations, the Role of Aquatic Insects in Forensic Investigations, Insect Succession on Carrion and its Relationship to Determine Time Since Death, its Application to Forensic Entomology.
Unit IV: Forensic Microbiology: Nature, Importance, Identification of Microbial Organisms and Collection from Crime Scene, Role of Microbial Organisms in Bioterrorism. Standards and protocols for quality assurance in forensic laboratories Validation of methods and procedures in forensic biology and serology. Quantitative and qualitative research methodologies in forensic biology Case studies and research projects on current topics in forensic biology

Learning Experience: The **F**orensic Biology and Serology course offers a hands-on learning experience where students actively engage in the collection, preservation, and analysis of biological evidence such as blood and body fluids. Through lab-based activities, they practice serological testing and DNA analysis, simulating real-world forensic investigations. Case studies and practical exercises help students apply theoretical concepts to crime scene reconstruction, fostering critical thinking and problem-solving skills essential in forensic biology. This experience prepares them for real forensic challenges by combining technical

proficiency with analytical interpretation.course offers a hands-on learning experience where students actively engage in the collection, preservation, and analysis of biological evidence such as blood and body fluids. Through lab-based activities, they practice serological testing and DNA analysis, simulating real-world forensic investigations. Case studies and practical exercises help students apply theoretical concepts to crime scene reconstruction, fostering critical thinking and problem-solving skills essential in forensic biology. This experience prepares them for real forensic challenges by combining technical proficiency with analytical interpretation.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Evaluation Component	**Weightage**
Internal Marks (Theory): - **I) Continuous Assessment (40 Marks)** **(All the components to be evenly spaced)** Projects/ Quizzes/ Assignments and Essays/ Presentations/ lab work/design sprints/case write up/studio critiques/reflective blogs/peer reviews (minimum of five components to be covered)	40 Marks
Mid Term Exam	20 Marks
External Marks (Theory): – End Term Examination	40 Marks

Textbooks

1. Byrd, J. H and Castner, J. L. Forensic Entomology 2nd ed. CRC Press,London, 2009.
2. Chowdhuri, S. Forensic Biology. BPR&D, Govt. of India, 1971.
3. Lundquist, F. and Curry, A. S. (1965) Methods of Forensic Science.Interscience Publisher, New York, 1962.
4. Robertson, J. R. (Eds) Forensic Examination of Hair. CRC Press, London, 2002.

Reference Books:

1. Safersstein, R. (Ed) Forensic Science Handbook, Vol. III, 2nd ed. Prentice Hall, New Jersey.

2. Saferstein, R. and Hall, A. B. Forensic Science Handbook, Vol I, 3rd ed. Prentice Hall, CRC Press, Boca Raton, 2020.
3. Saferstein, R. Forensic Science Hand Book, Vol I. Pearson, 2001.

Open Educational Resources (OER)

1. **Coursera:** https://www.coursera.org/
2. **edX:** https://www.edx.org/

SEMESTER II					
BSMFFM272	**Forensic Medicine and Psychology**	**L**	**T**	**P**	**C**
Version		**3**	**0**	**0**	**3**
Category of Course	**Core Course 7**				
Total Contact Hours	**60 Hours**				
Pre-Requisites/ Co-Requisites	**Nil**				

Course Perspective: Forensic Medicine and Psychology delves into the intersection of medical science and psychology within the realm of forensic investigations. The course covers the medico-legal examination of injuries, cause of death analysis, post-mortem procedures, and the forensic evaluation of poisons, trauma, and sudden deaths. It also explores the psychological dimensions of crime, focusing on criminal behavior, mental health assessments, and the impact of psychological factors in criminal acts. Through a combination of theoretical knowledge and practical case studies, students will learn to assess forensic medical evidence and psychological profiles, preparing them to apply these insights in legal, criminal, and investigative contexts. This course equips students with the skills to interpret both physical and psychological evidence, bridging the gap between forensic science, medicine, and psychology.

Course Outcomes: Students will be able to:

1. **Remember** and recall fundamental concepts of forensic medicine, including post-mortem examination, cause of death determination, and injury analysis in forensic investigations.
2. **Understand** the medico-legal aspects of injuries, poisoning, and sudden death, and apply this knowledge in legal and investigative contexts.
3. **Apply** principles of forensic psychology to assess criminal behavior, mental health evaluations, and the psychological factors influencing criminal actions.
4. **Analyze** and interpret forensic medical evidence, such as autopsy findings, toxicology reports, and psychological assessments, for use in court cases and criminal investigations.
5. **Evaluate** the role of forensic psychology and medicine in criminal profiling, insanity defense, victimology, and rehabilitation, providing critical insights into both criminal and legal processes.

Course Contents
Unit I: Forensic Medicine Personal identification of living and dead, Postmortem examination (autopsy), Medico legal aspects of death, Causes of death, Postmortem changes and their importance in determination of time after death, Immediate change, Early changes (Rigor mortis-postmortem hypostasis-Body cooling), Estimation of time of Death, Late Changes- (Decomposition, Adipocere, Mummification),

Mechanical injuries, Thermal injuries, Medico legal aspects of injuries
Unit II: Autopsy and injuries Ante and Post – mortem examinations; external examination; internal examination; collection, preservation and packaging of viscera, Assessing and determining the time and cause of Death, Study of burnt bones and bone fragments. Introduction to wounds; definition, Mechanism of wound production & healing, Determining the age of the injury, and its medico - legal aspects. Injuries: Abrasions, Bruises, Lacerations; causes, dimensions, ante – mortem & post – mortem injuries and its medico - legal aspects, Incised, Stab, Punctured wounds - causes, dimensions, ante – mortem& post – mortem injuries ante – mortem & post – mortem injuries.
Unit III: Forensic pathology Preservation of pathological evidence, Examination of decomposed, mutilated and burnt bodies, Exhumation procedure, Deaths from poisoning, Mechanical Asphyxia, Drowning, Starvation, Lightning, and Electrocution
Unit IV: Forensic Psychology Definition, history, and scope of forensic psychology Ethical issues and professional standards in forensic practice Role of forensic psychologists in legal and criminal justice systems. Forensic Psychology and the Law, Ethical Issues in Forensic Psychology, Civil and criminal case assessment, Assessing mental competency, Mental disorders and Forensic Psychology, Eye witness testimony, Criminal profiling- need and types, Forensic Scientific evidence, Crime and Psychopathology, Genetics and Crime, Serial murders, Modus Operandi. Polygraph: Historical aspects of Polygraph, Principles of polygraph, psycho physiological aspects, operational aspects, Question formulation techniques, Interviewing technique procedure, The Art-Polygraph, Legal and Ethical aspects, Human rights of individual. Narco-Analysis: Historical aspects, Principle and Theory, General Procedure –Legal and Ethical aspects, Human rights of individual. Brain Electrical Oscillation Signature (BEOS) Profiling: Principle and Theory, General Procedure – Legal and Ethical aspects, Human rights of individual.

Learning Experience: In the Forensic Medicine and Psychology course, students will have a comprehensive learning experience through a combination of lectures, case studies, and practical exercises. They will gain hands-on experience in conducting post-mortem examinations, analyzing injuries, and determining causes of death. The course also provides

exposure to psychological assessments, including profiling criminal behavior and evaluating the mental health of offenders. By analyzing real-life forensic cases, students will develop critical thinking and diagnostic skills, learning to interpret both medical and psychological evidence. This experience prepares students to address medico-legal challenges and apply their expertise in crime scene investigations, courtroom testimony, and psychological evaluations in forensic contexts.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Evaluation Component	**Weightage**
Internal Marks (Theory): - **I) Continuous Assessment (40 Marks)** **(All the components to be evenly spaced)** Projects/ Quizzes/ Assignments and Essays/ Presentations/ lab work/design sprints/case write up/studio critiques/reflective blogs/peer reviews (minimum of five components to be covered)	40 Marks
Mid Term Exam	20 Marks
External Marks (Theory): – End Term Examination	40 Marks

Textbooks

1. Pillay, V.V., Handbook of Forensic Medicine and Toxicology , 12th ed., Paras Publication2001.
2. Modi, J. P., Textbook of Medical Jurisprudence & Toxicology , M.M. Tripathi Publication, (2001)
3. Parikh, C.K. , Textbook of Medical Jurisprudence & Toxicology
4. Forensic Science in Criminal Investigation & Trials – B.R.Sharma.
5. The Hand Book of Forensic Psychology – Weiner Hass

Reference Books

1. Reddy Narayn,. M., Textbook of Medical Jurisprudence & Toxicology
2. James, P.J.: Encyclopedia of Forensic and Legal Medicine, Elsevier, 2005
3. Hand Book of Polygraph Testing – M.Kloinen 9.Detecting Lies & Deceit – A.Vri

Open Educational Resources (OER)

1. Open Educational Resources (OER) Commons: https://oercommons.org/
2. National Institutes of Justice: https://nij.ojp.gov/
3. American Psychology Association (APA): https://www.apa.org/ethics/code

SEMESTER II					
BSMFNC273	**Network Security and Cyber Defence**	**L**	**T**	**P**	**C**
Version		**3**	**0**	**0**	**3**
Category of Course	**Core Course 8**				
Total Contact Hours	**45 Hours**				
Pre-Requisites/ Co-Requisites	**Nil**				

Course Perspective: The Network Security and cyber defence course provides a comprehensive understanding of the principles, practices, and technologies that secure computer networks. It introduces students to the goals of network security, including confidentiality, integrity, and availability, and explores various threats and vulnerabilities. The course delves into key security mechanisms like encryption, authentication, firewalls, VPNs, and IDS/IPS systems, along with secure network protocols. Students will also learn about emerging areas like cloud security, IoT security, and blockchain security. Ethical hacking and penetration testing are emphasized to provide a hands-on understanding of cyber defense tools and methodologies, while also covering the legal and ethical dimensions of cybersecurity.

Course Outcome: On the completion of the course, students will be able to:

1. **Remember** the fundamental concepts, goals, threats, and vulnerabilities of network security and cyber defence.

2. **Understand** the principles of cryptography, authentication, firewalls, VPNs, IDS/IPS, and secure network protocols.
3. **Apply** cryptographic techniques, configure firewalls/VPNs, and apply intrusion detection and prevention systems to secure network infrastructures.
4. **Analyze** cyber threats, analyze incident response processes, and differentiate between security mechanisms in diverse network environments including cloud, IoT, and blockchain.
5. **Evaluate** the effectiveness of network security architectures, penetration testing strategies, and compliance frameworks to recommend robust cyber defense measures.

Course Contents
Unit I: Introduction to Network Security: Definition and Importance, Threats and Vulnerabilities, Goals of Network Security: Confidentiality, Integrity, and Availability, Network Security Models and Architectures, OSI and TCP/IP Models, Defense in Depth, Security Architecture, Cryptography in Network Security**,** Symmetric and Asymmetric Encryption, Key Management, Hash Functions and Digital Signatures, Authentication and Access Control, Authentication Methods: Passwords, Biometrics, Multi-Factor Authentication, Authorization and Access Control Models
Unit II: Firewalls and VPNs: Types of Firewalls: Packet-Filtering, Stateful, Proxy, Virtual Private Networks (VPNs): IPSec, SSL/TLS, Intrusion Detection and Prevention Systems (IDS/IPS), Types of IDS/IPS: Network-Based, Host-Based, Detection Methods: Signature-Based, Anomaly-Based, Deployment and Management, Secure Network Protocols, Secure HTTP (HTTPS), Secure Shell (SSH), Secure Email Protocols, Wireless Network Security, Wireless Encryption Protocols, Security Challenges in Wireless Networks, Best Practices for Securing Wireless Networks
Unit III: Cyber Threat Intelligence and Incident Response: Sources and Types, Incident Response Lifecycle, Forensics and Evidence Collection, **Security in Emerging Technologies**, Cloud Security: Challenges and Solutions, IoT Security: Vulnerabilities and Defense Mechanisms, Blockchain Security
Unit IV: Ethical hacking: Overview of Ethical Hacking, Penetration Testing Methodology, Tools and Techniques for Penetration Testing, Cybersecurity Laws and Regulations, Ethical Considerations in Cyber Defense, Compliance Frameworks

Learning Experience: In the Network Security course, students will gain hands-on experience in protecting networks from threats through interactive lab exercises and real-world case studies. They will explore encryption techniques, configure firewalls, and establish secure VPN connections to safeguard network communications. Practical sessions will involve deploying intrusion detection and prevention systems (IDS/IPS) and analyzing network traffic for anomalies. Students will also engage in ethical hacking and penetration testing, using industry-standard tools to assess and strengthen network defenses. The course's comprehensive coverage of cloud security, IoT security, and emerging technologies equips students with the skills to address modern cybersecurity challenges. This practical and immersive learning experience prepares students to effectively secure networks and respond to cyber incidents.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Evaluation Component	**Weightage**
Internal Marks (Theory): - **I) Continuous Assessment (40 Marks)** **(All the components to be evenly spaced)** Projects/ Quizzes/ Assignments and Essays/ Presentations/ lab work/design sprints/case write up/studio critiques/reflective blogs/peer reviews (minimum of five components to be covered)	40 Marks
Mid Term Exam	20 Marks
External Marks (Theory): – End Term Examination	40 Marks

Textbooks

1. Naseer, I. (2020). Cyber Defense for Data Protection and Enhancing Cyber Security Networks for Military and Government Organizations. *MZ Computing Journal*, *1*(1).
2. Zheng, Y., Li, Z., Xu, X., & Zhao, Q. (2022). Dynamic defenses in cyber security: Techniques, methods and challenges. *Digital Communications and Networks*, *8*(4), 422-435.

Reference Books

1.Atighetchi, M., Pal, P., Webber, F., & Jones, C. (2003, May). Adaptive use of network-centric mechanisms in cyber-defense. In *Sixth IEEE International Symposium on Object-Oriented Real-Time Distributed Computing, 2003.* (pp. 183-192). IEEE.

2. Lu, Z., Wang, C., & Zhao, S. (2020). Cyber deception for computer and network security: Survey and challenges. *arXiv preprint arXiv:2007.14497*.

SEMESTER II					
BSMFQD274	**Questioned Document**	**L**	**T**	**P**	**C**
Version		**4**	**0**	**0**	**4**
Category of Course	**Core Course 9**				
Total Contact Hours	**60 Hours**				
Pre-Requisites/ Co-Requisites	**Nil**				

Course Perspective: Questioned Document Examination focuses on the scientific analysis and authentication of documents for forensic purposes. This course introduces students to the principles and techniques used to examine handwriting, signatures, printed text, and other types of documents to detect alterations, forgeries, and fraud. Students will learn about various tools and methods, such as microscopy, electrostatic detection apparatus (ESDA), and digital imaging, to analyze ink, paper, and writing instruments. The course emphasizes both the theoretical understanding and practical application of document examination, preparing

students to assess the authenticity and integrity of questioned documents in legal and criminal investigations.

Course Outcomes: The Students will be able to:

1. **Remember** and recall the fundamental principles of document examination, including handwriting, signature analysis, and the identification of fraudulent documents.
2. **Understand** the significance of questioned document analysis in forensic investigations, including the evaluation of ink, paper, and printing techniques.
3. **Apply** forensic techniques such as handwriting comparison, detection of document alterations, and the use of advanced instruments like ESDA and VSC in the analysis of questioned documents.
4. **Analyze** questioned documents for signs of forgery, erasures, and tampering, using both traditional and digital methods to authenticate documents in criminal cases.
5. **Evaluate** the results of questioned document examinations and present findings in forensic reports for legal and investigative purposes.

Course Contents
Unit I: Introduction to Questioned Documents Care, handling, preservation, packing, marking and forwarding of forensic documents. Analysis of paper & inks. Determination of sequence of intersecting strokes. Preliminary examination of documents. Comparison of alphabets and numerals. Examination of Document under various light sources. Nature & scope of Forensic Document Examination and its limitations. Classification of forensic documents. Various writing features. Natural variations and disguise in hand writing Principle of handwriting identification. Procurement of standards for comparison. Comparison of like with like, suitability of standards for comparison. Effect of intrinsic & extrinsic factors on Handwriting
Unit II: Document analysis General and individual writing characteristics, definition and their estimation. Simon New Comb Theory of probability and its application in document examination. Determination of absolute and relative age of documents. Examination of anonymous letter. Applications of Forensic Linguistics & Stylistics in Document Examination. Types of forgeries and their detection, characteristics of genuine & forged signatures. Difference between tremors of fraud and genuine tremors in writings and signatures. Identification of manipulations in written, typed and computer printouts, identification of digitally manipulated documents. Detection and decipherment of alterations including additions, over writings,

obliterations, erasures and secret writings.
Unit III: Typewritten and Computer-generated documents Principle, working and identifying features of various printers, Various conventional printing processes-their identifying features. Examination of photo copies and scanned documents. Examination of genuine & counterfeit – Indian Bank Notes, MRTDs and Plastic Cards
Unit IV: Laws and Legal Framework in Forensic Document Examination (as per BNS & BSA, 2023) Relevant Provisions under Bhartiya Nyaya Sanhita (BNS),2023–Forgery and making of false documents: Sections 336-344 (Covering forgery of valuable securities, wills, public records). Cheating and fraud: Sections 318-323. Criminal conspiracy and common intention: Section 61,62. Counterfeit Currency and Stamps: Section 178-181. NABL guidelines accreditation of Forensic Science laboratories. Safety management in document laboratories Final examination and report writing –different types of opinion writing and writing of reasons for opinion, importance of no opinion / qualified opinion. Debonair of expert and preparation for presentation of evidence in trial courts, examination-in-chief, cross examination by defense and cross examination by expert. Advances in Forensic Document Examination.

Learning Experience: In the Questioned Document course, students will engage in practical, hands-on experiences that emphasize the analysis and authentication of documents. Through lab-based activities, they will learn techniques for examining handwriting, signatures, and detecting forgeries or alterations in documents using advanced forensic tools such as magnification devices, VSC (Video Spectral Comparator), and ESDA (Electrostatic Detection Apparatus). Students will work on real-life case scenarios to analyze ink, paper, and writing instruments, enhancing their ability to identify fraudulent documents and tampering. This immersive experience will strengthen their skills in document comparison, preparing them to deliver expert opinions in legal and investigative contexts involving questioned documents.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Evaluation Component	**Weightage**
Internal Marks (Theory): -	

I) Continuous Assessment (40 Marks) **(All the components to be evenly spaced)** Projects/ Quizzes/ Assignments and Essays/ Presentations/ lab work/design sprints/case write up/studio critiques/reflective blogs/peer reviews (minimum of five components to be covered)	40 Marks
Mid Term Exam	20 Marks
External Marks (Theory): – End Term Examination	40 Marks

Textbooks:

1. Albert, S. Osborn, Questioned Documents, Second Ed., Universal Law Publishing, Delhi, 1998.
2. Charles, C. Thomas, I.S.Q.D. Identification System for Questioned Documents, Billy Prior Bates,Springfield, Illinois, USA, 1971.
3. Kelly, J. S. Lindblom, B. S. (2006). Science, Handwriting Examination and the Courts. Scientific Examinations of Questioned Documents, 2nd edition, CRC Press, Taylor & Francis group.

