



**K.R. MANGALAM UNIVERSITY**  
THE COMPLETE WORLD OF EDUCATION

**SCHOOL OF BASIC AND APPLIED SCIENCES  
(SBAS)**

**Programme Handbook  
(Programme Structure & Evaluation Scheme)**

**Bachelor of Science (Honours / Honours with Research) in  
Forensic Science**

**Program Code- 212**

**FOUR YEAR UNDERGRADUATE PROGRAMME**

**As per National Education Policy 2020  
(Multiple Entry and Exit in Academic Programmes)  
(with effect from 2025-26 session)**

**Approved in the 38<sup>th</sup> Meeting of Academic Council Held on 28<sup>th</sup> June  
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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 presents four years undergraduate programme Bachelor of Science (Hons. with Research) Forensic Science i.e. (B.Sc. (Hons. with Research) Forensic Science) according to the New Education Policy-2020. We have designed a flexible choice-based credit system, multidisciplinary approach, and multiple entry and exit options for the duration of 2024-2028.

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 four-year undergraduate programme **B.Sc. (Hons. / Hons. with Research) 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: Important features integrated in the curriculum

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 21<sup>st</sup> century. Following the guidelines of NEP-2020 regarding curriculum structure and duration of the undergraduate programme, we now offer a Four-Year Undergraduate Programme with multiple entry and exit points, along with re-entry options, and relevant certifications.

- **UG Certificate** after completing 1 year (2 semesters with the required number of credits) of study, and an additional vocational course/internship of 4 credits during the summer vacation of the first year.
- **UG Diploma** after completing 2 years (4 semesters with the required number of credits) of study, and an additional vocational course/internship of 4 credits during the summer vacation of the second year.
- **Bachelor's Degree** after completing 3-year (6 semesters with the required number of credits) programme of study.
- 4-year **bachelor's degree (Honours)** with the required number of credits after eight semesters programme of study.
- Students who secure 75% marks and above in the first six semesters and wish to undertake research at the undergraduate level can choose a research stream in the fourth year. Upon completing a research project in their major area(s) of study in the 4th year, a student will be awarded **bachelor's degree (Honours with Research)**.

Advantage of pursuing 4-year bachelor's degree programme with Honours/Honours with Research is that the master's degree will be of one year duration. Also, a 4-year degree programme will facilitate admission to foreign universities.

**Table 1: Minimum Credit Requirement for Four Year UG Program**

S. No.	Broad Categories of Courses	Minimum Credit Requirement for Four Year UG Program
1	Major (Core)	72-74
2	Minor	32
3	Multidisciplinary (Open electives)	9
4	Ability Enhancement Course (AEC)	08

5	Skill Enhancement Course (SEC)	16
6	Value-Added Course (VAC)	04
7	Summer Internship	04
8	Research Project/Dissertation	08-10
9	Co-curricular activity	02
10	Discipline Specific elective	18
9	Total	176

## 2.1 Categories of Courses

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

**Minor:** Students will have the option to choose courses from disciplinary/interdisciplinary minors and skill-based courses. Students who take enough courses in a discipline or an interdisciplinary area of study other than the chosen major will qualify for a minor in that discipline or in the chosen interdisciplinary area of study.

**Students have multiple minor streams to choose from. They can select one minor stream from the available options, which will be pursued for the entire duration of the programme.**

**Multidisciplinary (Open Elective):** These courses are intended to broaden the intellectual experience and form part of liberal arts and science education. These introductory-level courses may be related to any of the broad disciplines given below:

- Natural and Physical Sciences
- Mathematics, Statistics, and Computer Applications
- Library, Information, and Media Sciences
- Commerce and Management
- Humanities and Social Sciences

**A diverse array of Open Elective Courses, distributed across different semesters and aligned with the aforementioned categories, is offered to the students. These courses enable students to expand their perspectives and gain a holistic understanding of various disciplines. Students can choose courses based on their areas of interest.**

**Ability Enhancement Course (AEC):** Students are required to achieve competency in a Modern Indian Language (MIL) and in the English language with special emphasis on language and communication skills. The courses aim at enabling the students to acquire and demonstrate the core linguistic skills, including critical reading and expository and academic writing skills, that help students articulate their

arguments and present their thinking clearly and coherently and recognize the importance of language as a mediator of knowledge and identity.

**Skills Enhancement Courses (SEC):** These courses are aimed at imparting practical skills, hands-on training, soft skills, etc., to enhance the employability of students.

**Value-Added Course (VAC):** The Value-Added Courses (VAC) are aimed at inculcating Humanistic, Ethical, Constitutional and Universal human values of truth, righteous conduct, peace, love, non-violence, scientific and technological advancements, global citizenship values and life-skills falling under below given categories:

- Understanding India
- Environmental Science/Education
- Digital and Technological Solutions
- Health & Wellness, Yoga education, Sports, and Fitness

**Research Project / Dissertation:** Students choosing a 4-Year Bachelor's degree (Honours with Research) are required to take up research projects under the guidance of a faculty member. The students are expected to complete the Research Project in the eighth 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 the 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 understanding ethical values and environmental realities

### **4. About the School of Basic and Applied Sciences**

The School of Basic and Applied Science imparts both teaching and research through its four disciplines of Forensic Science, Chemistry, 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 endeavours. 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: Bachelor of Sciences (Honours / Honours with Research) in Forensic Science**

The B.Sc. (Hons. / Hons. with Research) Forensic Science is an undergraduate 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 of basic and applied sciences. Students in this program will study fundamental principles of forensic science, engage in complex problem-solving, and enhance their analytical and critical thinking skills.. Students in this program will study fundamental principles of forensic science, engage in complex problem-solving, and enhance their analytical and critical thinking skills. Combining hands-on lab work with theoretical learning, they'll gain practical experience and a solid grasp of scientific research methods. The B.Sc. (Hons. / Hons. with Research) 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 B.Sc. (Hons. / Hons. with Research) 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 Four Year Undergraduate Degree programme B.Sc. (Hons. / Hons. with Research) Forensic Science with Multiple Entry- Multiple Exit option from the academic session 2023-24. Through multiple entry/exit option, students will be able to enter and exit the program at various stages. This course emphasized hands on practice, innovative thought process and project-based learning.