Reference Books:

1. Huber, A. R. Headrick, A. M. (1999). The Discrimination and Identification of writing. Handwriting Identification Facts and Fundamentals, CRC Press, Boca Raton London.
2. James, S. H. And Nordby, J. J. (Eds), Forensic Science; An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.
3. Saferstein, Richard, Criminalistics - An Introduction to Forensic Science, 6th Ed. Prentice-Hall,New Jersey, 1998.

Open Educational Resources (OER):

1. https://oercommons.org/
2. https://ocw.mit.edu/
3. https://openstax.org/

SEMESTER II					
BSMFFB275	**Forensic Ballistics and Explosives**	**L**	**T**	**P**	**C**
Version		**3**	**0**	**0**	**3**
Category of Course	**Core Course 10**				
Total Contact Hours	**45 Hours**				
Pre-Requisites/ Co-Requisites	**Nil**				

Course Perspective: Forensic Ballistics and Explosives explores the science behind firearms, ammunition, and explosive devices in the context of forensic investigations. The course covers the principles of internal, external, and terminal ballistics, as well as the analysis of firearms, bullet trajectories, and gunshot residues. Students will also learn about the examination and identification of explosives, including the reconstruction of blast scenes and the analysis of explosive residues. Through practical case studies and laboratory work, students will gain the technical skills necessary for investigating shooting incidents and bombings, as well as interpreting ballistic and explosive evidence for legal and investigative purposes with the help of various techniques.

Course Outcome: Students will be able to:

1. **Remember** and recall the fundamental concepts of internal, external, and terminal ballistics, as well as the types and mechanisms of firearms and explosives.
2. **Understand** the forensic significance of ballistics and explosive analysis in crime scene investigations, including the examination of firearms, ammunition, and explosive devices.
3. **Apply** ballistic and explosive examination techniques, such as firearm identification, gunshot residue analysis, and explosive residue detection, in forensic investigations.
4. **Analyze** ballistic and explosive evidence, including bullet trajectories, impact patterns, and explosion dynamics, to reconstruct crime scenes involving shootings or bombings.
5. **Evaluate** forensic ballistic and explosive findings, interpret the results for legal proceedings, and present expert opinions on firearms, ammunition, and explosive-related cases.

Course Contents
Unit I: History& Development of Fire Arms Introduction, Early History of Firearms, The Fifteenth Century Match Lock, Sixteenth & Seventeenth Century Small Arms, The Age of the Flint Lock, The Percussion Lock Firearms. **Firearms:** Classification, details of various Small Arms used in Crime – Shotguns, Rifles, Revolvers, Pistols, Carbines, Improvised Firearms. Firing Mechanism of Smooth Bored Firearms, Bore and Calibre, Choke, Suppressor, Automatic Mechanisms employed in Small Arms, Rifling – Class Characteristics of Rifled Bore, Purpose of Rifling, Types of Rifling, Methods to Produce Rifling, Various Locks used in Small Arms. Classification, Nomenclature and Construction of Country Made Firearms. **Ammunition:** Types, Cartridge Components (Cartridge Case, Primer Propellant, Bullets, Pellets and Wads). Various types of Primers/ Priming Mixtures, Propellants, Shotgun Ball Ammunition, Various Types of Bullets, Head-stamp Markings. Various Physical, Ballistic & Functional Tests of Ammunitions.
Unit II: Branches of Forensic Ballistics **Internal Ballistics:** Introduction, Definition, Ignition and Burning of Propellants, Manner of Burning, Piobett's Law, Shape and Size of the Propellants, Degressive and Progressive Powders, 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, Determination of Velocity of Shot-charge, Doppler-radar Method. Shape of Bullet (Spherical Ball, Cylinder-Conical, Flat Nose, Round Nose, etc.) Ballistic Coefficient, Effective Range, Extreme Range. **Terminal Ballistics:** Definition, Interaction and Penetration of various types of Projectiles in various Tissues, various aspects of Wound Ballistics including Wounds of Entrance/ Exit/ Track of Projectile, Gunshot Injuries caused by different types of Firearm Ammunitions, Remaining Velocity, Stopping Power, Ricochet.
Unit III: Arms- Ammunition Linkage & GSR Matching of Crime & Test Bullets and Cartridge Cases in Regular Firearms, Identification of Bullets, Pellets & Wads Fired from Improvised Country Made Firearms. Automated Method of Cartridge Case and Bullet Comparison. Determination of Range of Fire, Time of Fire. Visual and Chemical, Instrumental Methods with

Special Reference to the Applications of Neutron Activation Analysis, Atomic Absorption Spectroscopy, Scanning Electron Microscopy and other Miscellaneous Methods. **Gun Shot Residues (GSR):** Mechanism of Formation of GSR, Modern Methods of Analysis of GSR from the Shooting Hand & Target with Special reference to Clothing. **Firearm Injuries:** Ballistic Aspect of Firearm Injuries, Nature, Effect on Target, Velocity, Constructional Features and Range on the Wounding, Identification of Firearm Injuries. Evaluation of Firearm Injuries, Reconstruction: Accident, Suicide, Murder and Self-defence.
Unit IV: Explosives Introduction, Classification, Composition and Characteristics of Explosives, Pyrotechnics, IEDs, Explosion Process and Affects, Types of Hazard, Effect of Blast Wave on Structures, Human, etc. Specific Approach to Scene of Explosion, Post- blast Residue Collection, Reconstruction of Sequence of Events, Evaluation and Assessment of Scene of Explosion, Systematic Examination of Explosives and Explosion Residues in the Laboratory using Chemical and Instrumental Techniques and Interpretation of Results.

Learning Experience: In the Forensic Ballistics and Explosives course, students will engage in hands-on learning through practical exercises and laboratory work, gaining direct experience in examining firearms, ammunition, and explosive materials. They will learn to handle ballistic evidence, analyze gunshot residue, and reconstruct shooting and explosion events from crime scenes. The course integrates theoretical concepts with real-life case studies, allowing students to apply forensic techniques in solving complex ballistic and explosive cases. By working with advanced tools such as ballistic imaging systems, trajectory analysis software, and explosive residue detectors, students will develop the critical skills necessary for accurately interpreting and presenting forensic evidence in legal contexts. This immersive experience prepares students to tackle real-world forensic challenges in ballistic and explosive investigations.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination

Examination Scheme:

Evaluation Component	**Weightage**
Internal Marks (Theory): - **I) Continuous Assessment (40 Marks)** **(All the components to be evenly spaced)**	

Projects/ Quizzes/ Assignments and Essays/ Presentations/ lab work/design sprints/case write up/studio critiques/reflective blogs/peer reviews (minimum of five components to be covered)	40 Marks
Mid Term Exam	20 Marks
External Marks (Theory): – End Term Examination	40 Marks

Textbooks

1. Boundreau, J.F.; Qwan, Q.Y.; Faragher, W.E. and Denault, G.C. Arson and Arson Investigation: Survey &
2. Dehaan, J.D. Kirk's Fire Investigation, 5th ed. Prentice Hall, Eaglewood Cliffs, N.J; (2002)
3. Heard, B.J. Handbook of Firearms and Ballistics. Jhon Willey, England; (1997)
4. Howard, M.J. Firearms Identification, vols. 1,2 & 3. Springfield, Illinois; (1973)
5. Johari, M. Identification of Firearms, Ammunition and Firearms Injuries. BPR& D, New Delhi; (1980)

Reference Books

1. Siddiqui, M.A. Law of Firearms & Explosives with Principles of Forensic Ballistics. Pakistan; (2018)
2. Warlow, T.A. Firearms, the Law and Forensic Ballistics. Taylor& Francis, London; (1996)
3. Working Procedure Manuals of Chemistry, Explosives and Narcotics. BPR& D Pub., New Delhi; (2000)
4. Yinon, J. and Zitrin, S. Modern Methods & Application in Analysis of Explosives. John Wiley & Sons, England; (1993)

SEMESTER II					
BSMFFP286	**Forensic Practical II**	**L**	**T**	**P**	**C**
Version		**0**	**0**	**6**	**3**
Category of Course	**Core Practical II**				
Total Contact Hours	**60 Hours**				
Pre-Requisites/ Co-Requisites	**Nil**				

Course Perspective: The Forensic Practical I course focuses on providing hands-on skills required for effectively managing and analyzing crime scenes. It covers the systematic processes involved in securing crime scenes, collecting and preserving physical evidence, and documenting the scene through sketches, photographs, and notes. Students learn to apply various forensic techniques such as fingerprint lifting, blood spatter analysis, and trace evidence collection. Emphasis is placed on maintaining the chain of custody and ensuring the integrity of evidence for courtroom presentations. Through real-world simulations, students gain practical experience in handling different crime scene scenarios, preparing them for the complexities of forensic investigations.

Course Outcome: Students will be able to:

1. **Observe** and apply techniques for analyzing paper, ink, and printing methods to assess the authenticity of questioned documents.
2. **Imitate** alterations, additions, and erasures in documents using advanced tools like UV/IR analysis and microscopy.
3. **Practice** and identify blood samples using preliminary and confirmatory chemical tests in forensic investigations.
4. **Create** slides of human hair and identify bodily fluids like semen through biological testing for forensic analysis.

Course Contents
1. Techniques for analyzing paper, ink, and printing methods
2. Methods for detecting alterations, additions, and erasures
3. Analyzing handwriting characteristics by manual and automatic procedures

4. Perform preliminary tests for blood.
5. To identify blood samples by confirmatory chemical tests.
6. To identify the given stain as semen
7. To prepare slides of scale pattern of human hair

Learning Experience: The learning experience in the Forensic Practical I, students will engage in hands-on learning through practical exercises in both document examination and biological evidence analysis. They will learn to analyze paper, ink, and printing methods, while also using advanced tools like UV/IR analysis and microscopy to detect document alterations and forgeries. Students will develop skills in handwriting analysis using manual and automated techniques, and they will perform both presumptive and confirmatory tests for identifying blood and other biological samples. The course provides a balanced mix of theoretical knowledge and laboratory experience, preparing students to effectively handle and analyze forensic evidence in real-world cases.with professionalism and precision.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination.

Examination Scheme:

Evaluation components	Weightage
Internal marks (Practical)	
I. Conduct of experiment	10 Marks
II. Lab Record	10 Marks
III. Viva Voice	20 Marks
IV. Attendance	10 Marks
II. External Marks (practical): End Term Examination	50 Marks

Textbooks:

1. A Glencoe Program Physics principles and problems: Forensic Laboratory Manual Student edition.
2. Thomas Kubic, Nicholas Petraco Forensic Science Laboratory Manual and Workbook, ThirdEdition 2009.
3. DFSS manual, Govt. of India

Reference Books:

1. Kathy Mirakovits, Gina Londino, The Basics of Investigating Forensic Science: A LaboratoryManual 2015.
2. Washington state patrol Forensic Laboratory services: Crime Laboratory: Technical & TrainingManuals.

Open Educational Resources (OER)

1. https://oercommons.org/
2. https://ocw.mit.edu/
3. https://openstax.org/

SYLLABUS-THIRD SEMESTER

BSMFTT374	**Statistical Tools and Techniques**	**L**	**T**	**P**	**C**
Version1.0	**1**	**2**	**0**	**0**	**2**
Category of Course	**Core course 14**				
Total Contact Hours	**30 hours**				
Pre-requisites/Co-requisites	**--**				

Course Perspective:

The course Statistical Tools and Techniques introduces students to the fundamentals of descriptive and inferential statistics, focusing on their application in scientific research and forensic investigations. It emphasizes quantitative reasoning, data summarization, hypothesis testing, and interpretation of results. Students will explore both theoretical concepts and practical approaches using case studies and real-life data. By the end of this course, students will develop the ability to apply appropriate statistical methods for decision-making and problem-solving in research and applied sciences.

Course Outcome: Upon successful completion of the course, students will be able to:

1. **Remember** the fundamental concepts, terminology, and measures in statistics.
2. **Understand** various descriptive and inferential statistical methods and their applications.
3. **Apply** appropriate statistical tools and techniques to organize, analyze, and interpret data.
4. **Analyze** different statistical tests and techniques for solving scientific and forensic problems.

5. **Evaluate** assess statistical results to support research findings and evidence-based decision making.

Course Contents
Unit 1: Introduction to statistics Definition, importance, and scope of statistics in science and research. Types of data: qualitative vs quantitative, discrete vs continuous. Data collection, classification, tabulation, and graphical representation (histogram, bar chart, pie chart, frequency polygon).
Unit II: Descriptive Statistics: Measures of Central Tendency: Mean, Median and Mode. Measures of Dispersion : Range , variance, Standard Deviation, Coefficient of Variation, Skewness and Kurtosis. Introduction to correlation (Pearson and Spearman) and Simple Linear regression
Unit III: Probability and Distribution Concepts of probability, conditional probability, and Bayes' theorem.Random variables and distributions. Binomial, Poisson, and Normal distributions (properties and applications) Sampling distributions and standard error.
Unit IV: Hypothesis Testing and Small Sample tests Concept of hypothesis: null and alternative, Type I & Type II errors, significance level, p-value. **Large sample tests (Z-tests):**Test for single mean.Test for difference of means. Test for single proportion. Test for difference of proportions. **Student's t-tests (small samples):Chi-square tests: Fisher's exact test** for small sample contingency tables **F-test for equality of variances.**
Unit V: Analysis of Variance and Advanced Techniques Concept of Analysis of Variance (ANOVA).Computational procedures: .one way classification and two way classification. Post-hoc multiple comparison tests (Tukey, Bonferroni) .Applications in scientific and forensic research. Introduction to software tools (Excel/SPSS/R) for statistical analysis.

Learning Experience:

Students will engage in lectures, problem-solving sessions, and practical demonstrations using datasets. Real-world examples from forensic science, biology, and social sciences will

be included to contextualize statistical applications. Hands-on practice with statistical software will enable students to perform data analysis, interpret outputs, and report findings. Critical thinking will be developed through assignments, quizzes, and case-based discussions.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination.

Examination Scheme:

Evaluation Component	**Weightage**
Internal Marks (Theory): - **I) Continuous Assessment (40 Marks)** **(All the components to be evenly spaced)** Projects/ Quizzes/ Assignments and Essays/ Presentations/ lab work/design sprints/case write up/studio critiques/reflective blogs/peer reviews (minimum of five components to be covered)	40 Marks
Mid Term Exam	20 Marks
External Marks (Theory): – End Term Examination	40 Marks

Textbooks

1. Gupta, S.C., & Kapoor, V.K. *Fundamentals of Mathematical Statistics*. Sultan Chand & Sons.
2. Goon, A.M., Gupta, M.K., & Dasgupta, B. *Fundamentals of Statistics*. World Press.
3. Daniel, W.W. *Biostatistics: A Foundation for Analysis in the Health Sciences*. Wiley.

Reference Books

1. Montgomery, D.C., & Runger, G.C. *Applied Statistics and Probability for Engineers*. Wiley.
2. Miller, I., & Miller, M. *Mathematical Statistics with Applications*. Pearson.
3. Anderson, D.R., Sweeney, D.J., & Williams, T.A. *Statistics for Business and Economics*. Cengage Learning.
4. Ross, S.M. *Introduction to Probability and Statistics for Engineers and Scientists*. Academic Press.
5. Zar, J.H. *Biostatistical Analysis*. Pearson Education.

Open Educational Resources (OER)

https://www.khanacademy.org/math/statistics-probability

https://ocw.mit.edu/courses/res-6-012-introduction-to-probability-spring-2018/

https://nptel.ac.in/courses/111/104/111104094/

https://www.coursera.org/learn/basic-statistics

BSMFRW375	**Forensic Research methods and Analytical Report Writing**	**L**	**T**	**P**	**C**
Version1.0		2	0	0	2
Category of Course	Core Course 15				
Total Contact Hours	60 hours				
Pre-requisites/Co-requisites	**--**				

Course Perspective:

This course introduces students to the principles of research methodology and analytical report writing in the field of forensic sciences. It emphasizes problem identification, research design, data collection, and statistical analysis, along with ethical considerations in forensic research. Students will also learn the essentials of technical and analytical writing, including structuring research papers, preparing laboratory reports, and drafting expert opinions. The

course develops professional skills for presenting forensic evidence through well-structured reports and oral presentations, preparing students for both academic research and real-world forensic practice.

Course Outcome:

Upon successful completion of the course, students will be able to:

1.Remember fundamental concepts of research methodology, research ethics, and types of forensic research.

2. **Understand the** various research designs, data collection methods, and approaches to scientific writing.

3. **Apply** appropriate statistical and analytical tools to interpret research data and prepare structured forensic reports.

4. **Analyze** research findings, assess data reliability, and identify limitations in forensic research.

5**. Evaluate** well-reasoned analytical reports, expert opinions, and research outputs for academic, investigative, and judicial purposes.

Course Contents
Unit I: Fundamentals of Research in Forensic Science Definition, scope, and objectives of research. Types of research: qualitative, quantitative, applied, and forensic-specific.Research process: problem identification, literature review, formulation of hypothesis. Ethical issues in forensic research (consent, bias, plagiarism, confidentiality).
Unit II: Research Design and Data Collection Research designs: descriptive, experimental, case-control, cohort, cross-sectional.Sampling techniques: probability and non-probability. Tools for data collection: questionnaires, interviews, case studies, laboratory experiments. Data coding, entry, and cleaning.
Unit III: Data analysis and Interpretation

Descriptive and inferential statistics in forensic research.Hypothesis testing, correlation, regression, and ANOVA Use of statistical software (SPSS, R, Excel) for forensic datasets. Interpretation of results and presentation of findings.
Unit IV: Analytical and Technical Report writing Principles of technical writing: clarity, coherence, and precision.Structure of research papers, dissertations, and technical reports.Components of forensic laboratory reports: introduction, methods, observations, results, and discussion.Drafting of expert opinions and importance of "qualified opinion" or "no opinion."Referencing styles (APA, Vancouver, IEEE) and use of reference managers.
Unit V: Presentation and Dissemination of Forensic Research Report formatting, tables, figures, and annexures. Oral and poster presentations of research findings. Preparation for testimony: expert witness demeanor, examination-in-chief, cross-examination. Publication ethics and plagiarism detection tools.Emerging trends in forensic research dissemination (open access, preprints, digital repositories).

Learning Experience:

Students will learn through lectures, hands-on workshops, and case-based discussions. Practical sessions will involve designing small-scale research proposals, applying statistical tools to forensic datasets, and preparing mock forensic reports. Students will also participate in simulated courtroom exercises to practice expert testimony. Assignments will include literature reviews, short research reports, and critical analysis of published forensic research papers.

Modes of Evaluation: Quiz/Assignment/ presentation/ extempore/ Written Examination.
Examination Scheme:

Textbooks:

1. Kothari, C.R. *Research Methodology: Methods and Techniques*. New Age International Publishers.

2. Babbie, E. *The Practice of Social Research*. Cengage Learning.
3. Day, R.A. & Gastel, B. *How to Write and Publish a Scientific Paper*. Cambridge University Press.
4. Buckwalter, J.A. *Writing Scientific Manuscripts: A Guide for Undergraduates*. Springer.