## **6.2. Aims of B.Sc. (Hons. / Hons. with Research) Forensic Science Programme**

The aims of the B.Sc. (Hons. / Hons. with Research) 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 B.Sc. (Hons. / Hons. with Research) 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 B.Sc. (Hons. / Hons. with Research) 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.

## **6.3 Definitions**

### **➤ Programme Outcomes (POs)**

Programme Outcomes are statements that describe what the students are expected to know and would be able to do upon the graduation. These relate to the skills, knowledge, and behavior that students acquire through the programme.

### **➤ 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.



## 6.4 Programme Educational Objectives (PEO)

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

**PEO1:** Graduates will evolve into proficient professionals, well-suited for roles in government, corporate, and research arenas, while also possessing the acumen for entrepreneurial pursuits in various interdisciplinary areas of forensic science.

**PEO2:** Graduates will demonstrate robust technical expertise to think critically and conduct thorough and accurate forensic analyses, interpreting results, and presenting findings effectively.

**PEO3:** Graduates will adhere to the ethical guidelines and legal frameworks governing the field, ensuring the responsible and unbiased application of forensic methodologies.

**PEO4:** Graduates will pursue lifelong learning and engage in advanced research, staying updated with emerging technologies and methodologies in forensic science.

**PEO5:** Graduates will demonstrate acumen for pursuing higher education and taking on roles in forensic laboratories, academic institutions, research or related industries, contributing to advancements in forensic science and public safety.

## 6.5 Programme Outcomes (PO)

At the time of graduation, students of undergraduate degree program will be able to:

**PO1- Critical Thinking:** Develop high order critical thinking skills to address and resolve real world forensic issues.

**PO2- Problem Solving:** Develop problem solving skills and employ innovative approaches for effectively investigating and reconstructing crime scene, handling evidence, scientific instruments and legal reports.

**PO3- Effective communication:** Develop strong communication skills including reading, writing, listening, and speaking, to effectively express ideas and viewpoints.

**PO4- Ethics:** Apply ethical principles and commit to professional ethics, responsibilities, and norms in academic and industrial environment.

**PO5- Interpersonal skills:** Interact wisely and smartly within the society at personal and professional levels with a focus on achieving their target without affecting the societal harmony.

**PO6- Environment and Sustainability:** Practice and abide by processes required for a sustainable, healthy and safe environment and maintain contextual understanding of current environmental issues.

**PO7- Team building and Leadership:** Foster self-confidence, leadership and collaborative skills to navigate between multicultural and multidisciplinary environments.

### 6.6 Programme Specific Outcomes (PSO)

At the end of the program the students will be:

**PSO 1:** Understanding basic principles, concepts, techniques and theories in forensic science to build a strong foundational knowledge.

**PSO 2:** Applying appropriate forensic methodologies and techniques to analyze physical, biological, chemical and digital evidence in real-life crime scenarios and laboratory settings.

**PSO 3:** Analyzing complex civil and criminal cases to develop critical thinking and problem-solving skills, enabling the formation of well-informed conclusions while upholding ethical standards and legal compliance.

**PSO 4:** Evaluating the validity and efficacy of various forensic approaches and modify them to enhance the accuracy and reliability of forensic analyses.

**PSO5:** Observe and apply spatial awareness to reconstruct crime scenes, using technical skills to accurately position evidence and illustrate potential event sequences effectively.

**PSO 6:** Creating innovative strategies to address and tackle complex challenges during forensic investigations and provide expert testimony in court.

### 6.7 Career Avenues

Graduates can pursue careers in research and development (R&D) in industries, work as research scientists or assistants in forensic science laboratories, or continue with higher education (M.Sc., PhD) leading to academic or specialized roles in Forensic Science. Opportunities also exist in sectors like govt. jobs, defence services, data science, finance, and competitive examinations.

### 6.8 Duration

The duration of this programme is four years (eight semesters) with multiple entry/exit options.

### 6.9 Criteria for award of certificates and degree

Name of Degree	Credits requirement	Completion Year
UG Certificate Forensic Science	<b>41 Credits</b>	First Year
UG Diploma Forensic Science	<b>92 Credits</b>	Second Year
B.Sc. Forensic Science	<b>132 Credits</b>	Third Year
B.Sc. (Hons. / Hons. With	<b>175 Credits</b>	Fourth Year (Students who

Research) Forensic Science-		secure 75% marks and above in the first six semesters and wish to undertake research at the undergraduate level)
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The student must fulfil the credit requirement as prescribed in Table 2 (Programme Study)

## **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**

The School of Basic and Applied Sciences (SBAS) emphasizes 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 offers 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
<b>Internal Marks (Theory): -</b> <b>I) Continuous Assessment (30 Marks)</b> <b>(All the components to be evenly spaced)</b> Projects/ Quizzes/ Assignments and Essays/ Presentations/ Participation/ Case Studies/ Reflective Journals (minimum of five components to be covered)	30 Marks
Mid Term Exam	20 Marks
<b>External Marks (Theory): –</b> End Term Examination	50 Marks

**\* (It is compulsory for a student to secure 40% marks in the Internal and End Term Examination separately to secure minimum passing grade).**

**Overview of Internal Evaluation (30 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 30 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**

Particular	Weightage
<b>Internal Marks (Practical): -</b>	
I) Conduct of Experiment	10 Marks
II) Lab Records	10 Marks
III) Lab Participation	10 Marks
IV) Lab Project	20 Marks
<b>External Marks (Practical): -</b>	
End Term Practical and Viva Voce	50 Marks

**\* (It is compulsory for a student to secure 40% marks in Internal and End Term Practical's and Viva Voce separately to secure minimum passing grade).**

**8.3 Evaluation scheme for research project**

Particular	Weightage
<b>Internal Marks: -</b> (Punctuality, Performance, Work Ethics, Efforts and Research Output)	50 Marks



<b>External Marks (Practical): -</b>	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**

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

#### **8.5 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.

<b>Marks Range (%)</b>	<b>Letter Grade</b>	<b>Grade Points</b>	<b>Description of the Grade</b>
%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