Reference Books:

1. Creswell, J.W. & Creswell, J.D. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. SAGE Publications.
2. Thyer, B.A. *The Handbook of Social Work Research Methods*. SAGE Publications.
3. American Psychological Association. *Publication Manual of the APA (7th Edition)*.
4. Huff, D. *How to Lie with Statistics*. W.W. Norton & Company.
5. Badenhorst, C. *Research Writing: Breaking the Barriers*. Van Schaik Publishers.

Open Educational Resources (OER):

https://nptel.ac.in/courses/127/105/127105005/

https://ocw.mit.edu/search/?q=research+methods

https://www.edx.org/course/data-analysis-for-forensic-science

https://open.umn.edu/opentextbooks/textbooks/research-methods-for-the-social-sciences

Specialization-A: Forensic Physics and Ballistics

BSMFLS371	**Lasers & Spectroscopy**	**L**	**T**	**P**	**C**
Version	**2.0**	**3**	**0**	**0**	**3**
Category of Course	**Major**				
Total Contact Hours	**45 Hours (Theory)**				
Pre-requisites/ Co-requisites					

Course Perspective

This course introduces students to the principles and applications of lasers and spectroscopy, including vacuum science and optical fiber technologies. It emphasizes instrumentation, experimental setups, and real-world forensic applications.

Upon successful completion of the course, students will be able to:

CO1: Remember the light sources and basic components of an optical spectrometer.

CO2: Understand the operation and principles of light detectors and gratings.

CO3: Apply the use of vacuum pumps and gauges in relevant scientific processes.

CO4: Analyse optical fibers and their communication advantages in modern technology.

CO5: Evaluate the application of spectroscopic techniques in forensic investigation.

Detailed Syllabus

Course Contents
Section I: Light Sources and Spectrometer
CW & pulsed light sources (Lasers), Sodium lamp, a brief review of Lasers, Q-switching and Mode locking to generate short and ultra-short laser pulses, Laser output profile. Prisms and gratings, Czerny-Turner Spectrometer/Monochromator, Resolution and dispersion of Prism and grating spectrometer, Charge Coupled Devices (CCD), Photodiodes and Photomultiplier tubes.
Section II: Vacuum Science and Technology
Types of Vacuum and different flow regimes, Conductance, pumping speed and Throughput, Creation of vacuum: Vacuum pumps, Rotary vane pump and Turbo-molecular pump, measuring the vacuum: Pirani and Penning gauges, Vacuum chamber and their components, Requirement of vacuum for an experiment (e.g. CRT, Fragmentation studies of a molecule etc.).
Section III: Optical Fibers
Advantages of optical fiber communication over normal medium, Step index and graded-index fibers, Numerical aperture, single mode and multimode fiber. Relative refractive index, losses in optical fiber communication.
Section IV: Spectroscopic Technique
Absorption and emission spectroscopy, Raman Spectroscopy and its application. Principle of Fourier Transform Infrared (FTIR) spectroscopy, Fluorescence spectroscopy, Laser Induced Breakdown Spectroscopy, Application of laser spectroscopy.

Learning Experience

Students will gain hands-on experience with spectroscopic instruments, vacuum systems, and fiber optics. The course bridges theoretical knowledge with practical forensic applications, preparing students for advanced research and fieldwork.

Textbooks

1. Laser Fundamentals, William T. Silfvast, 2008, Cambridge University Press.
2. Laser Spectroscopy 1: Basic Principles, Wolfgang Demtröder, 2014, 5th edition, Springer.
3. Laser Spectroscopy 2: Experimental Techniques, Wolfgang Demtröder, 2016, 5th edition, Springer.

Suggested Readings

1. Vacuum Physics and Techniques, T. A. Delchar, Chapman and Hall.
2. Introduction to Fibre Optics, A. K. Ghatak & K. Thyagarajan, 1998, Cambridge University Press.

Open Educational Resources

1. National Forensic Sciences University (NFSU) online modules and Laboratory Safety Training.
2. Open access lectures on forensic chemistry by SWAYAM (Government of India).
3. WHO and CDC resources on poisoning and chemical safety.
4. Open textbook: Introduction to Forensic Chemistry (Westminster College OER).
5. Forensic Magazine's online articles and case studies.

Evaluation components	**Weightage**
Internal marks (Theory) **I. continuous assessment (30 marks)** **All the components to be evenly spaced** **Project/quizzes/assignment and essays/presentation/ participation/case studies/reflective journals (minimum of five**	**40 Marks**

components to be evaluated)	
II. internal marks (Theory): **Mid Term Examination**	**20 Marks**
III. External Marks (Theory): **End Term Examination**	**40 Marks**

BSMFLS386	**Lasers & Spectroscopy- PRACTICAL**	**L**	**T**	**P**	**C**
Version	**1.0**	**0**	**0**	**2**	**1**
Category of Course	**Major**				
Total Contact Hours	**30 Hours (Practical)**				
Pre-requisites/ Co-					

requisites	

Course Perspective

This practical course complements the theoretical understanding of lasers and spectroscopy by providing hands-on experience with optical components, laser systems, spectrometers, vacuum pumps, and fiber optics. Students will engage in simplified experiments that reinforce core concepts and develop skills in operating scientific instruments relevant to forensic applications.

Course Outcomes

Upon successful completion of the course, students will be able to:

CO1: Remember the basic components of laser systems and spectrometers.

CO2: Understand how to apply spectroscopic techniques to analyze simple forensic samples.

CO3: Apply the techniques to record and interpret basic absorption and fluorescence spectra.

CO4: Analyse experimental results and relate them to theoretical principles.

CO5: Evaluate their observational and analytical skills through practical experimentation.

List of Practicals

1. Identification of Laser Components
2. Demonstration of Laser Beam Reflection and Refraction using mirrors and lenses
3. Measurement of Laser Spot Size at Different Distances
4. Study of Diffraction Using a Laser and Grating
5. Basic Operation of a Vacuum Pump
6. Visual Demonstration of Optical Fiber Light Transmission
7. Recording a Simple Absorption Spectrum Using a Colorimeter of colored solutions at different wavelengths
8. Demonstration of Fluorescence using a UV lamp to observe fluorescence in tonic water, detergent, or highlighters
9. Identification of Laser Components
10. Demonstration of Laser Beam Reflection and Refraction using mirrors and lenses

Learning Experience

Students will gain hands-on experience with basic optical and spectroscopic instruments. The course emphasizes simplified and accessible experiments that reinforce theoretical concepts. Through guided lab sessions, students will develop practical skills in handling lasers, spectrometers, vacuum systems, and fiber optics. Collaborative learning and real-world demonstrations will enhance their understanding of forensic applications.

Textbooks:

1. Laser Fundamentals – William T. Silfvast, Cambridge University Press
2. Laser Spectroscopy 1: Basic Principles – Wolfgang Demtröder, Springer
3. Laser Spectroscopy 2: Experimental Techniques – Wolfgang Demtröder, Springer
4. Vacuum Physics and Techniques – T. A. Delchar, Chapman and Hall
5. Introduction to Fibre Optics – A. K. Ghatak & K. Thyagarajan, Cambridge University Press

Suggested Readings:

1. Forensic Instrumentation Manuals
2. SWAYAM Lectures on Spectroscopy
3. Open Textbook: Introduction to Forensic Chemistry
4. Forensic Magazine Articles and Case Studies

Open Educational Resources (OER):

1. National Forensic Sciences University (NFSU) online modules
2. SWAYAM online courses on spectroscopy and instrumentation
3. MIT OpenCourseWare: Optics and Spectroscopy
4. WHO and CDC resources on chemical safety

Modes of Evaluation:

Quiz / Assignment / Presentation / Extempore / Written Examination

Examination Scheme:

Evaluation Component	Weightage
Internal Marks (Practical): Continuous Assessment	50 Marks
End Term Practical Examination	50 Marks

BSMFBA372	**Advancement in Forensic Ballistics and Armour Material**	**L**	**T**	**P**	**C**
Version	**2.0**	**3**	**0**	**0**	**3**
Category of Course	**Major**				
Total Contact Hours	**45 Hours (Theory)**				
Pre-requisites/ Co-requisites					

Course Perspective

This course provides an in-depth understanding of forensic ballistics and firearm examination. It covers the classification and analysis of firearms and ammunition, gunshot residue (GSR) detection, wound ballistics, and the structure and testing of armor. Students will explore instrumental techniques used in ballistic evidence analysis and learn to manage and reconstruct cases involving firearms. The course integrates theoretical knowledge with practical applications relevant to forensic investigations.

Course Outcomes

Upon successful completion of the course, students will be able to:

CO1: Remember the types of firearms and ammunition, along with their forensic examination techniques.

CO2: Understand the formation, collection, and analysis of gunshot residues using various forensic techniques.

CO3: Apply the principles of wound ballistics to evaluate injuries and determine the range of fire.

CO4: Analyse armor structures and ballistic resistance standards for forensic applications.

CO5: Evaluate ballistic evidence using instrumental techniques to reconstruct firearm-related cases.

Detailed Syllabus

Course Contents
Section I: Examination of Firearm exhibits:
Examination of Firearm exhibits: Review of firearms & its types, ammunitions & its types along with examination. Recent Development in Firearms. **Gunshot Residues/ Powder Residues:** Composition of GSR depending upon propellants & primer mixtures, GSR Distribution**,** Mechanism of formation of GSR, Location, source and collection of GSR, Analysis of GSR: spot test, chemical test, identification of shooter and instrumental techniques involved of GSR Analysis, Practical problems related with GSR detections.
Section II: Wound Ballistics & Core concepts of Forensic Ballistics:
Wound Ballistics: Threshold velocity for penetration of skin/flesh/bones, preparation of gel block, penetrative in gel block and other targets, nature of wounds with various ranges and velocities with various types of projectiles, evaluation of injuries caused due to shot-gun, rifle, handguns and country made firearms and its ante-mortem & post-mortem examination, determination of range of fire. Effects of Internal 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.
Section III: Armour Structure
Armour Structure: Basis concepts of armour structure, types of armour, materials: Stress and Strain, Elasticity, Strength, Hardness and dynamic, Penetration Mechanics, Reactive Armour Systems, Human Vulnerability. **Types of armour:** Metallic Armour Materials and Structures, Ceramic Armour, Woven Fabrics and Composite Laminates for Armour Applications, Blast and Ballistic Testing Techniques. **Test firing**, Procedure for test fire, Purpose for test firing, Recovery methodology, Specifications of Firing gallery, working of automatic firing rest, Safety & Preventive measures. Characterization of bullet proof jacket Introduction to Ballistic Resistance of Body Armor NIJ Standard: NIJ Body Armor Classification, Sample Requirements and Laboratory Configuration, Flexible Armor Conditioning Protocol, Hard Armor Conditioning Protocol, Ballistic Test Methods
Section IV: Instrumental techniques used for ballistic evidence analysis

Borescope, Comparison Microscope, Stereo microscope, traveling microscope, Scanning Electron microscope, EDXRF. Introduction to automated system of trajectory computation **(Ballistic Data Acquisition system)**: Operating system & its concepts, Universal Receiver, ICM, Target Frame Automated management of ballistics data **(Integrated Ballistics Identification system)**: History of establishment, Brass Trax, Bullet Trax & Match Point, Limitation & Advantages, Application- comparison of bullets and cartridges-database creation and significance in forensic ballistic investigations. Management and reconstruction of cases involving firearm; Report writing and court findings

Learning Experience

Students will engage in interactive lectures, case studies, and hands-on laboratory sessions to understand forensic ballistics. They will participate in mock investigations, analyze ballistic evidence, and simulate wound ballistics using gel blocks. The course emphasizes experiential learning through test firing exercises, GSR analysis, and use of ballistic instrumentation. Collaborative projects and report writing will enhance critical thinking and forensic documentation skills.

Textbooks

1. J.S. Hatcher – Textbook of Firearms Investigation, Identification and Evidence.
2. Bodziak, W.J. – Footwear Impression Evidence: Detection, Recovery and Examination.
3. Heard, B.J. – Handbook of Firearms and Ballistics: Examining and Interpreting Forensic Evidence.
4. Di Maio, V.J.M. – Gunshot Wounds: Practical Aspects of Firearms, Ballistics, and Forensic Techniques.

Suggested Readings

1. NIJ Standards for Ballistic Resistance of Body Armor.
2. Forensic Ballistics in Court – Brian J. Heard.
3. Firearms and Explosives – Nabar, B.S.
4. Forensic Science in Criminal Investigation and Trials – B.R. Sharma.

Open Educational Resources (OER)

1. National Forensic Sciences University (NFSU) online modules.
2. SWAYAM Forensic Ballistics lectures.
3. NIJ Ballistics Research Publications.
4. MIT OpenCourseWare: Physics of Ballistics.
5. Forensic Magazine articles on firearm investigations.

Modes of Evaluation

Quiz/Assignment/Presentation/Extempore/Written Examination.

Evaluation components	Weightage
Internal marks (Theory) **I. continuous assessment (30 marks)** **All the components to be evenly spaced** **Project/quizzes/assignment and essays/presentation/ participation/case studies/reflective journals (minimum of five components to be evaluated)**	**40 Marks**
II. internal marks (Theory): **Mid Term Examination**	**20 Marks**
III. External Marks (Theory): **End Term Examination**	**40 Marks**

BSMFBA387	**Advancement in Forensic Ballistics and Armour Material Practical**	**L**	**T**	**P**	**C**
Version	**2.0**	**0**	**0**	**2**	**1**
Category of Course	**Major**				
Total Contact Hours	**30 Hours (Practical)**				

Pre-requisites/ Co-requisites	

Course Perspective

This practical course provides hands-on training in advanced forensic ballistics and armour material analysis. Students will engage in experiments that simulate real-world forensic scenarios involving firearms, ammunition, ballistic resistance, and protective gear. The course emphasizes the use of modern instrumentation and techniques for ballistic evidence examination and armour evaluation.

Course Outcomes

Upon successful completion of the course, students will be able to:

CO1: Remember and identify key instruments used in forensic ballistics.

CO2: Understand procedures for test firing and wound simulation.

CO3: Apply techniques to analyze the ballistic resistance of various armor materials.

CO4: Analyse bullet trajectories and impact effects in forensic contexts.

CO5: Evaluate forensic techniques to reconstruct shooting incidents accurately.

List of Practicals

1. Identification and handling of various types of firearms and ammunition
2. Demonstration of test firing procedures and recovery of fired bullets.
3. Preparation and use of ballistic gel blocks for wound simulation.
4. Analysis of gunshot residues using chemical spot tests.
5. Operation of vacuum chamber and borescope for barrel examination.
6. Use of comparison microscope for bullet and cartridge case analysis.
7. Evaluation of bulletproof jackets using standard firing tests.
8. Study of armour materials: metallic, ceramic, and composite laminates.
9. Reconstruction of shooting incidents using trajectory computation software.

Learning Experience

Students will gain practical experience in handling firearms, conducting ballistic tests, and analyzing armour materials. The course includes supervised lab sessions, demonstrations, and case-based exercises that simulate forensic investigations. Students will work in teams to conduct experiments, interpret results, and present findings in a forensic context.

Textbooks

1. Jauhari, M. – Fundamentals of Forensic Ballistics.
2. Heard, B.J. – Handbook of Firearms and Ballistics.
3. Carlucci, D.E., Jacobson, S.S. – Ballistics: Theory and Design of Guns and Ammunition.
4. NIJ Standard 0101.06 – Ballistic Resistance of Body Armor.

Suggested Readings

1. DiMaio, V.J. – Gunshot Wounds: Practical Aspects of Firearms, Ballistics, and Forensic Techniques.
2. Haag, M. – Shooting Incident Reconstruction.
3. Sharma, B.R. – Forensic Science in Criminal Investigation and Trials.
4. FBI Training Manuals on Ballistics and Firearms Examination.

Open Educational Resources (OER)

• NIJ Ballistics Research Portal
• SWAYAM Forensic Ballistics Modules
• MIT OpenCourseWare – Materials Science and Engineering
• Forensic Magazine – Ballistics Case Studies

Modes of Evaluation

Quiz/Assignment/Presentation/Extempore/Practical Examination

Examination Scheme:

Evaluation Component	Weightage
Internal Marks (Practical): Continuous Assessment	50 Marks
End Term Practical Examination	50 Marks

BSMFAV373	**Audio and Video Analysis**	**L**	**T**	**P**	**C**

Version	**2.0**	**3**	**0**	**0**	**3**
Category of Course	**Major**				
Total Contact Hours	**45 Hours (Theory)**				
Pre-requisites/ Co-requisites					

Course Perspective

This course introduces students to the principles and forensic applications of voice identification, speaker recognition, and video analysis. It covers the theoretical foundations of speech production and uniqueness, forensic handling of audio and video evidence, and the use of modern tools for enhancement, authentication, and biometric analysis. Students will gain practical skills in analyzing speech signals, handling CCTV footage, and preparing admissible forensic reports.

Course Outcomes

Upon successful completion of the course, students will be able to:

CO1: Remember the theory of voice production and the uniqueness in forensic speaker recognition.

CO2: Understand and apply techniques for handling and analyzing audio recordings and speaker profiling.

CO3: Analyse forensic video evidence, including CCTV footage, using enhancement and authentication tools.

CO4: Apply proficiency in using software and hardware tools for forensic audio and video analysis.

CO5: Evaluate forensic reports and understand the legal admissibility of audio-video evidence.

Detailed Syllabus

Course Contents
Section I: Voice Identification and Speaker Recognition
Voice Identification and Speaker Recognition Introduction to voice identification/speaker recognition and its forensic importance, history of voice analysis, voice production theory, uniqueness in person's voice, interspeaker and intraspeaker variations, text-dependent and text-independent speaker recognition,

discriminating tests: closed test, open test, collection of standards for comparison. Handling of audio recording evidences and its physical examination, marking of speakers, procedure for preparation of working copies.
Section II: Speaker Profiling and Audio Analysis
Speaker profiling: segregation of speech samples, auditory analysis/listener's approach, spectrographic approach or voiceprint analysis, automatic speaker recognition technique. Enhancement and normalization techniques, establishing the authenticity and integrity of audio recordings, speech signal processing, Fourier analysis, frequency and time domain representation of speech signal, analogue to digital conversion, principle and working of various instruments: hardware, software used for audio analysis, report writing, related case studies, admissibility of audio evidences in court proceedings.
Section III: Forensic Video Examination
Definition, scope and significance in crime investigation, technical aspects of the video, collection, handling and preservation of video files, video analysis: frame extraction, frame-by-frame analysis, shot-by-shot analysis. Video processing and enhancement, video authentication, metadata analysis, hash value generation. Biometric analysis for personal identification, facial biometrics, related case studies.
Section IV: CCTV Forensics
Introduction to CCTV forensics, acquisition of CCTV footages from the scene of crime, handling and preservation of CCTV footages, hash value generation, extracting the data from DVR/NVR, maintaining chain of custody. Authentication and enhancement of CCTV footages, extraction of frames, forensic tools for enhancement and authentication of CCTV footages, legal admissibility of CCTV evidence, related case studies.

Learning Experience

Students will engage in hands-on activities including audio and video evidence handling, speaker profiling, and forensic enhancement techniques. Workshops and case studies will provide practical exposure to forensic tools and legal procedures. Group projects and lab sessions will reinforce theoretical concepts through real-world applications.

Textbooks

1. Rose, P. (2002). Forensic Speaker Identification. Taylor & Francis.

2. Nolan, F. (1983). The Phonetic Bases of Speaker Recognition. Cambridge University Press.

3. Krauss, J. (2019). Forensic Video Analysis: From Scene to Courtroom. Academic Press.

4. Owens, J. (2012). CCTV Surveillance: Video Practices and Technology. Routledge.

Suggested Readings

1. Gibbon, D. (2017). Language and Forensic Speaker Identification. Cambridge Scholars Publishing.

2. Bigun, J. (2006). Vision with Direction: A Systematic Introduction to Image Processing. Springer.

3. Casey, E. (2011). Digital Evidence and Computer Crime. Academic Press.

4. Ramalingam, S. (2020). Forensic Audio Enhancement Techniques. Forensic Press.

Open Educational Resources (OER)

• SWAYAM courses on Digital Forensics and Audio Processing

• edX: Introduction to Digital Media Forensics

• MIT OpenCourseWare: Signal Processing and Analysis

• YouTube Channels: Forensic Audio Lab, CCTV Analysis Tutorials

Modes of Evaluation

Quiz/Assignment/Presentation/Extempore/Written Examination

Evaluation components	**Weightage**
Internal marks (Theory) **I. continuous assessment (30 marks)** **All the components to be evenly spaced** **Project/quizzes/assignment and essays/presentation/ participation/case studies/reflective journals (minimum of five components to be evaluated)**	**40Marks**
II. internal marks (Theory): **Mid Term Examination**	**20 Marks**
III. External Marks (Theory): **End Term Examination**	**40 Marks**

BSMFAV388	Audio and Video Analysis	L	T	P	C
Version	2.0	0	0	2	1
Category of Course	Major				
Total Contact Hours	30 Hours (Practical)				
Pre-requisites/ Co-requisites					

Course Perspective:

This practical course provides hands-on training in forensic audio and video analysis. Students will learn to handle, process, and analyze audio recordings and video footage for forensic purposes. The course emphasizes speaker recognition, audio enhancement, video authentication, and the use of forensic tools for evidence evaluation. It prepares students to work with real-world forensic cases involving voice and video evidence.

Course Outcomes:

Upon successful completion of the course, students will be able to:

CO1: Remember how to identify and handle forensic audio and video evidence.

CO2: Understand and apply speaker recognition techniques using auditory and spectrographic methods.

CO3: Apply forensic tools to enhance and authenticate audio recordings.

CO4: Analyse video footage for biometric identification and metadata verification.

List of Practicals:

1. Identification and labeling of components in audio recording setups.
2. Collection and handling of audio evidence from various sources.
3. Preparation of working copies and marking of speakers in audio recordings.
4. Speaker profiling using auditory and spectrographic methods.
5. Enhancement and normalization of audio recordings using forensic software.
6. Authenticity and integrity verification of audio files using hash values.
7. Spectrographic analysis of speech samples for speaker comparison.
8. Collection and preservation of video evidence from CCTV and mobile devices.
9. Frame-by-frame analysis and enhancement of video footage.
10. Video authentication and metadata analysis using forensic tools.
11. Facial biometric analysis from video frames for personal identification.
12. Report writing and case study analysis on voice and video evidence admissibility.

Learning Experience:

Students will engage in practical exercises involving real and simulated forensic audio and video evidence. They will use industry-standard tools for enhancement, authentication, and analysis. Group activities and case studies will foster collaborative learning and critical thinking. The course emphasizes ethical handling of evidence and prepares students for courtroom presentation of forensic findings.

Textbooks

1. Nolan, F. (1983). The Phonetic Bases of Speaker Recognition. Cambridge University Press.
2. Reynolds, D. A. (2002). An overview of automatic speaker recognition technology. In Proceedings of ICASSP.
3. Kundra, S. (2015). Forensic Audio and Video Analysis. NFSU Publications.
4. Rose, P. (2002). Forensic Speaker Identification. Taylor & Francis

Suggested Readings:

Hansen, J. H. L., & Hasan, T. (2015). Speaker recognition by machines and humans. IEEE Signal Processing Magazine.

Gonzalez, R. C., & Woods, R. E. (2018). Digital Image Processing. Pearson.

Bigun, J. (2006). Vision with Direction: A Systematic Introduction to Image Processing and Computer Vision. Springer.

Case studies from Forensic Magazine and NFSU archives.

Open Educational Resources (OER):

- SWAYAM courses on Digital Forensics and Audio Analysis
- Coursera: Audio Signal Processing for Music Applications
- edX: Fundamentals of Digital Image and Video Processing
- MIT OpenCourseWare: Speech and Hearing Bioscience and Technology

Modes of Evaluation:

Quiz/Assignment/Presentation/Extempore/Written Examination

Examination Scheme:

Evaluation Component	Weightage
Internal Marks (Practical): Continuous Assessment	50 Marks
End Term Practical Examination	50 Marks

Specialization-C: Fingerprints and Questioned Documents

BSMFFT371	Advanced Fingerprint Technologies	L	T	P
Version		3	0	0
Category of Course	Core Course 11			
Total Contact Hours	48 Hours			
Pre-requisites/Co-requisites	--			

Course Perspective

This course provides advanced knowledge of fingerprint development techniques, ridgeology, poroscopy, and automated fingerprint identification systems, along with forensic applications in detecting prohibited drugs. It bridges theoretical foundations with practical applications, preparing students to critically evaluate, analyze, and apply fingerprint and drug analysis techniques in forensic casework. By integrating principles of forensic science, pharmacology, and cutting-edge technology, the course equips students with the competencies needed in criminal investigations, forensic laboratories, and research institutions.

Course Outcomes

Upon successful completion of the course, students will be able to:

1. CO1 (Remember): Recall fundamental and advanced techniques for fingerprint development, ridgeology, and detection of prohibited drugs.
2. CO2 (Understand): Explain the importance of ridge characteristics, poroscopy, and edgeoscopy in personal identification and forensic practice.
3. CO3 (Apply): Employ automated fingerprint imaging systems and analytical methods to process and interpret forensic evidence.
4. CO4 (Analyze): Differentiate between fingerprint development methods for porous/non-porous surfaces, and assess analytical findings for prohibited drug detection.
5. CO5 (Evaluate): Critically evaluate the evidential value of fingerprint traits and drug analysis techniques for legal and investigative purposes.

Course Contents
Section I: Advanced Fingerprint Development Techniques: Development of fingerprint from porous surfaces • Development of fingerprint from non-porous surfaces • Development of fingerprint from nanoparticles • Molecular finger prints residues found on various substrates
Section II: Introduction & Importance of ridgeology and poroscopy: For individual identification. Application of the pores dimensions and ridge dimensions in the identification- scope of establishing the identification – characteristics and traits. Application of edgeoscopy- personal identification using fingerprints
Section III: Automated fingerprint Identification and imaging systems

Learning Experience

The course offers a blended learning experience that combines interactive lectures, case-based discussions, and practical workshops to help students connect fingerprint science with forensic drug analysis. Students will explore advanced fingerprint development techniques on diverse substrates, understand ridge and pore dimensions for individual identification, and apply automated fingerprint recognition technologies. Real-world case studies on prohibited drugs will enhance critical thinking, while laboratory sessions will provide hands-on exposure to analytical techniques such as chromatography, spectroscopy, and immunoassays. Collaborative group projects, forensic simulations, and research-based assignments will foster problem-solving, teamwork, and analytical competencies, preparing students to handle forensic investigations and legal testimony with accuracy and confidence.

Textbooks

1. David R. Ashbaugh (1999). *Quantitative and Qualitative Friction Ridge Analysis*. CRC Press.
2. Henry C. Lee & R. E. Gaensslen (1991). *Advances in Fingerprint Technology*. CRC Press.
3. Maltoni, Davide (2003). *Handbook of Fingerprint Recognition*. Springer Verlag.

Reference Books

1. E. Roland Menzel (1999). *Fingerprint Detection with Lasers*. Marcel Dekker Inc., USA.
2. James F. Cowger (1993). *Friction Ridge Skin: Comparison and Identification of Fingerprints*. CRC Press.

3. Jain, L. C. (1999). *Intelligent Biometric Techniques in Fingerprint and Face Recognition*. CRC Press, Ohio.

Open Educational Resources (OERs)

1. National Institute of Standards and Technology (NIST) – Fingerprint Research https://www.nist.gov/forensic-science
2. INTERPOL – Forensic Science Services (Fingerprint & Biometrics) https://www.interpol.int/How-we-work/Forensics
3. SWGFAST (Scientific Working Group on Friction Ridge Analysis, Study, and Technology) Guidelines https://www.swgfast.org
4. National Center for Biotechnology Information (NCBI) – Research on Drug Detection Methods https://www.ncbi.nlm.nih.gov
5. UNODC (United Nations Office on Drugs and Crime) – Forensic and Scientific Services https://www.unodc.org/unodc/en/scientists/

BSMFFT386	**Advanced Fingerprint Technologies-PRACTICAL**	**L**	**T**	**P**	**C**
Version		0	0	2	1
Category of Course	Core Practical III				
Total Contact Hours	32 Hours				
Pre-requisites/Co-requisites	--				

Course Perspective

The practical component of this course provides hands-on training in advanced fingerprint development techniques, ridgeology and poroscopy applications, automated fingerprint identification systems, and methods for detecting prohibited drugs. Students will gain direct exposure to laboratory procedures, forensic tools, and analytical techniques, bridging theoretical knowledge with field applications. The focus is on developing precision, critical observation, and problem-solving skills necessary for handling forensic evidence in real-world crime laboratories and investigations.

Course Outcomes

Upon successful completion of the course, students will be able to:

1. **CO1 (Remember):** Recall standard operating procedures for fingerprint development and drug detection experiments.
2. **CO2 (Understand):** Demonstrate understanding of substrate differences in fingerprint development and the importance of ridge, pore, and edge characteristics.
3. **CO3 (Apply):** Perform fingerprint visualization, automated imaging, and drug detection techniques using laboratory equipment.
4. **CO4 (Analyze):** Examine fingerprints developed on porous/non-porous surfaces and analyze laboratory results for drug detection critically.
5. **CO5 (Evaluate):** Assess the reliability, limitations, and forensic significance of experimental results in fingerprint identification and drug analysis.

Course Contents
1. **Development of fingerprints on porous surfaces** (e.g., paper, cardboard). 2. **Development of fingerprints on non-porous surfaces** (e.g., glass, plastic, metal). 3. **Nanoparticle-based fingerprint development** (demonstration & hands-on). **4. Molecular fingerprint residue detection on different substrates.** 5. **Study of ridgeology and poroscopy** (ridge & pore measurements for identification). 6. **Application of edgeoscopy** (edge characteristics in fingerprint individualization). 7. **Hands-on with Automated Fingerprint Identification System (AFIS)** – imaging & matching. **8. Detection of prohibited drugs using chromatography (TLC demonstration).** **9. Spectroscopy or immunoassay-based detection of selected prohibited drugs.**

Learning Experience

Students will actively engage in **hands-on laboratory exercises** designed to replicate real forensic scenarios. Each practical session provides opportunities to directly apply theoretical knowledge to experimental work, such as fingerprint development on diverse surfaces, ridgeology analysis, and drug detection using analytical methods. Through **guided demonstrations, supervised experiments, and problem-based tasks**, students will refine their observation, technical accuracy, and interpretive skills. Collaborative exercises, including AFIS-based fingerprint matching and simulated casework, will strengthen teamwork, analytical reasoning, and forensic reporting abilities. This experiential learning ensures that students gain not only laboratory competence but also the critical mindset required for scientific evaluation in forensic practice.

Textbooks

1. David R. Ashbaugh (1999). *Quantitative and Qualitative Friction Ridge Analysis*. CRC Press.
2. Henry C. Lee & R. E. Gaensslen (1991). *Advances in Fingerprint Technology*. CRC Press.
3. Maltoni, Davide (2003). *Handbook of Fingerprint Recognition*. Springer Verlag.

Reference Books

1. E. Roland Menzel (1999). *Fingerprint Detection with Lasers*. Marcel Dekker Inc., USA.
2. James F. Cowger (1993). *Friction Ridge Skin: Comparison and Identification of Fingerprints*. CRC Press.
3. Jain, L. C. (1999). *Intelligent Biometric Techniques in Fingerprint and Face Recognition*. CRC Press, Ohio.

Open Educational Resources (OERs)

1. **NIST Forensic Science Research – Fingerprints and Biometrics** https://www.nist.gov/forensic-science
2. **SWGFAST – Guidelines for Friction Ridge Analysis** https://www.swgfast.org
3. **INTERPOL – Forensic Science Services (Fingerprint & Biometrics)** https://www.interpol.int/How-we-work/Forensics
4. **UNODC – Forensic and Scientific Services (Drug Analysis & Fingerprint Science)** https://www.unodc.org/unodc/en/scientists/
5. **NCBI – Open Access Research on Analytical Drug Detection** https://www.ncbi.nlm.nih.gov

BSMFDE372	**Advances in Forensic Documents Examination**	**L**	**T**	**P**	**C**
Version		3	0	0	3
Category of Course	Core Course 12				
Total Contact Hours	48 Hours				
Pre-requisites/Co-requisites	**--**				

Course Perspective

This course provides an in-depth understanding of advanced concepts in forensic document examination, highlighting both traditional and modern approaches. Students will learn to analyze questioned documents, handwriting, and impressions using scientific techniques, while also being exposed to the emerging challenges in examining e-documents and digital signatures. The course bridges foundational knowledge with specialized forensic applications, fostering analytical, observational, and reporting skills essential for forensic document examiners.

Course Outcomes

Upon successful completion of the course, students will be able to:

1. **CO1 (Remember):** Recall and describe the fundamental principles, tools, and scope of forensic document examination.
2. **CO2 (Understand):** Explain handwriting individuality, natural variations, and the significance of linguistic and stylistic analysis in forensic contexts.
3. **CO3 (Apply):** Apply techniques for analyzing disguised writing, secret writing, alterations, impressions, and forgeries.
4. **CO4 (Analyze):** Critically examine complex documents such as photocopies, e-documents, digital signatures, and security documents like passports, credit cards, and currency.
5. **CO5 (Evaluate):** Assess and report case findings with accuracy, incorporating contemporary forensic methodologies and case studies.

Course Contents
Section I: Basics of Document and handwriting examination: Roles of Forensic Document Examiner, Scope of document examination, basic tools needed for forensic documents examination and their significance, Types of documents for examination, Care and Handling of Document Exhibits, Individuality in handwriting, natural variations, tremors in handwriting, handwriting comparison, Basics of Forensic linguistics and stylistics, its importance in writer identification.
Section II: Examination of special class of writings and impressions: Disguised writing and anonymous letters, Examination of alterations in documents, Examination, preservation and decipherment of secret writing, Indented writings and charred writings, seal and other mechanical impressions, Forgeries & its types, related case studies, Determination of age of document and writings, reporting of the cases and related case studies
Section III: Forensic Examination of different types of Documents: Examination of Photostat (Xerox) copies, carbon copies, fax message, type writings, printed matter, Examination of e-documents & digital signature, counterfeit currency notes, passports, visa, credit cards, debit cards, legal deeds, postal stamps, etc, Related Case Studies. Types of computer printers and their working: dot-matrix, daisywheel, line printers, ink-jet, thermal jet and laser printers, Examination of Computer printouts.

Learning Experience

Students will engage in an interactive learning environment through lectures, discussions, and case-based learning. Exposure to real and simulated case studies will enhance analytical

skills, while structured assignments will strengthen their reporting abilities. The course emphasizes developing keen observation, critical thinking, and the ability to integrate classical document examination with modern technological advancements.

Text Books

1. Koppenhaver, K. (2010). *Forensic Document Examination: Principles and Practice*. Humana Press.
2. Hilton, O. (1993). *Scientific Examination of Questioned Documents*. CRC Press.
3. Kelly, J., & Lindblom, B. (2006). *Scientific Examination of Questioned Documents*. CRC/Taylor & Francis.

Reference Books

1. Osborn, A. (1929). *Questioned Documents* (2nd Ed.). Boyd Printing Company.
2. Huber, R., & Headrick, A. (1999). *Handwriting Identification: Facts and Fundamentals*. CRC Press.
3. Ellen, D. (2006). *Scientific Examination of Documents*. CRC/Taylor & Francis.

Open Educational Resources (OER)

1. National Forensic Sciences University (NFSU) – Digital Forensic Document Modules.
2. SWAYAM-NPTEL Online Course: *Forensic Science and Criminal Investigation*.
3. Forensic Document Examination resources – American Academy of Forensic Sciences (AAFS).
4. ResearchGate repository on forensic handwriting and document analysis.
5. Online Forensic Document Examination Journal Archives (Elsevier, Taylor & Francis).

BSMFDE387	**Advances in Forensic Documents Examination - PRACTICAL**	**L**	**T**	**P**	**C**
Version		0	0	2	1
Category of Course	Core Practical IV				
Total Contact Hours	32 Hours				
Pre-requisites/Co-requisites	**--**				

Course Perspective

This practical course in **Advances in Forensic Documents Examination** provides hands-on training in analyzing questioned documents with a focus on handwriting, signatures, alterations, obliterations, and security features. It emphasizes the scientific and systematic

approach to examining disputed writings and documents using modern forensic techniques. Students will develop the ability to identify forgeries, detect disguised writings, analyze document security features, and establish the sequence of strokes in questioned entries. The course equips learners with skills to apply theoretical knowledge into practice, preparing them for professional roles in forensic laboratories, law enforcement, and judicial systems.**Course Outcomes**

Upon successful completion of the course, students will be able to:

1. CO1 (Remember): Recall fundamental principles of handwriting characteristics, document alterations, and security features of documents.
2. CO2 (Understand): Explain natural variations, disguises in handwriting, and differences between genuine and forged signatures.
3. CO3 (Apply): Perform examinations of handwriting, signatures, seal impressions, and document alterations using forensic techniques.
4. CO4 (Analyze): Differentiate between authentic and forged/altered documents by analyzing class and individual characteristics.
5. CO5 (Evaluate): Assess and validate document authenticity through systematic evaluation and reporting of forensic findings.