## 9. 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.

**Table 2. Programme Structure**

Semester-I										
S. No.	Category of Course	Course Code	Course	L	T	P	C	Hours/week	Multiple Exit and Entry	
1	Major 1	BSFSIF101	Introduction to Forensic Science	3	0	0	3	3	Award: UG Certificate [after completing 1 year of study (2	
2	Major 2	BSFSFC102	Forensic Criminology	3	0	0	3	3		
3	Major 3	BSFSCH103	Inorganic and Organic chemistry-I	2	0	0	2	2		
4	Major Lab I	BSFSPC151	Practical-Chemistry I	0	0	2	1	2		
5	Major 4	BSFSPH104	Forensic photography	3	0	0	3	3		
6	SEC I	BSFSFP152	Forensic Practical I	0	0	4	2	4		
7	VAC I		Environmental Studies	2	0	0	2	2		
8	DSE I	BSFSCB105/ BSFSEP105	Cell Biology /Elements of Physics	3	0	0	3	3		

	Total Credits							19	22	semesters with credits as prescribed), and an additional vocational course/internship of 4 credits to be covered within 6-8 weeks during the summer vacation of the first year]
Semester - II										
S. No.	Category of Course	Course Code	Course	L	T	P	C	Hours/week		
9	Major 5	BSFSFD201	Forensics Dermatoglyphics	3	0	0	3	3		
10	Major 6	BSFSQD202	Questioned Document	3	0	0	3	3		
11	Major 7	BSFSCH203	Chemistry of elements	2	0	0	2	2		
12	Major Lab II	BSFSPC251	Practical-Chemistry II	0	0	2	1	2		
13	Minor I	UNMIDF206	Fundamentals of Digital Forensics & its legal implications	3	0	2	4	5		
14	SEC II	BSFSFP252	Forensic Practical II	0	0	4	2	4		
15	OE I*		Choose any one	3	0	0	3	3		
16	DSE II	BSFSBC205/ BSFSME205	Biodiversity and Classification/Physics of Mechanics	3	0	0	3	3		
17	Co-curricular activity I		Club and Society	0	0	0	1	0		
	Total credits							22	25	
* Internship will be of 4-6 weeks duration at the end of Semester II during summer break and the evaluation will be done during Semester III										

<b>Semester-III</b>										
<b>S. No.</b>	<b>Category of Course</b>	<b>Course Code</b>	<b>Course</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>Hours/week</b>	<b>Multiple Exit and Entry</b>	
18	Major 8	BSFSFB301	Forensic Ballistics and Explosives	3	0	0	3	3	Award: UG Diploma [after completing 2 years of study]	
19	Major 9	BSFSBS302	Forensic Biology and Serology	3	0	0	3	3		
20	Major 10	BSFSCH303	Physical chemistry	2	0	0	2	2		
21	Major Lab III	BSFSPC351	Practical-Chemistry III	0	0	2	1	2		
22	Minor II	UNMIDF301	Mobile Device Forensics and Investigation	3	0	2	4	5		

23	SEC III	BSFSFP352	Forensic Practical III	0	0	4	2	4	(4 semesters with credits as prescribed), and an additional vocational course/internship of 4 credits to be covered within 6-8 weeks during the summer vacation of the second year]	
24	DSE III	BSFSDZ305/ BSFSPM305	Developmental zoology/Physics of Electricity and magnetism	3	0	0	3	3		
25	SI	BSFSIN306	Evaluation of Summer internship-I	0	0	0	2	0		
26	OE II*		Choose any one	3	0	0	3	3		
27	AEC I		Self Awareness	2	0	0	2	2		
28	Co-curricular activity II		Community services	0	0	0	1	0		
	Total Credits							26	27	Entry: The student who took exit after completion of the first year (UG Certificate) is allowed to enter the diploma programme within five years from the first entry in the programme, four years in case of degree program and three years in case of Hons. degree to complete the programme within the stipulated time period of seven years.
Semester IV										
S. No.	Category of Course	Course Code	Course	L	T	P	C	Hours/week		
29	Major11	BSFSBS401	Forensic Physics and Biometric System	3	0	0	3	3		
30	Major 12	BSFSFA402	Forensic Anthropology	3	0	0	3	3		
31	Major 13	BSFSCH403	Analytical chemistry	2	0	0	2	2		
32	Major Lab IV	BSFSPC451	Practical-Chemistry IV	0	0	2	1	2		
33	Minor III	UNMIDF401	Operating Systems and Cloud Forensics	3	0	2	4	5		
34	SEC IV	BSFSFP452	Forensic Practical IV	0	0	4	2	4		
35	VAC II		Forensic Engineering	3	0	0	3	3		
36	DSE IV	BSFSMZ405/ BSFSWA405	Molecular Zoology /Wave and optics	0	0	0	2	0		
37	OE III*		Choose any one	3	0	0	3	3		
38	AEC II		Communication and Personality Development	2	0	0	2	2		
	Total Credits							25	27	

**\* Internship will be of 4-6 weeks duration at the end of Semester IV during summer break and the evaluation will be done during Semester V**

Semester-V									
S. No.	Category of Course	Course Code	Course	L	T	P	C	Hours/ week	
39	Major 14	BSFSFM501	Forensic Medicine	3	0	0	3	3	<b>Award: Bachelor's Degree</b> [after completing 3-year of study (6 semester s with credits as prescribed)] Entry: The student who took exit after completion of two years of study (UG Diploma) are allowed to re-enter the degree programme within three years and complete the degree programme within the stipulated maximum period of seven years.
40	Major 15	BSFSCT502	Forensic Chemistry and Toxicology	3	0	0	3	3	
41	Major 16	BSFSCH503	Inorganic and Organic chemistry-II	2	0	0	2	2	
42	Major Lab V	BSFSPC551	Practical-Chemistry V	0	0	2	1	2	
43	Minor IV	UNMIDF501	Social Media Forensics and Data Privacy	3	0	2	4	5	
44	SEC V	BSFSFP552	Forensic Practical V	0	0	4	2	4	
45	DSE V	BSFSEZ505 /BSFSTP505	Evolutionary Zoology/Thermal Physics	3	0	0	3	3	
46	AEC III		Arithmetic Reasoning & Skills	2	0	0	2	2	
47	SI	BSFSIN506	Evaluation of Summer internship-II	0	0	0	2	0	
48	Minor V	UNMIDF502	Digital Forensic Project	0	0	0	4	0	
	Total Credits						26	24	
Semester VI									
S. No.	Category of Course	Course Code	Course	L	T	P	C	Hours/week	
49	Major 17	BSFSPP601	Forensic Psychology	3	0	0	3	3	
50	Major 18	BSFSCH602	Inorganic and Organic Chemistry-III	2	0	0	2	2	
51	Major Lab VI	BSFSPC651	Practical-Chemistry VI	0	0	2	1	2	
52	Minor VI	UNMIDF601	Digital Forensics & Cyber Security	3	0	2	4	5	