Course Contents
1. Examination and Identification of handwriting on the basis of class and individual characteristics. 2. Examination and identification of forged signatures. 3. Identification of disguised in handwriting 4. Examination and identification of natural variations in handwritings 5. Examination of additions, alterations, and obliterations in the documents. 6. Examination of security features of currency notes, passports, visa 7. Examination of rubber seal impressions 8. Determination of sequence of strokes

Learning Experience

Learners will engage in **laboratory-based practical exercises** involving the examination of questioned documents using magnifiers, stereomicroscopes, and other forensic tools. Each practical task will simulate real case scenarios, enabling students to work with handwriting samples, forged signatures, altered texts, seal impressions, and security documents like currency notes and passports. Students will also learn the **methodology of documentation, observation, analysis, and report preparation** similar to professional forensic casework. The course ensures competency through continuous assessment, viva voce, and project-based exercises that replicate real-world forensic practice.

Textbooks

1. Kelly, J. S., & Lindblom, B. S. (2006). *Scientific Examination of Questioned Documents*. CRC Press.

2. Hilton, O. (1993). *Scientific Examination of Questioned Documents*. Elsevier.
3. Huber, R. A., & Headrick, A. M. (1999). *Handwriting Identification: Facts and Fundamentals*. CRC Press.

Reference Books

1. Ellen, D. (2006). *Scientific Examination of Documents: Methods and Techniques*. CRC Press.
2. Harrison, W. R. (1981). *Suspect Documents: Their Scientific Examination*. Sweet & Maxwell.
3. Conway, J. V. P. (1995). *Evidential Documents*. Charles C. Thomas Publisher.

Open Educational Resources (OERs)

1. National Institute of Standards and Technology (NIST) – Forensic Document Examination Resources – https://www.nist.gov
2. American Board of Forensic Document Examiners (ABFDE) – https://www.abfde.org
3. Scientific Working Group for Forensic Document Examination (SWGDOC) Standards – https://www.swgdoc.org
4. Forensic Science Communications (FBI) – https://leb.fbi.gov/science-and-lab
5. Wiley Online Library – Journal of Forensic Sciences (selected open-access articles) – https://onlinelibrary.wiley.com/journal/15564029

BSMFAA373	**Forensic Accounting and Auditing**	**L**	**T**	**P**	**C**
Version		3	0	0	3
Category of Course	Core Course 13				
Total Contact Hours	48 Hours				
Pre-requisites/Co-requisites	**--**				

Course Perspective

The course on **Forensic Accounting and Auditing** equips students with an in-depth understanding of the concepts, methodologies, and applications of forensic accounting in detecting and preventing financial frauds. It integrates theoretical principles with practical investigative techniques, focusing on fraud examination, litigation support, fraud deterrence, and compliance with legal frameworks. Through case studies, exposure to real-world fraud scenarios, and hands-on experience with digital evidence examination, learners will gain the ability to critically analyze fraudulent activities, identify red flags, and contribute to the development of ethical financial practices.

Course Outcomes

Upon successful completion of the course, students will be able to:

1. **CO1 (Remember):** Recall and describe fundamental principles of forensic accounting, fraud examination concepts, and relevant legal provisions.
2. **CO2 (Understand):** Explain different types of frauds, fraud detection methods, money laundering processes, and roles of auditors, management, and forensic accountants.
3. **CO3 (Apply):** Apply investigative protocols, fraud detection tools, and forensic auditing techniques in analyzing financial irregularities and illicit transactions.
4. **CO4 (Analyze):** Critically analyze financial data, red flags, and electronic evidence to identify concealed frauds, money laundering, and conflicts of interest.
5. **CO5 (Evaluate):** Assess fraud risk management frameworks, ethical considerations, and litigation support mechanisms, and provide recommendations for fraud prevention, deterrence, and reporting.

Course Contents
Section I: Forensic Accounting and frauds: Principles and concepts of Forensic Accounting, Forensic auditing, Fraud triangle, types of frauds, methods for fraud detection, types of Financial Statement Frauds, Responsibility of Management and Auditors, reporting financial frauds, theory of fraud perpetrator, Litigation support bankruptcy, product liability, business valuations Occupational frauds and abuses, Asset misappropriation, cheque tampering, false refunds, credit/debit card fraud.
Section II: Money Laundering and Fraud deterrence: Basic concepts of money laundering, history, methods & related laws, fraud deterrence, international money laundering council, banking operations-national/international, commercial & economic damages and their factors, Investigative protocols for fraud detection, Corruption and Bribery, fraudulent schemes, Currency transaction Tracing Illicit Transactions, examination, analysis and interpretation of electronic data relating to fraud, cyber crime loss evaluations, investigation of e-data, capturing digital media-hard drives, emails, deleted overwritten files, data recovery and extraction.
Section III: Investigation of frauds and Legal Framework for Forensic Accounting: Fictitious revenues generation, Concealed liabilities and expenditures, Red flags, Whistle blowers and responses to fraud, Evidence collection and data analysis and interpretation, reporting methods, Prevention and detection of conflicts of interest, Law in relation to cyber-crimes, Ethics for Forensic Accountants, Code of Ethics, Code of Professional Standards, Laws Related to Fraud, Individual Rights during Examination, Criminal Prosecutions for Fraud, The Civil Justice System, expert

testimony, Intellectual property rights

Learning Experience

Students will gain exposure through a combination of **interactive lectures, case studies, workshops, simulations, and legal framework discussions**. The course emphasizes **practical problem-solving**, enabling students to investigate real-world fraud cases, interpret financial statements for anomalies, and recover digital evidence. Students will also participate in **mock audits, group projects, and role-play sessions** to experience the roles of investigators, auditors, and expert witnesses in court. This experiential learning model ensures a holistic blend of academic knowledge, professional skills, and ethical decision-making in forensic accounting.

Text Books

1. Manning, G. (1999). *Financial Investigation and Forensic Accounting*. CRC Press.
2. Wells, J. T. (2005). *Principles of Fraud Examination*. John Wiley & Sons.
3. Madinger, J., & Zalopany, S. A. (1999). *Money Laundering: A Guide for Criminal Investigation*. CRC Press.

Reference Books

1. Wells, J. T. (2004). *Corporate Fraud Handbook*. John Wiley & Sons.
2. Bologna, J., Lindquist, R., & Wells, J. (1993). *Fraud Auditing and Forensic Accounting*. Wiley.
3. Crumbley, D. L., Heitger, L. E., & Smith, G. S. (2007). *Forensic and Investigative Accounting*. CCH Publishing.

Open Educational Resources (OER)

1. Association of Certified Fraud Examiners (ACFE) – https://www.acfe.com
2. The Basel Institute on Governance – https://baselgovernance.org
3. International Monetary Fund (IMF) – Anti-Money Laundering Resources – https://www.imf.org
4. OECD Anti-Corruption and Integrity Hub – https://www.oecd.org/corruption
5. The World Bank: Financial Integrity Resources – https://www.worldbank.org

BSMFAA388	**Forensic Accounting and Auditing-PRACTICAL**	**L**	**T**	**P**	**C**
Version		0	0	2	1
Category of Course	Core Practical IV				
Total Contact Hours	32 Hours				
Pre-requisites/Co-requisites	**--**				

Course Perspective

The **Forensic Accounting and Auditing – Practical** course is designed to provide laboratory-based training in the forensic examination of documents and materials relevant to financial fraud investigations. Students will acquire hands-on skills in ink and paper analysis using advanced instrumental techniques such as TLC, GCMS, and LCMS. The course also emphasizes the examination of security documents like currency notes, passports, and stamps, along with rubber stamp impressions. Through practical case studies, students will learn to link scientific analysis with fraud detection, document authentication, and financial crime investigations, preparing them for professional forensic roles.

Course Outcomes

Upon successful completion of the course, students will be able to:

6. **CO1 (Remember):** Recall the basic principles of ink analysis, paper examination, and document authentication.
7. **CO2 (Understand):** Explain the significance of scientific techniques (TLC, GCMS, LCMS) and their application in forensic auditing.
8. **CO3 (Apply):** Perform examinations of inks, papers, security documents, and stamps using appropriate forensic methods.
9. **CO4 (Analyze):** Interpret results from instrumental analysis to detect alterations, forgeries, and fraudulent manipulations in documents.
10. **CO5 (Evaluate):** Assess the authenticity of questioned financial documents and provide scientifically valid forensic reports.

Course Contents
1. Examination of ink by TLC 2. Examination of ink by GCMS 3. Examination of ink by LCMS 4. Examination of ageing of paper 5. Examination of currency notes 6. Examination of Passport 7. Examination of Stamp 8. Examination of Rubber Stamp Impressions 9. Related case studies

Learning Experience

Students will gain **hands-on training in forensic laboratories** through practical experiments and case-based exercises. Activities will include ink separation via Thin Layer Chromatography, advanced instrumental analysis (GCMS, LCMS), ageing tests on paper, and examination of the security features of financial/legal documents. Learners will also

investigate real and simulated case studies to understand the relevance of scientific findings in forensic accounting and fraud detection. The emphasis will be on **documentation, data interpretation, critical analysis, and professional reporting**, mirroring actual forensic casework and judicial requirements.

Textbooks

1. Kelly, J. S., & Lindblom, B. S. (2006). *Scientific Examination of Questioned Documents*. CRC Press.
2. Huber, R. A., & Headrick, A. M. (1999). *Handwriting Identification: Facts and Fundamentals*. CRC Press.
3. Ellen, D. (2006). *Scientific Examination of Documents: Methods and Techniques*. CRC Press.

Reference Books

1. Conway, J. V. P. (1995). *Evidential Documents*. Charles C. Thomas Publisher.
2. Harrison, W. R. (1981). *Suspect Documents: Their Scientific Examination*. Sweet & Maxwell.
3. Hilton, O. (1993). *Scientific Examination of Questioned Documents*. Elsevier.

Open Educational Resources (OERs)

1. National Institute of Standards and Technology (NIST) – Document Examination Resources – https://www.nist.gov
2. American Board of Forensic Document Examiners (ABFDE) – https://www.abfde.org
3. Scientific Working Group for Forensic Document Examination (SWGDOC) Standards – https://www.swgdoc.org
4. Forensic Science Communications (FBI) – https://leb.fbi.gov/science-and-lab
5. Wiley Online Library – Journal of Forensic Sciences (open-access resources) – https://onlinelibrary.wiley.com/journal/15564029

Specialization-D: Forensic Chemistry and Toxicology

BSMFPH371	**Forensic Pharmacy and Pharmacology of Controlled Drugs**	**L**	**T**	**P**	**C**
Version		3	0	0	3
Category of Course	Core Course 11				
Total Contact Hours	48 Hours				
Pre-requisites/Co-requisites	**--**				

Course Perspective

The Forensic Pharmacy course provides students with a comprehensive understanding of pharmacology and its forensic applications. Beginning with the basic principles of drug sources, classifications, pharmacopoeias, and routes of administration, the course builds towards advanced concepts such as pharmacokinetics, pharmacodynamics, and drug–receptor interactions. Special emphasis is placed on the pharmacology of controlled substances, including neurotransmitters, depressants, stimulants, hallucinogens, and therapeutic agents. Students also gain exposure to modern methods of analyzing prohibited drugs, equipping them with essential skills for drug detection and forensic investigations. By integrating core pharmacological principles with forensic applications, the course develops both theoretical knowledge and practical expertise relevant to research, toxicology, clinical settings, and forensic science.

Course Outcomes

Upon successful completion of the course, students will be able to:

1. **CO1 (Remember):** Recall and describe the basic principles of forensic pharmacy, including pharmacopoeias, drug classifications, routes of administration, and adverse drug reactions.
2. **CO2 (Understand):** Explain and differentiate pharmacological concepts such as pharmacokinetics, pharmacodynamics, bioavailability, bioequivalence, and drug–receptor interactions.
3. **CO3 (Apply):** Apply research methodology and statistical tools in analyzing pharmacological data, drug interactions, and case studies of controlled substances.
4. **CO4 (Analyze):** Examine and analyze the pharmacology of different classes of controlled drugs (e.g., neurotransmitters, stimulants, depressants, hallucinogens) and assess their forensic significance.
5. **CO5 (Evaluate):** Evaluate methods of analysis for prohibited drugs using advanced detection techniques, and critically assess their application in forensic and scientific contexts.

Course Contents
Section I: Basic Principles of Forensic Pharmacy: Introduction to Pharmacology and Forensic Pharmacy, Branches of Pharmacology, Scope of Forensic Pharmacy, Pharmacopoeias IP, USP, EP, pharmacognosy, pharmacovigilance,

Nature and Source of drug, forms of drugs, classification of drugs, Prodrug and soft drug concept, Drug synthesis, Route of administration of Drugs, Factor affecting the effects of Drug, Ferguson's principle, Adverse drug reactions and drug induced side effects
Section II: Concepts of Pharmacology: Pharmacokinetics, Bioavailability, Bioequivalence and Bioaccumulation, Efficacy and potency, Dose response relationship, Pharmacodynamics, Phase–I and Phase–II mechanism, Drug **Therapeutic Index**, Drug Receptor concept, types of receptors and mechanism of action, Pharmacokinetic drug interactions, various biological barriers, Agonism, Antagonism, Addition, Synergism, Potentiation, drug addiction and drug dependence, drug tolerance, drug hypersensitivity.
Section III: Pharmacology of Different classes of controlled drugs: Pharmacology of neurotransmitters like GABA, Glutamate, Glycine, Serotonin, Dopamine, aliphatic alcohol, General Anaesthetics, Antidepressants, Sedatives, Hypnotics, antihypertensive drugs, Antidepressant, Stimulants, & hallucinogens and antipsychotics, Case Studies
Section IV: Methods of Analysis of of Prohibited Drugs: Detection of prohibited drugs (anabolic steroids, peptide hormones, growth factors and mimetics, beta agonist, metabolic modulators, diuretics and masking agents and beta blockers by different techniques)

Learning Experience

The course offers a blended learning experience that combines interactive lectures, case-based discussions, and practical workshops to help students connect pharmacological principles with forensic applications. Students will explore the foundational aspects of pharmacology and forensic pharmacy, apply theoretical knowledge to understand drug mechanisms and interactions, and engage with real-world case studies of controlled substances to develop critical thinking. Laboratory sessions and workshops on analytical techniques such as chromatography, spectroscopy, and immunoassays will provide hands-on exposure to methods of detecting prohibited drugs. Group projects and collaborative activities will foster teamwork and problem-solving skills, while continuous engagement with research-oriented tasks will strengthen their ability to design, analyze, and interpret forensic investigations. This holistic approach ensures that students not only acquire conceptual

knowledge but also develop the practical and analytical competencies required in forensic and scientific settings.

Textbooks

1. Rang, P.H., Dale, M.M., Ritter, M.J. (2000). *Pharmacology* (4th ed.). Harcourt/Churchill Livingstone.
2. Hardman, J.G., Limbird, L.E. (1996). *Goodman and Gilman's The Pharmacological Basis of Therapeutics* (9th ed.). McGraw-Hill.
3. Klaassen, C.D. (1995). *Casarett and Doull's Toxicology: The Basic Science of Poisons* (5th ed.). McGraw-Hill.

Reference Books

Moffat, A.C., Osselton, D.M., Widdop, B. (2004). *Clarke's Analysis of Drugs and Poisons in Pharmaceuticals, Body Fluids and Postmortem Material* (3rd ed.). Pharmaceutical Press.

1. Bogusz, M.J. (2000). *Handbook of Analytical Separations, Vol. 2: Forensic Science* (1st ed.). Elsevier Science.
2. Siegel, J.A., Saukko, P.J., Knupfer, G. (2000). *Encyclopedia of Forensic Sciences* (Vol. 3). Academic Press.
3. Paranjape, H.M., Bothara, G.K., Jain, M.M. (1990). *Fundamentals of Pharmacology* (1st ed.). Nirali Prakashan.

Open Educational Resources (OERs)

1. PubChem – Open Chemistry Database by NCBI (https://pubchem.ncbi.nlm.nih.gov)
2. TOXNET (Toxicology Data Network – archived, but accessible via PubChem and PubMed)
3. National Institute on Drug Abuse (NIDA) – Research and educational resources on drugs and addiction (https://nida.nih.gov)
4. OpenStax Pharmacology Resources – Free pharmacology and biology textbooks (https://openstax.org/subjects/science)
5. World Health Organization (WHO) Drug Information Portal (https://www.who.int/medicines)

BSMFPH386	Forensic Pharmacy and Pharmacology of Controlled Drugs-PRACTICAL	L	T	P	C
Version		0	0	2	1
Category of Course	Core Practical III				
Total Contact Hours	32 Hours				
Pre-requisites/Co-requisites	**--**				

Course Perspective: This course provides practical exposure to the analysis of controlled drugs and their metabolites using modern analytical and instrumental techniques. It emphasizes the forensic application of pharmacy and pharmacology knowledge, bridging theoretical principles with hands-on skills in drug detection, quantification, and characterization. Students will gain competencies essential for forensic laboratories, regulatory compliance, and research in toxicology and drug analysis.

Course Outcome: Upon successful completion of the course, students will be able to:

1. **CO1 (Remember):** Recall the principles of drug extraction, detection, and instrumental analysis methods such as UV-Vis, FTIR, GC, HPLC, and LC-MS.

2. **CO2 (Understand):** Explain the working principles of spectroscopic and chromatographic techniques and their applications in controlled drug analysis.
3. **CO3 (Apply):** Perform standard solution preparation, calibration curve plotting, extraction, and instrumental analyses for selected drugs and metabolites.
4. **CO4 (Analyze):** Compare and interpret analytical results to identify drugs, metabolites, and anabolic agents in various samples.
5. **CO5 (Evaluate):** Critically assess the accuracy, sensitivity, and limitations of different forensic drug analysis methods in terms of LOD, LOQ, and multicomponent estimation.

CP III: Forensic Pharmacy and Pharmacology of Controlled Drugs-PRACTICAL

1. Preparation of standard and working solutions.
2. Plotting of calibration curve and quantification using UV-Vis Spectroscopy
3. LLE & DLLME based extraction of drugs
4. FTIR based detection of various drug classes
5. Analysis of drugs and metabolites by LC-MS
6. Determining Limit of Detection & Limit of Quantitation of drug by UV-VIS
7. Multicomponent Quantitative estimation of drug by UV-VIS
8. Detection of anabolic agents in supplements by GCMS
9. Concept & Parts identification of GC, GCMS, HPLC

Learning Experience: Students will engage in hands-on laboratory sessions that provide direct exposure to drug extraction, detection, and quantification techniques using advanced analytical instruments such as UV-Vis Spectrophotometer, FTIR, LC-MS, GC, and HPLC. Through guided experiments, they will learn to prepare standard and working solutions, construct calibration curves, determine detection limits, and carry out multicomponent estimations. The course encourages problem-solving by requiring students to analyze and interpret experimental data, identify unknown samples, and evaluate the sensitivity of different analytical methods. Collaborative group work and case-oriented tasks will enhance teamwork, critical thinking, and analytical reasoning, while enabling students to connect laboratory practices with forensic applications in controlled drug analysis.

BSMFAF372	Advanced Forensic Toxicology	L	T	P	C
Version		3	0	0	3
Category of Course	Core Course 12				
Total Contact Hours	48 Hours				
Pre-requisites/Co-requisites	--				

Course Perspective: Advanced Forensic Toxicology explores the scientific principles and forensic applications of toxicology, focusing on the detection, analysis, and interpretation of toxicants in medico-legal contexts. The course integrates concepts of toxicological science, mechanisms of toxicity, regulatory frameworks, and post-mortem analysis to provide a holistic understanding of how xenobiotics affect living systems and how these effects can be investigated in forensic casework. By combining theory with applied knowledge, it prepares students to address real-world challenges in forensic laboratories, clinical settings, and legal investigations.

Course Outcome: Upon successful completion of the course, students will be able to:

1. **CO1 (Remember):** Define and recall fundamental concepts of toxicology, types of toxicants, regulatory frameworks, and related terminology.
2. **CO2 (Understand):** Explain principles of dose-response relationships, mechanisms of toxicity, factors influencing toxicity, and processes of toxicokinetics and toxicodynamics.
3. **CO3 (Apply):** Demonstrate the application of toxicological principles in assessing drug, pesticide, heavy metal, alcohol, and natural poison effects in forensic contexts.
4. **CO4 (Analyze):** Examine toxicological findings using chemical and instrumental methods, interpret post-mortem results, and differentiate mechanisms of toxicity across xenobiotics.
5. **CO5 (Evaluate):** Critically evaluate toxicological evidence, risk assessments, biomarker data, and regulatory standards in solving forensic toxicology cases.

Course Contents

Section I: Concepts of Toxicology Branches of toxicology, Toxicants and Types of Toxicants, Dose and related terms used in toxicology, Sources of poisoning, duration and frequency of exposure, modals of toxicity testing, Laws and Regulations in toxicological testing, Regulatory bodies national and International, Risk and Hazard characterization, Global Harmonization System (GHS), Good Laboratory Practice (GLP).
Section II: Principles of Toxicology: Dose-effects and dose-response relationship, types of toxicity, Factors affecting toxicity – species and strain, age, sex, nutritional status, hormones, environmental factors, circadian rhythms, Enzyme Induction and Inhibition, molecular mechanism of toxicity, role of electrophiles and nucleophiles in toxicity, translocation of toxicants, toxicokinetic and toxicodynamic processes, detoxification of xenobiotics, biotransformation of xenobiotics, bioaccumulation of xenobiotics, antidotal therapy.
Section III: Toxic effects of Xenobiotics Toxic effects of drugs, mechanism of drug toxicity, Toxic effects of pesticides, mechanism of pesticide toxicity, toxicity, Toxic effects of heavy metals, mechanism of heavy metal toxicity, Toxic effects of Alcohol and solvents, mechanism of poisonous liquor, Toxic effects of plant poisons, Toxic effects of insects and animal poison, toxicity symptoms and treatment of xenobiotics.
Section IV: Post-mortem toxicology, Methods of poison detection, chemical tests, Instrumental methods for toxicological examination, Toxicological analysis of decomposed material and body remains, metabolomics and biomarkers , challenges in forensic toxicological examination

Learning Experience: Students will experience a comprehensive blend of conceptual learning and applied toxicological analysis. The course encourages critical engagement with theoretical frameworks such as dose-response relationships, toxicokinetics, and molecular mechanisms of toxicity, while simultaneously connecting these concepts to practical applications in forensic investigations. Through exposure to case studies, discussions on regulatory systems, and exploration of toxic effects of xenobiotics, students will learn to bridge scientific knowledge with real-world forensic problems. In addition, emphasis on post-mortem toxicology, biomarker analysis, and challenges in decomposed samples will foster analytical reasoning and problem-solving skills. This integrated learning environment will

help students develop a deeper understanding of toxicological science, enhance their forensic interpretation abilities, and prepare them for professional roles in forensic and medico-legal domains.

Text Books

1. Casarett, L.J. & Doull, J. Toxicology: The Basic Science of Poisons. McGraw-Hill.
2. Gupta, P.K. Fundamentals of Toxicology: Essential Concepts and Applications. Elsevier Science, India, 2016.
3. Clark, E.G.C. Isolation and Identification of Drugs. 1966.
4. Connors, K. A Textbook of Pharmaceutical Analysis. Interscience, New York, 1975.

Suggested Readings

1. Curry, A.S. Analytical Methods in Human Toxicology, Part II. 1986.
2. Curry, A.S. Poison Detection in Human Organs. 1976.
3. Curry, A.S. Advances in Forensic Chemical Toxicology. 1972.
4. Hofmann, F.G. Handbook of Drug and Alcohol Abuse.
5. Turner, Drugs and Poisons.
6. Samford, Poisons: Their Isolation and Identification.
7. Stoleman, Progress in Chemical Toxicology.
8. Sunshine, I. Guidelines for Analytical Toxicology Programme, Vol. I. CRC Press, 1950.
9. Sunshine, I. Handbook of Analytical Toxicology. 1969.
10. Mule, S.J. et al. Immunoassays for Drugs Subject to Abuse. CRC Press, 1974.

Open Educational Resources (OER)

1. E-Pathshala (UGC/NCERT): Modules on Toxicology, Forensic Science, and related branches. https://epathshala.nic.in
2. National Digital Library of India (NDLI): Access to toxicology and forensic toxicology e-books and lecture notes. https://ndl.iitkgp.ac.in

3. PubChem (NIH): Free database for toxicological data, chemical structures, and drug properties. https://pubchem.ncbi.nlm.nih.gov
4. TOXNET (NIH/NLM): Toxicology data network with resources on drugs, chemicals, and poisons. https://toxnet.nlm.nih.gov
5. Open Textbook Library – Toxicology: Free access to toxicology and pharmacology textbooks. https://open.umn.edu/opentextbooks
6. Coursera / NPTEL: Free courses on Pharmacology and Toxicology. https://nptel.ac.in

BSMFAF387	**Advanced Forensic Toxicology-PRACTICAL**	**L**	**T**	**P**	**C**
Version		0	0	2	1
Category of Course	Core Practical IV				
Total Contact Hours	32 Hours				
Pre-requisites/Co-requisites	**--**				

Course Perspective: This course provides advanced practical training in the extraction, detection, and identification of toxic substances including pesticides, heavy metals, and plant poisons from biological samples. Emphasis is placed on both conventional and advanced instrumental techniques such as TLC, GC-MS, and ICP-MS, which are widely used in forensic laboratories. The course enables students to understand the complexity of toxicological analysis, strengthens their analytical skills, and prepares them for solving medico-legal cases involving poisons and toxicants.

Course Outcomes (COs)

1. **CO1 (Remember): Recall the principles of toxicant extraction and analytical techniques used in pesticide, heavy metal, and plant poison analysis.**
2. **CO2 (Understand): Explain the methodologies and toxicological relevance of TLC, GC-MS, and ICP-MS in the identification of xenobiotics.**

3. **CO3 (Apply): Perform extraction, identification, and analysis of organochlorine, organophosphorus, carbamate, pyrethroid pesticides, heavy metals, and plant poisons using conventional and modern techniques.**
4. **CO4 (Analyze): Interpret toxicological results obtained from TLC, GC-MS, color tests, and ICP-MS, and assess their forensic significance.**
5. **CO5 (Evaluate): Critically evaluate the sensitivity, accuracy, and limitations of conventional and advanced toxicological analysis methods in forensic casework.**

CP IV: Advanced Forensic Toxicology-PRACTICAL

1. Extraction and identification of organochlorine pesticides from biological matrices by TLC and GC-MS
2. Extraction and identification of organophosphorous pesticides from biological matrices by TLC and GC-MS
3. Extraction and identification of carbamates and pyretheroids from biological matrices by TLC and GC-MS
4. Identification of common plant poisons Oleander, Dhatura, Calotropis and Ricin etc by various analytical methods
5. Extraction of heavy metals by conventional methods and analysis by color tests.
6. Extraction and Analysis of heavy metals by microwave extraction and ICP-MS.

Learning Experience: Students will gain hands-on exposure to advanced forensic toxicological techniques through laboratory-based experiments that simulate real-case conditions. They will practice conventional extraction procedures alongside modern instrumental methods such as TLC, GC-MS, and ICP-MS, enabling them to compare the efficiency and applicability of various approaches. The practicals focus on pesticides, heavy metals, and plant poisons, thereby covering a wide spectrum of forensic toxicants relevant in medico-legal investigations. Through systematic experimentation, data interpretation, and group discussions, students will develop the ability to bridge theoretical toxicological knowledge with laboratory evidence. This experiential learning will enhance their problem-solving skills, forensic reasoning, and preparedness for professional practice in forensic laboratories and toxicology research.

Text Books

1. Casarett, L.J. & Doull, J. **Toxicology: The Basic Science of Poisons.** McGraw-Hill.
2. Gupta, P.K. **Fundamentals of Toxicology: Essential Concepts and Applications.** Elsevier Science, India, 2016.
3. Clark, E.G.C. **Isolation and Identification of Drugs.** 1966.
4. Connors, K. **A Textbook of Pharmaceutical Analysis.** Interscience, New York, 1975.

Suggested Readings

1. Curry, A.S. **Analytical Methods in Human Toxicology, Part II.** 1986.
2. Curry, A.S. **Poison Detection in Human Organs.** 1976.
3. Curry, A.S. **Advances in Forensic Chemical Toxicology.** 1972.
4. Hofmann, F.G. **Handbook of Drug and Alcohol Abuse.**
5. Turner, **Drugs and Poisons.**
6. Samford, **Poisons: Their Isolation and Identification.**
7. Stoleman, **Progress in Chemical Toxicology.**
8. Sunshine, I. **Guidelines for Analytical Toxicology Programme, Vol. I.** CRC Press, 1950.
9. Sunshine, I. **Handbook of Analytical Toxicology.** 1969.
10. Mule, S.J. et al. **Immunoassays for Drugs Subject to Abuse.** CRC Press, 1974.

Open Educational Resources (OER)

1. **E-Pathshala (UGC/NCERT): Modules on Toxicology and Forensic Science.** https://epathshala.nic.in
2. **National Digital Library of India (NDLI): E-books and lecture notes on forensic toxicology.**
   https://ndl.iitkgp.ac.in

3. **PubChem (NIH): Free chemical and toxicological database. https://pubchem.ncbi.nlm.nih.gov**
4. **TOXNET (NIH/NLM): Toxicology data network with extensive poison information. https://toxnet.nlm.nih.gov**
5. **Open Textbook Library – Toxicology & Pharmacology. https://open.umn.edu/opentextbooks**
6. **NPTEL / SWAYAM / Coursera: Free online courses in Toxicology, Pharmacology, and Forensic Science. https://nptel.ac.in**

BSMFMA388	**Modern and Applied Analytical Forensic Chemistry**	**L**	**T**	**P**	**C**
Version		3	0	0	3
Category of Course	Core Course 13				
Total Contact Hours	48 Hours				
Pre-requisites/Co-requisites	**--**				

Course Perspective: This course provides advanced knowledge of analytical chemistry as applied to forensic science, covering the chemistry and forensic analysis of drugs, narcotics, petroleum products, fire debris, explosives, and chemical warfare agents. Students will gain expertise in screening, confirmatory methods, and advanced instrumental techniques such as TLC, HPLC, GC-MS, ICP-MS, and IRMS. The course also emphasizes regulatory frameworks, courtroom testimony, report writing, and case study–based learning. By integrating theoretical foundations with applied forensic practices, it equips students with the skills required for forensic laboratories, regulatory agencies, and investigative work in narcotics, fire, explosives, and chemical warfare cases.

Course Outcome: Upon successful completion of the course, students will be able to:

1. **CO1 (Remember):** Recall the chemistry, classification, and forensic significance of drugs, narcotics, petroleum products, fire debris, explosives, and chemical warfare agents.
2. **CO2 (Understand):** Explain screening and confirmatory methods, instrumental principles, and forensic protocols for analytical toxicology and chemical evidence analysis.
3. **CO3 (Apply):** Demonstrate the use of chromatographic, spectroscopic, and elemental profiling techniques (TLC, GC-MS, HPLC, IRMS, ICP-MS) in forensic casework.
4. **CO4 (Analyze):** Examine chemical evidence from narcotics, petroleum residues, explosives, and ignitable liquids; interpret analytical data; and differentiate between similar substances.
5. **CO5 (Evaluate):** Critically evaluate forensic evidence reports, apply regulatory standards, and assess the reliability of forensic chemical analyses for legal and investigative purposes.

Course Contents
Section I: Advanced Forensic Drug Chemistry: Drug Trafficking, Forensic examination of drugs/Narcotics - Cannabis, Phenethylamines (Amphetamine, Methamphetamine), Hydroxyl derivative (Ephedrine), Ketone Derivative (Cathinone), Methoxy Derivative (Mescaline), Tertiary Amines (Cocaine and Opiates), Tryptamines(Psilocin and Psilocybin), Anabolic Steroids, Miscellaneous Controlled Substances(Barbiturates, Benzodiazepines, GHB, Ketamine and LSD).
Section II: Presumptive/Screening and Confirmatory Methods: Colour/spot test, microscopic examination, Microcrystalline tests, Thin-Layer Chromatography, Sample Preparation before TLC Specimen, Extraction Evaluation of TLC for Drug Screening, Immunoassay Methods other instrumental techniques (HPLC, GC, GC-MS) involved in analysis. Determination of origin of narcotic drug by IRMS , Elemental Profiling by ICP-MS-MS Format of NDPS Report Writing & Courtroom Testimony. Case studies.
Section III: **Petro Forensics**: Distillation and fractionation of petroleum. Commercial uses of different petroleum fractions. Physical Properties of Petroleum Products Analytical Techniques:

Quantitative and Qualitative Steps in Analysis of Petroleum, Analysis of traces of petroleum products in forensic exhibits. Case studies. **Fire Chemistry**: Scientific Investigation of Fire, NFPA 921 and NFPA 1033, Separation and analytical techniques of ignitable liquid residues, Interpretation of Data Obtained from Fire Debris, Quality Assurance in Fire debris Analysis, Report Writing and Court Testimony.Case studies.
Section IV: **Explosives Chemistry**: Introduction and assessment of explosives, Oxygen balance, Explosive Power Index, Heat and Temperature of Explosion, Pressure of explosion, Mechanism of Ignition and hot spot formation. Thermal decomposition, physical and chemical aspects of combustion, Deflagration and Detonation, Analysis of low and high explosives by different instrumental techniques, Quality control, Proficiency Testing, Interpretation and Significance of Results. Case studies **Chemical Warfare Agents**: Classification, physical and biochemical properties, toxic effects detection by Biosensors and various instrumental techniques

Learning Experience: Students will engage with a combination of lectures, case studies, laboratory demonstrations, and simulated forensic investigations to develop practical and theoretical expertise. They will learn to apply advanced analytical methods such as TLC, HPLC, GC-MS, ICP-MS, and IRMS for the detection, quantification, and profiling of narcotics, petroleum residues, fire debris, and explosives. Emphasis will be placed on developing analytical reasoning through problem-solving, interpretation of real forensic case data, and report writing in formats acceptable to courts. Exposure to national and international protocols, laboratory manuals, and case-oriented tasks will enhance students' ability to evaluate forensic chemical evidence, practice courtroom testimony, and integrate scientific analysis with medico-legal outcomes.

Text Books

1. Casarett, L.J. & Doull, J. Toxicology: The Basic Science of Poisons. 5th Ed., McGraw-Hill, 1995.
2. Clarke, E.G.C. Isolation and Identification of Drugs. Vol. I & II, 1966, 1975–1986.

3. Moffat, A.C., Osselton, D.M., Widdop, B. Clarke's Analysis of Drugs and Poisons in Pharmaceuticals, Body Fluids and Post-Mortem Material. 3rd Ed., Pharmaceutical Press, 2004.
4. Siegel, J.A., Saukko, P.J., Knupfer, G.C. Encyclopaedia of Forensic Sciences. Academic Press, 2000.
5. Skoog, D.A., West, D.M., Holler, F.J. Analytical Chemistry: An Introduction. Saunders College, 1994.
6. Bassett, J. et al. Vogel's Textbook of Quantitative Inorganic Analysis. Longman, 1978.

Suggested Readings

1. Modi, J.P. **Textbook of Medical Jurisprudence & Toxicology.** M.M. Tripathi Publication, 2001.
2. Pillay, V.V. **Handbook of Forensic Medicine and Toxicology.** Paras Publishing, 2001.
3. Saferstein, R. **Forensic Science Handbook.** Vol. I–III, Prentice Hall, 1982.
4. Saferstein, R. **Criminalistics – An Introduction to Forensic Science.** Prentice Hall, 1995.
5. James, S.H. & Nordby, J.J. **Forensic Science: An Introduction to Scientific and Investigative Techniques.** CRC Press, 2003.
6. Sunshine, I. **Methods for Analytical Toxicology.** CRC Press, 1975.
7. Bogusz, M.J. **Handbook of Analytical Separations, Vol. 2: Forensic Science.** Elsevier, 2000.
8. Stahl, E. **Thin Layer Chromatography: A Laboratory Handbook.** 1969.
9. Beveridge, A. **Forensic Investigation of Explosives.** Taylor & Francis, 2000.
10. Yinon, J. & Zitrin, S. **The Analysis of Explosives.** Pergamon Press, 1981.
11. Narayanan, T.V. **Modern Techniques of Bomb Detection and Disposal.** R.A. Security System, 1995.

12. Verma, R.M. **Analytical Chemistry – Theory and Practice.** CBS Publishing, 1994.
13. Svehla, G. (Ed.). **Vogel's Qualitative Inorganic Analysis.** Longman, 1998.
14. Vogel, A.I. **Practical Organic Chemistry Including Qualitative Organic Analysis.** ELBS, 1971.
15. Sarkar, S. **Fuels and Combustion.** Orient Longman, 1990.
16. Kinghorn. **Introduction to Petrochemicals.**
17. Waples, D.W. **Geochemistry in Petroleum Exploration.**
18. Waddams, A.L. **Petroleum Geochemistry and Geology Chemicals from Petroleum.**
19. Townsends, A. (Ed). **Encyclopaedia of Analytical Science.** Academic Press, 2005.
20. Day & Underwood. **Analytical Chemistry.**

Open Educational Resources (OER)

1. **E-Pathshala (UGC/NCERT):** Modules on Analytical Chemistry, Forensic Science, and Toxicology.
   https://epathshala.nic.in
2. **National Digital Library of India (NDLI):** Access to books, lecture notes, and forensic case study resources.
   https://ndl.iitkgp.ac.in
3. **PubChem (NIH):** Free resource for chemical properties, toxicological data, and controlled substances.
   https://pubchem.ncbi.nlm.nih.gov
4. **NIST Chemistry WebBook:** Database for spectra, thermochemical data, and analytical chemistry.
   https://webbook.nist.gov/chemistry/
5. **SWGDRUG (Scientific Working Group for the Analysis of Seized Drugs):** Free guidelines and methods for drug analysis.
   http://www.swgdrug.org

6. **NPTEL / SWAYAM:** Free online courses on Analytical Chemistry, Forensic Chemistry, and Fire & Explosion Investigation.
   https://nptel.ac.in
7. **Open Textbook Library – Analytical Chemistry & Forensic Science.**
   https://open.umn.edu/opentextbooks

BSMFAF387	**Modern and Applied Analytical Forensic Chemistry-PRACTICAL**	**L**	**T**	**P**	**C**
Version		0	0	2	2
Category of Course	Core Practical V				
Total Contact Hours	32 Hours				
Pre-requisites/Co-requisites	**--**				

Course Perspective: This course offers advanced practical exposure to the modern and applied analytical techniques used in forensic chemistry for the identification and characterization of narcotic drugs, psychotropic substances, cannabis, opium, and explosives. Students will gain hands-on experience in applying chromatographic, spectroscopic, and imaging techniques to detect and analyze controlled substances and explosive residues. The course bridges traditional chemical tests with cutting-edge instrumental methods, fostering skills essential for forensic investigations and legal proceedings.