53	SEC VI	BSFSFP652	Forensic Practical VI	0	0	4	2	4	
54	DSE VI	BSFSAZ605/BSF SSP605	Applied Zoology/Solid state physics	3	0	0	3	3	
55	AEC IV		Organisational Management	0	0	4	2	4	
56	Major 19	BSCCRM606	Research methodology	3	0	0	3	3	
<b>Total Credits</b>						<b>20</b>	<b>26</b>		

Semester-VII [For B.Sc. (H) Forensic Science]									
S. No.	Category of Course	Course Code	Course	L	T	P	C	Hours/week	Multiple Entry
58	Major 20	BSFSIN701	Instrumental Techniques	3	0	0	3	3	<b>Entry</b> The student who took exit after completion of three years of study (UG degree) is allowed to re-enter the degree programme maximum within three years and complete the degree programme within the stipulated maximum period of seven years.
59	Minor VII	UNMIDF702	Multimedia Forensics	3	0	2	4	5	
60	Major 21	BSFSQM703	Quality management	3	0	0	3	3	
61	Major 22	BSFSFO704	Forensic Odontology	4	0	0	4	4	
62	SEC VII	BSFSFP751	Forensic Practical VII	0	0	4	2	4	
	Total Credits						16	19	
Semester-VIII [For B.Sc. (H) Forensic Science]									
S. No.	Category of Course	Course Code	Course	L	T	P	C	Hours/week	
63	Major 23	BSFSFG801	Forensic Genomics and DNA profiling	3	0	0	3	3	
64	Minor VIII	UNMIDF802	Network Security and Incident Response	3	0	2	4	5	

65	Major 24	BSFSWF803	Wildlife Forensics	0	0	4	2	4	
66	SECVIII	BSFSFP851	Forensic Practical VIII	4	0	0	4	4	
67	Project	BSFSPP804	Capstone Project	0	0	0	8	0	
<b>Total Credits</b>							<b>21</b>	<b>16</b>	

Semester-VII [For B.Sc. (H) Forensic Science with Research]									
S. No.	Category of Course	Course Code	Course	L	T	P	C	Hours/week	Multiple Entry
58	Major 20	BSFSIN701	Instrumental Techniques	3	0	0	3	3	<b>Entry</b> The student who took exit after completion of three years of study (UG degree) is allowed to re-enter the degree programme maximum within three years and complete the degree programme within the stipulated
59	Minor VII	UNMIDF702	Multimedia Forensics	3	0	2	4	5	
60	Major 21	BSFSQM703	Quality management	3	0	0	3	3	
61	Major 22	BSCCRW706	Research Report Writing	3	0	0	3	3	
62	SEC VII	BSFSFP751	Forensic Practical VII	0	0	4	2	4	
	Total credits						15	18	
Semester-VIII [For B.Sc. (H) Forensic Science with Research]									



S. No.	Category of Course	Course Code	Course	L	T	P	C	Hours/week	maximum period of seven years.
63	Major 23	BSFSFG801	Forensic Genomics and DNA profiling	3	0	0	3	3	
64	Minor VIII	UNMIDF802	Network Security and Incident Response	3	0	2	4	5	
65	Major 24	BSFSST803	Biostatistics	3	0	0	3	3	
66	SECVIII	BSFSFP851	Forensic Practical VIII	0	0	4	2	4	
67	Project	BSFSDR804	Dissertation	0	0	0	10	0	
Total Credits							22	15	

**TOTAL CREDITS -175**

DISCIPLINE SPECIFIC ELECTIVE -I						
Semester	Course Code	Course	L	T	P	C
1	BSFSCB105	Cell Biology	3	0	0	3
2	BSFSBC205	Biodiversity and classification	3	0	0	3
3	BSFSDZ305	Developmental zoology	3	0	0	3
4	BSFSMZ405	Molecular Zoology	3	0	0	3
5	BSFSEZ505	Evolutionary Zoology	3	0	0	3
6	BSFSAZ605	Applied Zoology	3	0	0	3

DISCIPLINE SPECIFIC ELECTIVE -II						
Semester	Course Code	Course	L	T	P	C
1	BSFSEP105	Elements of Physics	3	0	0	3
2	BSFSME205	Physics of Mechanics	3	0	0	3
3	BSFSPM305	Physics of Electricity and magnetism	3	0	0	3

<b>4</b>	<b>BSFSWA405</b>	Wave and optics	3	0	0	3
<b>5</b>	<b>BSFSTP505</b>	Thermal Physics	3	0	0	3
<b>6</b>	<b>BSFSSP605</b>	Solid state physics	3	0	0	3

<b>Details of Digital Forensics as Minor</b>						
<b>Semester</b>	<b>Course Code</b>	<b>Course</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>2</b>	<b>UNMIDF206</b>	Fundamentals of Digital Forensics & its legal implications	3	0	2	4
<b>3</b>	<b>UNMIDF301</b>	Mobile Device Forensics and Investigation	3	0	2	4
<b>4</b>	<b>UNMIDF401</b>	Operating Systems and Cloud Forensics	3	0	2	4
<b>5</b>	<b>UNMIDF501</b>	Social Media Forensics and Data Privacy	3	0	2	4
<b>5</b>	<b>UNMIDF502</b>	Minor Project (DFIS)	0	0	0	4
<b>6</b>	<b>UNMIDF601</b>	Digital Forensics & Cyber Security	3	0	2	4
<b>7</b>	<b>UNMIDF702</b>	Multimedia Forensics	3	0	2	4
<b>8</b>	<b>UNMIDF802</b>	Network security and Incident Response	0	0	0	4

## 11. Syllabi

### FIRST SEMESTER

<b>BSFSIF101</b>	Introduction to Forensic Science	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version 1.0</b>		3	0	0	3
<b>Category of Course</b>	Major				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** This course offers an in-depth understanding of forensic science's evolution, principles, and its application in criminal investigations. It covers the development of forensic labs, evidence types, and the role of expert testimony in court. Students will learn about crime scene

investigation, documentation, and crime scene reconstruction, equipping them with practical skills in forensic analysis and legal applicability. The course blends theoretical knowledge with hands-on approaches, preparing students for real-world forensic challenges.

**Course Outcome:** Students will be:

**CO1. Understanding** the history and development of forensic science, including its definitions, principles, and the organizational structure of forensic laboratories, as well as the processes involved in report writing and chain of custody.

**CO2. Applying** knowledge of crime scene investigation techniques by defining crime scenes, identifying challenges associated with different types of crime scenes, and employing effective documentation and evidence handling practices.

**CO3 Analysing** modus operandi, crime scene reconstruction procedures by understanding the requirements for reconstruction along with analysis of applications of various types of evidence in court, exploring the laws of evidence and the significance of expert testimony in establishing the admissibility of scientific evidence within the legal framework.

**CO4. Evaluating** the importance of crime scene management roles and responsibilities of the investigating officer and expert teams along with analysis of various searching techniques used for locating physical evidence, as well as the impact of effective documentation on the overall investigation process.

<b>Course contents</b>	<b>:45 Hours</b>
<b>Unit I: History and development of Forensic Science</b>	<b>:10Hours</b>
Definition, Description, Principles, Concept, Needs and scope. History of Forensic Science and Forensic Science Labs; Progressive development and transformation of Forensic Science Labs; Hierarchical set up of Central Forensic Science Laboratories, State Forensic Science Laboratories; Basic services and optional services; Main Authority, Organizational structure of Forensic Science Laboratory – roles and responsibilities, Sections/ Divisions, Services provided, Process of report writing and submission to court, Chain of custody.	
<b>Unit II: Evidence Applicability in Court</b>	<b>:10Hours</b>
Definition, Various types of evidences, Laws of evidence, Expert's testimony and admissibility of scientific evidence in Court of Law.	
<b>Unit III: Crime Scene investigation</b>	<b>:15Hours</b>
Defining a crime and crime scene, Importance of crime scene, Problems associated with crime scenes (indoor and outdoor), Location and processing of Crime Scene; Introduction to Crime Scene Management, Handling clues and evidence; Types of crime scenes, Primary, Secondary crime scene, Mobile, Indoor and Outdoor crime scenes; Searching techniques used for locating physical evidences at scene of crime; Crime Scene documentation, Barricade of Crime Scene, Crime Scene Photography,	

Videography; Sketching; Notes making.

#### **Unit IV: Crime Scene Reconstruction**

**:10Hours**

Procedure and requirement for Crime Scene Reconstruction, Modus operandi, Expert team constitution for different crime scenes, Roles of Investigating Officer.

#### **Learning Experience:**

This course will be a mix of lectures, interactive sessions, and hands-on learning to deepen the understanding of origin of forensic science, history of forensic science, evidences at crime scene and crime scene investigation.

#### **Instruction Methods:**

1. **Lectures:** Core concepts will be taught using multimedia presentations and problem-solving sessions.
1. **Interactive Sessions:** Q&A segments, live quizzes, and discussions will engage students and reinforce learning.

#### **Technology Use:**

1. **Online Platforms:** An LMS will provide resources, recorded lectures, and discussion forums for extended learning.

#### **Assessments:**

1. **Formative:** Quizzes and online discussions will provide continuous feedback.
2. **Summative:** Exams, peer reviews, and presentations will evaluate overall understanding.

**Support:** The course instructor will be available for additional guidance, and peer collaboration will be encouraged. Regular feedback will help students improve and achieve course outcomes

#### **Textbook:**

1. DeForest, P., Gaensslen, R., and Lee, H., Forensic Science; an Introduction to Criminalistics, McGraw Hill, New York, 1983.

#### **Reference Books :**

1. James, S. H. And Nordby, J. J. (Eds), Forensic Science - An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.

- James, S., and Eskerc, W., Interpretation of Blood Stain Evidence at Crime Scenes, (2<sup>nd</sup>Edn) CRC Press, Boca Raton, Florida, 1999.
- Saferstein, Richard, Criminalistics, An Introduction to Forensic Science, 6<sup>th</sup> Ed. Prentice- Hall, New Jersey, 1998.
- Sharma, B. R., Forensic Science in Criminal Investigation and Trials (3<sup>rd</sup>Edn) Universal Law Publishing Co. Ltd. New Delhi, 2001.

### Open Educational Resources (OER)

- <https://www.open.edu/openlearn/science-maths-technology/what-forensic-science>
- <https://www.coursera.org/learn/forensic-science>
- <https://www.futurelearn.com/courses/introduction-to-forensic-science>

### Examination Scheme:

Evaluation components	Weightage
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>BSFSFC102</b>	Forensic Criminology	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version 1.0</b>		3	0	0	3
<b>Category of Course</b>	Major				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** This course provides an interdisciplinary foundation in forensic criminology, combining criminological theories with scientific investigative methods. It covers classical, positivist, and sociological perspectives on criminal behavior, along with modern practices like offender profiling. Exploring various crime typologies, including cybercrime, hate crimes, and white-collar offenses, while examining the structure and functioning of the criminal justice system. The course also emphasizes

understanding key legal frameworks such as the IPC, CrPC, IEA, and newly implemented BNS, BSA, and BNSS. Through critical engagement with crime data, including NCRB statistics and global trends, learners will develop analytical skills for evaluating criminal patterns and designing prevention strategies.

**Course Outcome:** Students will be:

**CO1. Understanding** the foundational concepts of forensic criminology, including definitions, aims, scope, and key theories of criminal behavior, demonstrating comprehension of interdisciplinary links with related fields.