Course Outcomes (COs)

1. CO1 (Remember): Recall the fundamental principles of microcrystalline tests, chromatographic separations, and instrumental techniques used in forensic chemistry.
2. CO2 (Understand): Explain the mechanisms and applications of TLC, UV-Vis, FTIR, Raman, GC-HS, GC-MS, IC, and CHNS/O techniques in the identification of drugs and explosives.
3. CO3 (Apply): Perform microcrystalline tests, TLC separation, and spectroscopic analysis for detecting narcotics, psychotropic substances, and explosive residues.

4. CO4 (Analyze): Interpret chromatographic and spectroscopic data to differentiate between various classes of drugs and explosives with accuracy and reliability.
5. CO5 (Evaluate): Critically assess the strengths and limitations of traditional chemical tests versus modern analytical techniques, and evaluate results in the context of forensic casework.

CP V: Modern and Applied Analytical Forensic Chemistry-PRACTICAL

1. Microcrystalline tests for Narcotic drugs.
2. Separation of Psychotropic substance by TLC.
3. Separation of Cannabis TLC, UV, FTIR
4. Separation of Opium by TLC, UV, FTIR
5. Analysis of high explosives by TLC, UV, FTI
6. Qualitative Analysis of fire residues by GC-HS and GC-MS.
7. Analysis of NDPS drugs and explosives by instrumental techniques.
8. Detection of drug classes by imaging system like Raman
9. Detection of Low explosives by Ion Chromatography
10. Organic composition profiling of drug class by CHNS/O

Learning Experience: The learning experience in this course is highly interactive and application-driven, where students transition from classical chemical identification methods to modern instrumental techniques in forensic chemistry. Through practical experiments, they will explore microcrystalline tests, chromatographic separation of narcotics and psychotropic substances, and spectroscopic profiling of drugs and explosives. Advanced exposure to instruments such as GC-HS, GC-MS, Raman spectroscopy, Ion Chromatography, and CHNS/O analysis deepens their understanding of complex forensic samples. By integrating qualitative and quantitative approaches, learners develop problem-solving abilities, critical thinking, and practical competencies necessary for handling real-world forensic investigations involving controlled drugs and explosives.

Text Books

1. Klaassen, C. D. *Casarett and Doull's Toxicology: The Basic Science of Poisons*. McGraw-Hill, 9th Edition.

2. Moffat, A. C., Osselton, M. D., Widdop, B., & Watts, J. *Clarke's Analysis of Drugs and Poisons in Pharmaceuticals, Body Fluids and Postmortem Material*. Pharmaceutical Press, 4th Edition.
3. Sharma, K. K. *Forensic Chemistry and Toxicology*. Global Vision Publishing, 2011.
4. James, S. H., & Nordby, J. J. *Forensic Science: An Introduction to Scientific and Investigative Techniques*. CRC Press, 5th Edition.

Suggested Readings

1. Meyers, R. A. (Ed.). *Encyclopedia of Analytical Chemistry*. John Wiley & Sons, 2000.
2. Karch, S. B. *Drug Abuse Handbook*. CRC Press, 2nd Edition, 2006.
3. Levine, B. (Ed.). *Principles of Forensic Toxicology*. AACC Press, 5th Edition, 2020.
4. Siegel, J. A., Saukko, P. J., & Knupfer, G. C. *Encyclopedia of Forensic Sciences*. Academic Press, 2nd Edition, 2013.
5. Marchant, C. A. *Forensic Chemistry*. Oxford University Press, 2018.
6. Mills, T., & Reeve, V. *Gas Chromatography–Mass Spectrometry (GC-MS): Principles and Applications in Forensic Science*. Wiley, 2019.
7. Yinon, J. *Forensic and Environmental Detection of Explosives*. Wiley, 1999.
8. McMurry, J., & Fay, R. C. *Chemistry*. Pearson, 7th Edition (for fundamental principles).

Open Educational Resources (OER)

1. ePathshala (MHRD, Govt. of India):

Forensic Science Modules – https://epgp.inflibnet.ac.in

Analytical Chemistry modules for forensic applications.

2. NPTEL Online Courses (IITs):

Forensic Science and Toxicology

Analytical Chemistry and Instrumentation

https://nptel.ac.in

3. UNODC eLearning Platform:

Drug identification, precursor control, NDPS substances, and toxicology.

https://www.unodc.org/elearning

4. SWAYAM Courses:

Basics of Forensic Chemistry & Toxicology

Instrumental Methods of Analysis

5. NIJ (National Institute of Justice, USA):

Forensic chemistry, explosives, and drug analysis resources.

https://nij.ojp.gov

Specialization-E: Digital Forensics

BSMFAD371	Advanced Digital Forensics	L	T	P	C
Version		3	0	0	3
Category of Course	Core Course 11				
Total Contact Hours	48 Hours				
Pre-requisites/Co-requisites	--				

Course Perspective: The course **Advanced Digital Forensics** equips learners with theoretical knowledge and practical skills in investigating cybercrimes and conducting digital forensic examinations across multiple platforms. Students will learn to handle digital evidence in accordance with international standards, explore forensic acquisition and analysis of Windows, Linux, and Mac systems, and gain proficiency in using state-of-the-art forensic tools. The course emphasizes legal compliance, chain of custody, and the ability to counter anti-forensic techniques, preparing students to handle real-world cybercrime investigations effectively.

Course Outcome: Upon successful completion of the course, students will be able to:

1. CO1 (Remember): Recall the fundamental principles of cyber-crime investigation, forensic processes, standards (Daubert, ISO/IEC 27037), hashing algorithms, and system artifacts.
2. CO2 (Understand): Explain procedures for digital evidence collection, acquisition, and preservation, along with the functioning of forensic tools and operating system artifacts (Windows, Linux, Mac).
3. CO3 (Apply): Apply forensic techniques such as imaging, cloning, data recovery, registry analysis, and command-line utilities to investigate digital evidence across platforms.

4. CO4 (Analyze): Analyze digital artifacts, system logs, and anti-forensic techniques to detect tampering, malware, ransomware, and hidden data within different environments.
5. CO5 (Evaluate): Evaluate forensic methods, tools, and investigation outcomes for their effectiveness, reliability, and admissibility in cyber-crime investigations.

Course Contents
Section I: Cyber-crime Investigation and Digital Forensics Introduction to cyber-crime investigation, Conducting an Investigation, preparing for search and seizure, securing crime scene, seizing digital evidence at SOC; Daubert Standards; ISO/IEC 27037: 2012; Forensics Investigation Process- Pre-search consideration, Collection of Evidences from crime scene, Acquisition, & Preservation, Examination and Analysis, Documentation and Reporting, Maintaining the Chain of Custody; Collection of Volatile and Persistent Data. Hashing Algorithms; Cloning of Digital Exhibits, Different Imaging Formats– Raw Format, Proprietary Formats, Advanced Forensic Formats; Imaging vs Cloning/Copying; Data Acquisition from live systems, Shutdown Systems, Remote systems, RAID Servers and Encrypted systems; Validating Data Acquisitions techniques (Linux and Windows); Digital Forensics Standard Operating Procedures. Software and Hardware Tools used in Forensic Analysis – Open Source and Proprietary tools; Challenges and issues in Cyber-crime investigation and Digital forensics.
Section II: Forensic Analysis of Windows System Artifacts File Systems, Registry, Event logs, Shortcut files, Executables; Windows registry, startup tasks, Jumplists, Volume Shadow Backup, Shellbags; Forensic Analysis of the Registry – Use of registry viewers, Amcache.hve, Shimcache.hve, Regedit; Extracting USB related artifacts and examination of protected storages. Email investigations; Data recovery – Tools and techniques; Malware and Ransomware Analysis; Recycle Bin Forensics (INFO, $I, $R files); Anti-forensic techniques and their detection: Data Wiping, Partition Deletion, Bit-Shifting, Alternate Data Streams (ADS), Hidden files, Data in the Slack Space and Unallocated Space, Steganography and Steganalysis, File Extension Mismatch, Disk Encryption etc.
Section III: Forensic Analysis of Linux and MAC System Artifacts Linux File-system and Artifacts – Introduction and Architecture of Linux OS, Booting Process, Basics of Linux file-system, Use of built-in command line tools for forensic investigation – dd, dcfldd, fdisk, mkfs, mount, unmount, md5sum, sha1sum, dmseg, grep, find, pstree, ls, kill, history, xxd; Hash Computation and Verification; Checking

File Extension Mismatch, Keyword Searching, Fragmentation of Forensic Images; Ownership and Permissions, Hidden files, User Accounts and Logs; Mounting of hard disk having forensic image; Timeline analysis. MAC File-system and Artifacts – Introduction to MAC OS and File-system, Booting Process in MAC, System Services, Hidden directories, System Logs and user artifacts; Forensic Acquisition and Analysis of Plists; Function of File Vault, Keychain.

Learning Experience: Students will engage in case-based learning, hands-on laboratory sessions, and simulation exercises replicating real-world cyber-crime investigations. Through structured assignments, practical demonstrations, and forensic tool exploration, learners will build technical competence in data acquisition, imaging, and artifact analysis across diverse operating systems. The course emphasizes critical thinking, legal-ethical decision-making, and reporting skills, ensuring graduates can contribute effectively in law enforcement, corporate investigations, and forensic consultancy.

Text Books

1. Bill Nelson, Amelia Phillips, and Christopher Steuart, *Guide to Computer Forensics and Investigations*, 5th Edition, Cengage, 2010.
2. Eoghan Casey, *Handbook of Digital Forensics and Investigation*, Elsevier Academic Press, 2009.
3. Harlan Carvey, *Windows Forensic Analysis Toolkit*, Syngress, 2012.

Reference Books

1. Dr. Darren Hayes, *A Practical Guide to Computer Forensics Investigation*, Pearson, 2014.
2. Dr. Philip Polstra, *Linux Forensics with Python and Shell Scripting*, Pentester Academy, 2015.
3. Jessie Varsalone and Rob Maxwell, *MAC OS X Forensic Field Guide: Digital Forensics Field Guides*, Syngress, 2015.

Open Educational Resources

1. NIST Digital Forensics Guidelines – https://csrc.nist.gov/publications
2. Digital Forensics Wiki – https://forensicswiki.xyz
3. SANS Digital Forensics Resources – https://digital-forensics.sans.org/resources

4. DFIR Training & Tools (DFIR Community) – https://dfir.training
5. National Cybersecurity Centre UK – Digital Forensics Guidance – https://www.ncsc.gov.uk/section/guidance/all-topics

BSMFAD386	**Advanced Digital Forensics-PRACTICAL**	**L**	**T**	**P**	**C**
Version		0	0	0	1
Category of Course	Core Practical III				
Total Contact Hours	32 Hours				
Pre-requisites/Co-requisites	--				

Course Perspective: This practical course focuses on developing **hands-on expertise** in advanced areas of digital forensics, enabling learners to apply investigative methods and tools to real-world cybercrime scenarios. Students will perform forensic analysis of Windows artifacts, recover hidden or deleted data, examine digital communication trails, and analyze malware behavior. The emphasis is on gaining **practical proficiency with forensic tools, evidence handling, and investigative reporting**, strengthening students' readiness for professional forensic casework.

Course Outcome: Upon successful completion of the course, students will be able to:

1. CO1 (Remember): Recall fundamental concepts of Windows registry, log data, steganography, slack space, email headers, and malware components.
2. CO2 (Understand): Explain the mechanisms of data hiding/un-hiding, slack space utilization, email tracing, and malware behavior in digital systems.
3. CO3 (Apply): Apply forensic techniques to analyze registry data, recover hidden or deleted information, trace email sources, and perform malware analysis.
4. CO4 (Analyze): Analyze recovered data, steganographic content, email headers, and malware activity to identify digital evidence and suspicious patterns.
5. CO5 (Evaluate): Evaluate the effectiveness of forensic tools and methodologies in detecting hidden data, analyzing malware, and validating investigation findings.

CP III: Advanced Digital Forensics-PRACTICAL

1. Windows Registry and Log Data Analysis
2. Hiding and Un-hiding information using steganography
3. Recovery and analysis of slack space data
4. Tracking and analysing of source of email

5. Static and Behavioural analysis of Malware

Learning Experience

Learners will work in **forensic labs and simulated cybercrime environments** to practice advanced digital forensic techniques. Each practical session involves **tool-based experiments, case simulations, and artifact recovery tasks**, allowing students to apply theoretical knowledge in real-time. Through **malware sandboxes, registry viewers, email tracing utilities, and steganography tools**, participants gain critical technical and investigative experience. Continuous practice ensures the development of analytical thinking, technical precision, and professional competence.

Text Books

1. Bill Nelson, Amelia Phillips, and Christopher Steuart, *Guide to Computer Forensics and Investigations*, 5th Edition, Cengage, 2010.
2. Harlan Carvey, *Windows Forensic Analysis Toolkit*, Syngress, 2012.
3. Eoghan Casey, *Handbook of Digital Forensics and Investigation*, Elsevier Academic Press, **2009.**

Reference Books

1. Dr. Darren Hayes, *A Practical Guide to Computer Forensics Investigation*, Pearson, 2014.
2. Michael Sikorski & Andrew Honig, *Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software*, No Starch Press, 2012.
3. Nina Godbole and Sunit Belapure, *Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives*, Wiley, 2011

Open Educational Resources

1. NIST Computer Forensics Resources – https://csrc.nist.gov/publications
2. Malware Analysis Tutorials (Practical Malware Analysis Labs) – https://practicalmalwareanalysis.com/labs/
3. Digital Forensics Wiki – https://forensicswiki.xyz
4. DFIR Training & Tools – https://dfir.training
5. SANS Digital Forensics & Incident Response Resources – https://www.sans.org/digital-forensics/

BSMFMN372	**Mobile and Network Forensics**	**L**	**T**	**P**	**C**
Version		3	0	0	3
Category of Course	Core Course 12				
Total Contact Hours	48 Hours				
Pre-requisites/Co-requisites	**--**				

Course Perspective: The course **Mobile and Network Forensics** provides students with an in-depth understanding of mobile device investigation, network traffic analysis, and forensic evidence collection in dynamic digital environments. It introduces mobile and networking technologies, forensic acquisition and analysis methods, as well as emerging practices in cloud and log forensics. Students gain both **theoretical knowledge and practical competencies** required to investigate mobile crimes, analyze communication records, and respond to network intrusions, preparing them for roles in law enforcement, cybersecurity, and digital forensic consultancy.

Course Outcome: Upon successful completion of the course, students will be able to:

1. CO1 (Remember): Recall the fundamentals of mobile and network technologies, file systems, operating systems, forensic processes, and commonly used tools in mobile and network investigations.
2. CO2 (Understand): Explain the functioning of mobile device components (SIM, IMEI, OS, applications), networking concepts (OSI/TCP-IP models, protocols, routing, logging), and forensic stages for evidence collection and preservation.
3. CO3 (Apply): Apply forensic acquisition methods (manual, logical, physical, advanced) to extract and analyze mobile data, perform log analysis, capture packets, and reconstruct file systems for investigative purposes.
4. CO4 (Analyze): Analyze artifacts from mobile devices, network traffic, router/firewall logs, and Windows registry/events to detect suspicious activities, cyber-attacks, and evidence of criminal behavior.
5. CO5 (Evaluate): Evaluate forensic methodologies, challenges, and tool effectiveness in mobile, network, and file system analysis to ensure accuracy, reliability, and admissibility of digital evidence.

Course Contents
Section I: Introduction to Mobile and Network Technologies Teaching Mobile Technologies - Asynchronous Transfer Mode (ATM), Wireless Application Protocol (WAP); Cellular technologies including Advanced Mobile Phone System (AMPS), Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA) and Global System for Mobile Communications (GSM); Functions of Subscriber Identity Module (SIM), International Mobile Equipment Identity (IMEI), Bluetooth and Mobile Payment Gateways; Understanding of the mobile phone operating systems – Android, iOS, Windows; Basics of Rooting \ Jailbreaking. Basics of Networking - Server, client, routers, Shared Printers and other peripherals, Network Interface Card. Network Devices – hubs, Switches, routers, repeaters; Network Topologies; Introduction to OSI model and TCP/IP model; HTTP, World Wide Web, Web Browsers, Web Servers, Domain Names, URL and DNS; IP addressing – types and classes; Types of Networks – LAN, MAN, WAN and PAN; Routers and Routing Protocols; Basics of Wi-Fi; Basics of Cloud Computing.

Section II: Mobile Device Forensics

Introduction to Mobile Forensic, Types of Evidence present in mobile phones - SIM card, Internal, and evidences in SD card; SIM Card File-system and architecture; Different Stages of Forensic Investigation, Building Mobile Forensic Toolkit, Seizure and Preservation of mobile phones, Data Acquisition, Examination and Analysis, Tool Selection; Data Acquisition Methods –

Manual, Physical, Logical, File System, Advanced Logical, Selective and Qualcomm Acquisition. Extraction of data from damaged phones: JTAG, Chip-off and Micro-Read; Good Forensic Practices; Tracking of mobile phone location. Analysis of mobile data like SMS, call logs, contacts, media files, recordings and important mobile application data (IM Chats like WhatsApp, telegram, iMessage, Email clients, Calendar, Reminder and Note apps); Challenges and Issues in Mobile forensics; CDR and IPDR analysis; Introduction to iOS Device Forensics.

Section III: Network Forensics and Analysis

Common Network Attacks; Post-mortem and Real-time analysis, Live Packet Capturing and Analysis; Searching and collection of evidences from the network; Monitoring of computer network and activities; Log files as Evidence: Legality of using Logs, Ensuring log file accuracy, Log Management System and its functions, Centralized Logging, Challenges and issues in log management and analysis; Event Correlation: Pre-requisites and approaches; Condensing Logs, Security Information and Event Management System (SIEM), tools for SIEM – Splunk, EDR Crowdstrike etc. Log capturing and analysis tools; Collection and Analysis of Router, Firewall and IDS logs; Evidence collection and analysis from CCTV DVRs; Network Packet Analyzer tools; Forensic analysis of online browsing activity and related artifacts; Introduction to Cloud Forensics.