**CO2. Applying** various forms and typologies of crime, including emerging crimes like cybercrime, and critically evaluate the causes, consequences, and behavioral patterns of offenders.

**CO3. Analysing** the structure and functioning of the criminal justice system, including policing, courts, corrections, and human rights considerations in forensic investigations.

**CO4. 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 law to assess their impact on crime prevention and justice delivery.

<b>Course contents</b>	<b>:45 Hours</b>
<b>Unit I: Foundations of Forensic Criminology</b> Definition, aims and scope. Theories of criminal behavior – classical, positivist, sociological; Criminal profiling; Understanding modus operandi. Interdisciplinary Nature of criminology-Relation with Penology, Psychology, Sociology, Victimology, Criminal Law, Forensic Science.	<b>:10 Hours</b>
<b>Unit II: Fundamentals of crime</b> Elements, nature, causes and consequences of crime. Deviant behavior. Forms of Crime and Criminal Typologies - White Collar, Organized, and Environmental Crimes - Habitual, Professional, Violent, Aggressive, Sexual Offenders, Recidivists, Emerging crimes - Cybercrime (Economic and Social Media Offences), Corporate Crimes - Hate Crimes, Gender Violence, Situational Criminality	<b>:10 Hours</b>
<b>Unit III: Criminal Justice System</b> Structure and functioning of the criminal justice system including policing, courts, and corrections; policing styles and principles; police powers, investigation procedures, and filing charges; community policing in a diverse society; correctional measures and offender rehabilitation; human rights in forensic investigations.	<b>:10 Hours</b>
<b>Unit IV: Modern Legal Reforms, Punishment, and Crime Prevention</b> 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	<b>:15 Hours</b>

**Learning Experience:** This course will be a mix of lectures, interactive sessions, and hands-on learning to deepen the understanding of key concepts of forensic criminology, from criminal profiling to emerging crime trends. Students will analyze criminal behavior through interdisciplinary perspectives, including psychology, sociology, and law, while gaining practical insights into the criminal justice system, policing, and legal procedures.

#### **Instruction Methods:**

1. **Lectures:** Core concepts will be taught using multimedia presentations and problem-solving sessions.
2. **Interactive Sessions:** Q&A segments, live quizzes, and discussions will engage students and reinforce learning.

#### **Technology Use:**

1. **Online Platforms:** An LMS will provide resources, recorded lectures, and discussion forums for extended learning.

#### **Assessments:**

1. **Formative:** Quizzes and online discussions will provide continuous feedback.
2. **Summative:** Exams, peer reviews, and presentations will evaluate overall understanding.

**Support:** The course instructor will be available for additional guidance, and peer collaboration will be encouraged. Regular feedback will help students improve and achieve course outcomes

#### **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>

#### Examination Scheme:

Evaluation components	Weightage
<b>Internal marks (Theory)</b> <b>I. Continuous assessment (30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks (Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>



<b>BSFSCH103</b>	<b>Inorganic and Organic chemistry-I</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		2	0	0	2
<b>Category of Course</b>	<b>Major</b>				
<b>Total Contact Hours</b>	<b>30</b>				
<b>Pre-requisites/ Co-requisites</b>	--				

### Course Perspective:

This course introduces foundational principles in chemistry, integrating concepts from atomic structure, acid-base theories, organic chemistry, and stereochemistry. Students will explore atomic models, chemical bonding, and molecular behavior, building a solid understanding of chemical reactivity and molecular interactions. Through systematic learning of structure, nomenclature, and reaction mechanisms, the course strengthens analytical thinking and visualization in chemistry. It lays the groundwork for advanced studies by emphasizing conceptual clarity and practical relevance in real-world chemical phenomena.

**Course Outcome:** Students will be:

**CO1:** Understanding the fundamental principles of atomic structure, quantum mechanical models, acid-base concepts, and stereochemistry, including orbital shapes, quantum numbers, and chirality.

**CO2:** Applying the mole concept, empirical and molecular formulae, electronic configurations, and IUPAC rules to solve basic problems in general and organic chemistry.

**CO3:** Analysing chemical behavior through interpretation of acid-base strength, reactivity patterns of hydrocarbons, types of reagents and intermediates, and stereochemical conformations and representations.

**CO4:** Evaluating stability of intermediates, resonance effects, stereochemical outcomes, and molecular structure–property relationships to predict chemical reactivity and behavior.

<b>Course contents</b>	<b>:30 Hours</b>
<b>Unit I: Atomic Structure</b>	<b>:10 Hours</b>
Dalton's atomic theory: concept of elements, atoms and molecules. Atomic and molecular masses. Mole concept and molar mass: molarity, normality, molality, percentage composition, empirical and molecular formula. de Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, quantum numbers, shapes of s, p, d orbitals. Aufbau and Pauli exclusion principles, Hund's Multiplicity rule. Electronic configurations of the elements, effective nuclear charge, Slater's rules.	
<b>Unit II: Concept of Acids and Bases</b>	<b>:11 Hours</b>

Arrhenius, Bronsted – Lowry and Lewis concepts of acids & bases, relative strength of acids & bases, Concept of Hard and Soft Acids & Bases.

**Unit III: Organic Chemistry**

**:12 Hours**

General introduction, Classification of hydrocarbons: Alkanes, Alkenes, Alkynes, Aromatic hydrocarbons. IUPAC nomenclature of branched and unbranched alkanes, the alkyl group, classification of carbon atoms in alkanes. Curved arrow notation, drawing electron movements with arrows, half-headed and double-headed arrows, homolytic and heterolytic bond breaking. Types of reagents – electrophiles and nucleophiles. Types of organic reactions. Reactive intermediates carbocations, carbanions, free radicals. Localized and delocalized chemical bond, resonance effect and its applications.

**Unit IV: Stereochemistry**

**:12 Hours**

Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Optical Isomerism: Optical Activity, Specific Rotation, Chirality/Asymmetry, Racemic mixture and resolution.

**Learning Experience:**

This course will be a mix of lectures, interactive sessions, and hands-on learning to deepen the understanding of fundamental principles of atomic structure, mole concept, hydrocarbons, acids and bases.