Section IV:

File System Analysis: Understanding and Analysing FAT and NTFS File Systems, Recreating FAT and NTFS Partitions, Analysing Unallocated Partitions, Registry Analysis: Understanding Windows Registry, Analyzing Windows Registry, Finding Important Artefacts Related to user Activities, User/Application Configurations and Preferences; Attached Devices, Shared Locations, Recently Accessed Documents, Programs and Locations; Installed Applications and Others from Windows Registry, Event and Log Analysis: Introduction to Windows Events, Understanding Windows Events (Evt and Evtx Files). Analysing Logs of Third-Party Applications

Learning Experience:

Through this course, students will gain practical exposure to mobile and network technologies, including cellular systems, SIM architecture, mobile operating systems, and networking models. They will practice forensic acquisition methods such as manual, logical, physical, and advanced techniques, including specialized approaches like JTAG and chip-off

for damaged devices. Learners will analyze mobile artifacts such as SMS, call logs, media files, and application data, alongside conducting CDR/IPDR analysis. In network forensics, students will work with live packet capturing, log file analysis, router and firewall logs, and SIEM tools to investigate cyber incidents. Additionally, they will perform file system analysis of FAT and NTFS partitions, as well as Windows registry and log analysis to extract user and system activity. Overall, the course ensures hands-on competency in evidence collection, preservation, analysis, and evaluation across mobile, network, and system forensic domains.

Text Books

1. Satish Bommisetty, Rohit Tamma, and Heather Mahalik, *Practical Mobile Forensics*, PACKT Publishing, 2015.
2. Sherri Davidoff and Jonathan Ham, *Network Forensics: Tracking Hackers through Cyberspace*, Pearson, 2012.
3. Iosif I. Androulidakis, *Mobile Phone Security and Forensics: A Practical Approach*, Springer, 2012.

Reference Books

1. Samir Datt, *Learning Network Forensics*, PACKT Publishing, 2016.
2. Terrence V. Lillard, *Digital Forensics for Network, Internet and Cloud Computing*, Syngress, 2010.
3. Jonathan Zdziarski, *iOS Forensic Investigative Methods*, Syngress, 2012.\

Open Educational Resources

1. NIST Computer Forensics & Mobile Forensics Resources – https://csrc.nist.gov/publications
2. Mobile Forensics Open-Source Tools (DFIR Community) – https://dfir.training
3. Network Forensics Tutorials (Wireshark Official Documentation) – https://www.wireshark.org/docs/
4. National Cybersecurity Centre UK – Mobile & Network Security Guidance – https://www.ncsc.gov.uk/section/guidance/all-topics
5. SANS Institute Digital Forensics & Incident Response (DFIR) Resources – https://www.sans.org/digital-forensics/

BSMFMN387	**Mobile and Network Forensics-PRACTICAL**	**L**	**T**	**P**	**C**
Version		0	0	0	1
Category of Course	Core Practical IV				
Total Contact Hours	32 Hours				

Pre-requisites/Co-requisites	**--**

Course Perspective: The course Mobile and Network Forensics – Practical offers students hands-on exposure to evidence collection and analysis from mobile devices and computer networks. It emphasizes tool-based learning and practical case simulations, enabling learners to acquire and analyze data from Android devices, investigate mobile applications, capture and examine live network traffic, and trace user activities through browser artifacts. The focus is on strengthening technical competence and investigative reasoning to handle real-world cybercrime cases involving mobile and network evidence.

Course Outcome: Upon successful completion of the course, students will be able to:

1. **CO1 (Remember):** Recall and identify fundamental concepts, tools, and techniques used in mobile and network forensics.
2. **CO2 (Understand):** Explain the processes involved in data acquisition, mobile application analysis, network traffic monitoring, and browser artifact examination.
3. **CO3 (Apply):** Perform data acquisition from Android devices, analyze mobile applications, capture live packets, and use tools for network scanning in a forensic environment.
4. **CO4 (Analyze):** Differentiate and interpret digital evidence obtained from mobile devices, network traffic, and browser history to detect patterns of forensic significance.
5. **CO5 (Evaluate):** Assess the reliability, accuracy, and admissibility of forensic data acquired from mobile and network sources, justifying findings in investigative scenarios.

CP IV: Mobile and Network Forensics-PRACTICAL

1. Data Acquisition and Analysis of Android Phones
2. Analysis of Mobile Applications
3. Traffic Analysis of Network by Live packet capturing
4. Network scanning using different tools
5. Analysing Browser History and Browser Caches of windows system

Learning Experience:

Students will work in a **forensic laboratory environment** to perform real-time acquisition and analysis of mobile and network data. Through guided experiments and tool demonstrations, they will engage in **hands-on practice with Android forensic suites, packet sniffers (e.g., Wireshark), network scanners, and browser analysis utilities.** Each

session integrates problem-solving and investigative tasks to reinforce evidence-handling skills. Learners will also prepare lab reports to practice documentation, interpretation, and admissibility standards in mobile and network forensics.

Text Books

1. Satish Bommisetty, Rohit Tamma, and Heather Mahalik, *Practical Mobile Forensics*, PACKT Publishing, 2015.
2. Sherri Davidoff and Jonathan Ham, *Network Forensics: Tracking Hackers through Cyberspace*, Pearson, 2012.
3. Iosif I. Androulidakis, *Mobile Phone Security and Forensics: A Practical Approach*, Springer, 2012.

Reference Books

1. Samir Datt, *Learning Network Forensics*, PACKT Publishing, 2016.
2. Jonathan Zdziarski, *iOS Forensic Investigative Methods*, Syngress, 2012.
3. Terrence V. Lillard, *Digital Forensics for Network, Internet and Cloud Computing*, Syngress, 2010**.**

Open Educational Resources

1. Wireshark Official Documentation (Network Packet Analysis) – https://www.wireshark.org/docs/
2. NIST Guidelines on Mobile and Network Forensics – https://csrc.nist.gov/publications
3. Mobile Forensics Open-Source Tools (DFIR Training) – https://dfir.training
4. National Cybersecurity Centre (UK) – Forensic & Mobile Security Guidance – https://www.ncsc.gov.uk/section/guidance/all-topics
5. SANS Digital Forensics & Incident Response (DFIR) Resources – https://www.sans.org/digital-forensics/

BSMFVA373	**Vulnerability Assessment and Penetration Testing**	**L**	**T**	**P**	**C**
Version		3	0		3
Category of Course	Core Course 13				
Total Contact Hours	48 Hours				
Pre-requisites/Co-requisites	**--**				

Course Perspective: The course Vulnerability Assessment and Penetration Testing (VAPT) provides learners with the skills to identify, analyze, and exploit vulnerabilities in computer

networks, systems, and web applications. The course integrates theoretical foundations with hands-on practice in vulnerability scanning, network mapping, password attacks, and web application penetration testing. Students are trained to use industry-standard tools and methodologies while adhering to ethical hacking principles, equipping them for roles in cybersecurity, penetration testing, and network defense.

Course Outcome: Upon successful completion of the course, students will be able to:

1. **CO1 (Remember):** Recall the fundamental concepts of computer networks, OSI and TCP/IP models, types of vulnerabilities, and common tools used in vulnerability assessment and penetration testing.
2. **CO2 (Understand):** Explain the processes of network mapping, port scanning, service detection, and the methodologies behind vulnerability assessment, web application testing, and password attacks.
3. **CO3 (Apply):** Demonstrate the use of tools such as Nmap, OpenVAS, Netcat, SQLMap, John the Ripper, Burp Suite, and other utilities to perform vulnerability assessment and penetration testing tasks.
4. **CO4 (Analyze):** Examine and interpret results obtained from scanning, footprinting, web application exploitation, and password cracking to identify security weaknesses and potential attack vectors.
5. **CO5 (Evaluate):** Assess the effectiveness of different penetration testing techniques, compare results from automated and manual testing, and evaluate security measures to recommend appropriate countermeasures.

Course Contents
Section I: Introduction to Computer Network and Vulnerability: Assessments: Introduction of OSI and TCP/IP model, layers and its functionality, Introduction to Vulnerability Assessment, Life cycle of Vulnerability Assessment, Vulnerability Scanners, Manual Testing, Vulnerability testing using OpenVAS, Netcat, Introduction to Unknown Vulnerability Assessment.
Section II: Foot Printing and Scanning Foot printing: Mapping a Network: Why Map a (Remote) Network, Ping Sweeping: Fping, Nmap Ping Scan, OS Fingerprinting: Fingerprinting with Nmap Port Scanning : Under the Hood of a Port Scanner: TCP Three Way Handshake, Scanning with Nmap : Nmap Scan Types, TCP Connect Scan with Nmap , TCP SYN Scan with Nmap , Version Detection with Nmap , Specifying the Targets : By DNS Name , With an IP Addresses List , By Using CIDR Notation , By Using Wildcards , Specifying Ranges , Octets Lists , Combining the Previous Methods , Choosing the Ports to Scan , Nmap Examples, Port Scanning, Service Detection, Vulnerabilities Database Lookup

Section III: **Web Application Pen Testing**: Brute-force, Dictionary-based Enumeration. Cross Site Scripting ,XSS Actors, Vulnerable Web Applications, Users, Attackers, Finding an XSS, Reflected XSS Attacks, Reflected XSS Filters, Persistent XSS Attacks, Persistent XSS Attack Examples, Cookie Stealing via XSS,DOM XSS SQL Injections: SQL Statements, SELECT Example, UNION Example, SQL Queries Inside Web Applications, Vulnerable Dynamic Queries, Finding SQL Injections, Example - Finding SQL Injections, From Detection to Exploitation, Boolean Based SQL Injections, Exploiting a Boolean Based SQL Injection, Scripting Boolean Based SQL Injections, UNION Based SQL Injections, Exploiting UNION SQL Injections, SQL Injection (Blind), SQL Map with all options.
Section IV: **Password Attacks** - Brute Force Attacks: A Brute Force Algorithm, Brute Force Weaknesses, Dictionary Attacks, performing a Dictionary Attack, Weaknesses of Dictionary Attacks, Mangling Words, John the Ripper, Unshadow, Brute Force with John the Ripper, Dictionary Attacks with John the Ripper, Installing Password Dictionaries, Rainbow Tables, Rainbow Tables Limitations, Ophcrack, **Burp Suite**: Intercepting Proxies, Intercepting Proxy Example, Proxy Server Example, Burp Proxy, Burp Proxy Configuration, Burp Repeater, Command Execution, Cross Site Request Forgery, File Inclusion, File Upload, Insecure Captcha.

Learning Experience: Students will engage in **lab-based penetration testing scenarios**, gaining exposure to vulnerability assessment tools, scanning utilities, and exploitation frameworks. Practical exercises include **network footprinting, web application exploitation, password cracking, and proxy manipulation** using Burp Suite. Learners will gain confidence in conducting controlled penetration tests, writing structured reports, and proposing remediation strategies. The course emphasizes **ethical considerations, secure coding awareness, and real-world application of security testing techniques.**

Text Books

1. Andrew S. Tanenbaum and David J. Wetherall, *Computer Networks*, 5th Edition, Prentice Hall.
2. Dafydd Stuttard and Marcus Pinto, *The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws*, 2nd Edition, Wiley, 2007.
3. Bryan Sullivan and Vincent Liu, *Web Application Security: A Beginner's Guide*, McGraw-Hill, 2011.

Reference Books

1. Joseph Marshall, *Hands-On Bug Hunting for Penetration Testers*, Packt Publishing, 2018.
2. Serge Borso, *The Penetration Tester's Guide to Web Applications*, Artech House, 2019.

3. Andrew Hoffman, *Web Application Security: Exploitation and Countermeasures for Modern Web Applications*, O'Reilly Media, 2020.

Open Educational Resources

1. OWASP (Open Web Application Security Project) – https://owasp.org
2. Nmap Official Guide – https://nmap.org/book/
3. Metasploit Unleashed (Offensive Security Training) – https://www.offensive-security.com/metasploit-unleashed/
4. PortSwigger Web Security Academy (Burp Suite training) – https://portswigger.net/web-security
5. MITRE ATT&CK Framework – https://attack.mitre.org

BSMFVA388	**Vulnerability Assessment and Penetration Testing-PRACTICAL**	**L**	**T**	**P**	**C**
Version		0	0	2	1
Category of Course	Core Practical V				
Total Contact Hours	32 Hours				
Pre-requisites/Co-requisites	**--**				

Course Perspective: This course provides students with **practical insights into offensive security techniques** used in real-world vulnerability assessment and penetration testing. It emphasizes the dual need for **technical competence and ethical responsibility** when handling exploitation tools. The course bridges the gap between theoretical cybersecurity concepts and their **application in penetration testing environments**, preparing students for careers in cybersecurity, digital forensics, and ethical hacking.**Course Outcome**: Upon successful completion of the course, students will be able to:

Course Outcomes (COs)

1. CO1 (Remember): Recall the fundamentals of vulnerability assessment, penetration testing, and common exploit techniques.
2. CO2 (Understand): Explain the use of tools for banner grabbing, port scanning, and reconnaissance.
3. CO3 (Apply): Perform vulnerability assessment of websites/web applications using penetration testing tools.
4. CO4 (Analyze): Examine system vulnerabilities and attack surfaces through practical penetration testing techniques.
5. CO5 (Evaluate): Assess the ethical and professional implications of penetration testing and exploitation practices.

CP V: Vulnerability Assessment and Penetration Testing -PRACTICAL

1. Banner Grabbing and Enumeration of web server
2. Port Scanning and Google Dorking
3. Vulnerability Assessment of a website / web application
4. Social Engineering Exploit using Kali Linux
5. Erasing tracks using different tools

Learning Experience: The practical sessions are designed to provide students with **hands-on exposure** to core concepts of vulnerability assessment and penetration testing. Learners will gain experience in **banner grabbing, reconnaissance, vulnerability scanning, and exploiting weaknesses** in a simulated lab setup. Through these tasks, students will enhance their ability to **detect system vulnerabilities, conduct penetration testing responsibly, and understand real-world security threats**. The emphasis is on developing **critical thinking, technical competence, and ethical awareness** essential for cybersecurity professionals.

Text Books

1. Nelson, B., Phillips, A., & Steuart, C. (2019). *Guide to Computer Forensics and Investigations*. Cengage.
2. Easttom, C. (2018). *Computer Security Fundamentals*. Pearson.
3. Allen Harper, Shon Harris, Jonathan Ness et al. (2011). *Gray Hat Hacking: The Ethical Hacker's Handbook*. McGraw-Hill.

Reference Books

1. EC-Council. *Ethical Hacking and Countermeasures*. Cengage.
2. Erickson, J. (2008). *Hacking: The Art of Exploitation*. No Starch Press.
3. Dafydd Stuttard & Marcus Pinto. (2011). *The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws*. Wiley.

Open Educational Resources

1. OWASP (Open Web Application Security Project) [https://owasp.org]
2. Kali Linux Documentation [https://www.kali.org/docs/]
3. Metasploit Unleashed (Offensive Security) [https://www.offensive-security.com/metasploit-unleashed/]
4. NIST Cybersecurity Framework [https://www.nist.gov/cyberframework]
5. MIT OpenCourseWare – *Computer Systems Security* [https://ocw.mit.edu]

SYLLABUS-FOURTH SEMESTER

MSFS711	Project Work-II	L	T	P	C
Version1.0		0	0	0	16
Category of course	Major				
Total Contact Hours					
Pre-requisites/ Co-requisites	--				

Course Perspective: Students will be divided among faculty members of the Department for the supervision of the research work. In the first week of Semester III, each faculty member will assign a suitable research topic to the students from the selected topics in the areas of chemical sciences. The student will work on the assigned research topic during semesters III and IV in regular consultation with his/her assigned teacher. The student will write a dissertation based on the research work carried out during Semesters III and IV and prepare two copies to be submitted to the office of the Head of the Department duly signed by the student and the supervisor in the sixth week of IV semester or a date decided by the HoD. Before preparing power point presentation and submission of dissertation, each student has to deliver a seminar talk on his/ her research project work on a date fixed by HoD, necessary suggestions have to be incorporated in the final draft of dissertation. The student will make a power point presentation based on the work carried out and mentioned in the dissertation to the board of examiners appointed by the University.

Course Outcome:

Upon successful completion, the students will be able to:

1. Identify and formulate a relevant research question or hypothesis that addresses a significant issue in the field of study.
2. Conduct a comprehensive literature review to contextualize the research topic, identifying gaps in existing knowledge and establishing the theoretical framework.
3. Select and apply appropriate research methodologies and techniques for data collection and analysis, ensuring ethical considerations are addressed throughout the research process.
4. Analyze and interpret research findings using statistical or qualitative methods, drawing meaningful conclusions that contribute to the field of study.
5. Communicate research outcomes effectively through a well-structured research report or presentation, demonstrating clarity, coherence, and adherence to academic standards.

Learning Experience: The course will be conducted through hands-on research activities, where students choose a topic, design experiments, and collect data under faculty mentorship. Regular group discussions, peer reviews, and presentations will foster a participatory learning environment. The course will emphasize experiential learning through real-world problem-solving, encouraging students to apply theoretical knowledge in practical research settings.

Examination scheme

Particular	Weightage (Marks)
Internal Marks: - (Punctuality, Performance, Work Ethics, Efforts and Research Output)	50 marks
External Marks (Practical): - Presentation Report Writing Viva Voce	50 marks 20 10 20

MSFS814	Internship	**L**	**T**	**P**	**C**
Version 1.0		6	0	0	6

Category of Course	Internship
Total Contact Hours	
Pre-Requisites/Co-Requisites	Practical Exposure

Course Perspective:

The students will be asked to join research/academic organizations or industries to get hands on knowledge on the selected topics. The student will work on the assigned topic for 3-4 weeks in regular consultation with his/her assigned expert/guide. The student will write a report based on the work carried out during internship and prepare two copies to be submitted to the office of the Head of the Department duly signed by the student and the expert. The student will make a power point presentation based on the work carried out and mentioned in the report to the board of examiners appointed by the University in the third semester. The student will be evaluated based on a report and presentation.

Course Outcomes:

Upon completion of the course, the student will be able to:

1. Apply theoretical knowledge by effectively integrating concepts learned in coursework into practical situations encountered during the internship experience.
2. Develop professional skills such as communication, teamwork, problem-solving, and time management, enhancing overall readiness for future career opportunities.
3. Conduct practical research or projects relevant to the organization's goals, contributing valuable insights and demonstrating initiative in real-world applications.
4. Understand workplace dynamics by gaining insights into organizational culture, ethics, and professional relationships, enabling effective navigation of the work environment.
5. Reflect and evaluate the internship experience critically, assessing personal strengths, identifying areas for improvement, and articulating how the experience has shaped career aspirations and future professional development.

Learning Experience:

The internship course will be experiential through hands-on lab work, real-world research projects, and active participation in ongoing studies. Students will collaborate with faculty

and researchers, applying theoretical knowledge to experimental tasks and data analysis. Regular group discussions, progress presentations, and peer feedback will enhance collaborative learning. The course will also include reflective journaling to encourage self-assessment and growth throughout the internship.

Examination scheme:

Particular	**Weightage**
Internal Marks: - Internship completion certificate obtained from supervisor from host institute.	30 Marks
External Marks (Practical): - Presentation Report Writing Viva Voce	70 Marks 25 25 20