**Instruction Methods:**

1. **Lectures:** Core concepts will be taught using multimedia presentations and problem-solving sessions.
2. **Interactive Sessions:** Q&A segments, live quizzes, and discussions will engage students and reinforce learning.

**Technology Use:**

1. **Online Platforms:** An LMS will provide resources, recorded lectures, and discussion forums for extended learning.

**Assessments:**

1. **Formative:** Quizzes and online discussions will provide continuous feedback.
2. **Summative:** Exams, peer reviews, and presentations will evaluate overall understanding.

**Support:** The course instructor will be available for additional guidance, and peer collaboration will be encouraged. Regular feedback will help students improve and achieve course outcomes

**Textbooks:**

1. Advanced Inorganic Chemistry by Satya Prakash
2. Textbook of Organic Chemistry by Rakesh K. Parashar and V.K. Ahluwalia

### 3. Concise Inorganic Chemistry by J.D. Lee's

#### Reference books:

1. Organic Chemistry by Wade
2. Organic Chemistry by Morrison and Boyd
3. Advanced Inorganic Chemistry by F. A. Cotton and G. Wilkinson

#### Open Educational Resources

1. [https://chem.libretexts.org/Bookshelves/Organic\\_Chemistry](https://chem.libretexts.org/Bookshelves/Organic_Chemistry)
2. <https://www.organic-chemistry.org/>
3. <https://www.masterorganicchemistry.com/>
4. <https://openstax.org/details/books/chemistry-2e/>  
[https://chem.libretexts.org/Courses/Kutztown\\_University\\_of\\_Pennsylvania/CHM\\_320%3A\\_Advanced\\_Inorganic\\_Chemistry\\_Textbook/05%3A\\_Coordination\\_Chemistry\\_I\\_Structure\\_and\\_Isomers/5.06%3A\\_Hard\\_and\\_Soft\\_Acids\\_and\\_Bases](https://chem.libretexts.org/Courses/Kutztown_University_of_Pennsylvania/CHM_320%3A_Advanced_Inorganic_Chemistry_Textbook/05%3A_Coordination_Chemistry_I_Structure_and_Isomers/5.06%3A_Hard_and_Soft_Acids_and_Bases)

#### Examination Scheme:

Evaluation components	Weightage
<b>Internal marks (Theory)</b> <b>I. continuous assessment (30 marks)</b> 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)	<b>30 Marks</b>
<b>II. internal marks (Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

BSFSPC151	Practical-Chemistry I	L	T	P	C
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<b>Version1.0</b>		0	0	2	1
<b>Category of Course</b>	<b>Major Lab I</b>				
<b>Total Contact Hours</b>	<b>15</b>				
<b>Pre-requisites/ Co-requisites</b>	--				

### Course Perspective:

The practical Chemistry 1 course offers a hands-on approach to fundamental techniques in pH determination, buffer preparation, and organic reaction mechanisms. Students will explore the application of pH meters, indicators, and pH papers to assess solution acidity or alkalinity. By conducting buffer preparation and identifying organic compounds based on functional groups, learners gain practical exposure to essential chemistry concepts. This course builds the skills necessary for advanced experimental chemistry, fostering a deeper understanding of both theoretical and applied chemistry.

**Course Outcome:** Students will be:

**CO1:** Observing and understand the principles and techniques for determining the pH of different solutions using pH paper, pH meter, and universal indicators, recognizing their importance in chemical analysis.

**CO2:** Imitating standard laboratory procedures to prepare buffer solutions, determine their pH, and understand their composition and function in maintaining pH balance.

**CO3:** Practice basic organic chemistry reactions such as substitution, addition, and elimination by performing experiments and writing accurate reaction mechanisms.

**CO4:** Creating a systematic approach for identifying organic compounds by detecting functional groups through qualitative analysis and confirming their presence using chemical tests.

<b>List of experiments</b>	<b>:</b>
1. Determination of the pH of different solutions using pH paper, pH meter, and universal indicators. 2. Preparation of buffer solutions and determination of their pH. 3. Performing and observing simple organic reactions (e.g., substitution, addition, and elimination) and writing the corresponding reaction mechanisms. 4. Systematic identification of organic compounds containing functional groups like alcohols, aldehydes, ketones, carboxylic acids, esters, and amines.	

### Learning experience

This practical course will be a mix of lectures, interactive sessions, and hands-on learning to deepen the understanding of application of pH meters, indicators, and pH papers to assess solution acidity or alkalinity.

#### **Instruction Methods:**

Interactive sessions with role-plays, case studies, and hands-on practice of forensic assessment tools.

#### **Technology Use:**

Use of virtual simulations, and online platforms for tests and learning materials.

#### **Assessments:**

Evaluation through practical exams, case reports, scoring accuracy, and class participation.

**Support:** The course instructor will be available for additional guidance, and peer collaboration will be encouraged. Regular feedback will help students improve and achieve course outcomes

#### **Textbooks:**

1. Vogel's **Textbook** of Practical Organic Chemistry by B.S. Furniss, A.J. Hannaford, P.W.G. Smith, and A.R. Tatchell.
2. Laboratory Manual of Organic Chemistry by Raj K. Bansal

#### **Reference books:**

1. A Guide to pH Measurement by Hanna Instruments.
2. Organic Chemistry by Jonathan Clayden, Nick Greeves, and Stuart Warren.

#### **Open Educational Resources**

1. [Organic Reaction Mechanisms](#)

#### **Examination Scheme:**

Evaluation components	Weightage
<b>Internal marks (Theory)</b> <b>I. continuous assessment (30 marks)</b> 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)	<b>30 Marks</b>
<b>II. internal marks (Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>BSFSPH104</b>	<b>Forensic Photography</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
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<b>Version 1.0</b>		3	0	0	3
<b>Category of Course</b>	Major				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** This course provides a comprehensive understanding of photographic principles and techniques specifically tailored for forensic applications. It covers the essential tools, methods, and legal considerations required to accurately document crime scenes, evidence, and injuries, ensuring the integrity and admissibility of photographic evidence in legal proceedings. The course aims to develop both theoretical knowledge and practical skills necessary for forensic professionals.

### **Course Outcome:**

Students will be:

**CO1 - Understanding** the fundamental principles of photography and their specific application in forensic science.

**CO2 - Applying** appropriate photographic instrumentation and techniques for documenting various types of evidence at crime scenes.

**CO3 - Analysing** the quality, authenticity, and admissibility of forensic photographs for legal purposes.

**CO4 – Evaluating** the specialized photographic procedures for difficult-to-visualize evidence, such as latent prints and impression evidence. Evaluating the quality, authenticity, and admissibility of forensic photographic evidence, justifying its legal relevance and presentation.

### **Course contents**

<b>Unit I: Fundamentals of Forensic Photography</b>	<b>:11 Hours</b>
Introduction to Forensic Photography: History, importance, role in criminal justice, basic types of forensic photographs (overall, mid-range, close-up). Basic Photographic Principles: Light, color temperature, exposure (aperture, shutter speed, ISO), depth of field, white balance. Camera and Lens Systems: Digital Single Lens Reflex (DSLR) and Mirrorless cameras, types of lenses (normal, wide-angle, macro), filters (polarizing, UV). Lighting Techniques: Natural light, artificial light sources (electronic flash, continuous light), oblique lighting, transmitted light, bounce flash, fill flash.	
<b>Unit II: Crime Scene and Evidence Documentation</b>	<b>:11 Hours</b>
Crime Scene Photography Procedures: Initial photographs, general views, mid-range views, close-up views with and without scales, systematic approach. Documenting Specific Evidence: Fingerprint photography (latent and patent prints, dusting, chemical enhancements), bloodstain pattern photography, firearms and ballistics photography (firearms, cartridge cases, bullets). Impression Evidence Photography: Footwear impressions, tire track impressions, tool mark impressions, casting techniques and photographic documentation. Injuries and Victim Photography: Documentation of trauma, ethical considerations, use of color and grayscale scales.	

<b>Unit III : Specialized Photographic Techniques and Digital Imaging</b>	<b>: 11 Hours</b>
<p>Alternate Light Source (ALS) Photography: Principles and applications of UV, Visible, and Infrared light for different types of evidence (fibers, fluids, questioned documents). Macro and Micro Photography: Principles, equipment, and applications for small-scale evidence (hairs, fibers, trace evidence), integration with microscopes. Digital Imaging Fundamentals: Pixels, resolution, file formats (JPEG, RAW, TIFF), digital image storage and management, metadata. Image Processing and Enhancement: Basic image processing software, ethical considerations in image enhancement, non-destructive editing.</p>	
<b>Unit IV : Legal Aspects and Emerging Technologies</b>	<b>: 12 Hours</b>
<p>Admissibility of Photographic Evidence: Legal requirements, chain of custody for photographic evidence, Daubert and Frye standards for scientific evidence. Digital Image Integrity and Authentication: Digital watermarking, hashing, preventing image manipulation, expert testimony regarding image authenticity. Courtroom Presentation: Preparing photographic exhibits for court, effective presentation of visual evidence, role of the forensic photographer as an expert witness. Emerging Technologies: Introduction to 3D crime scene scanning, photogrammetry, drone photography, and their applications in forensic investigations.</p>	

### **Learning Experience:**

This course will be a mix of lectures, interactive sessions, and hands-on learning to deepen the understanding of essential tools, methods, and legal considerations required to accurately document crime scenes, evidence, and injuries, ensuring the integrity and admissibility of photographic evidence in legal proceedings.

### **Instruction Methods:**

1. **Lectures:** Core concepts will be taught using multimedia presentations and problem-solving sessions.
2. **Interactive Sessions:** Q&A segments, live quizzes, and discussions will engage students and reinforce learning.

### **Technology Use:**

1. **Online Platforms:** An LMS will provide resources, recorded lectures, and discussion forums for extended learning.

### **Assessments:**

1. **Formative:** Quizzes and online discussions will provide continuous feedback.
2. **Summative:** Exams, peer reviews, and presentations will evaluate overall understanding.

**Support:** The course instructor will be available for additional guidance, and peer collaboration will be encouraged. Regular feedback will help students improve and achieve course outcomes

### **Textbook :**

Jacobson, B.H.E., Ray, Sidney, Attridge G. G., The Manual of Photography; Focal Press, London, 1988. (R1)

### Reference Books :

1. Robinson, Edward. *Crime Scene Photography*. Pearson Prentice Hall, 2011. (R2)
2. Grubb, Robert C. *Forensic Photography: A Practitioner's Guide*. CRC Press, 2018. (R3)
3. Gardner, Ross M., and Donna R. Krouskup. *Practical Crime Scene Processing and Investigation*. CRC Press, 2018. (R4)
4. Stroebel, Leslie, et al. *Basic Photographic Materials and Processes*. Focal Press, 2000. (R5)
5. James, Stuart H., et al. *Forensic Biology*. CRC Press, 2005. (R6)
6. Geradts, Z. *Handbook of Forensic Digital Image Enhancement*. Academic Press, 2015. (R7)

### Open Educational Resources (OER)

- <https://photographylife.com> – General photography tutorials and guides.
- <https://www.nfstc.org/training-resources/crime-scene-photography/> – Resources on crime scene photography.
- <https://www.nist.gov> – Digital image forensics resources.

### Examination Scheme:

Evaluation components	Weightage
<b>Internal marks (Theory)</b> <b>I. continuous assessment (30 marks)</b> 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)	<b>30 Marks</b>
<b>II. internal marks (Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>



<b>BSFSFP152</b>	Forensic practical I	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version 1.0</b>		0	0	4	2
<b>Category of Course</b>	Skill Enhancement Course				
<b>Total Contact Hours</b>	60 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** It is a foundational exercise in forensic science, providing a hands-on opportunity to apply theoretical concepts. It focuses on crime scene investigation, sketching, photography, note-taking, searching, and camera basics. Students will learn to identify, document, and preserve evidence at crime scenes, create accurate sketches, capture relevant details through photography, record observations and evidence, employ various searching methods, and understand the parts and functions of a camera. This practical experience not only develops essential skills for forensic professionals but also fosters attention to detail, problem-solving abilities, and teamwork. Additionally, students will be introduced to the ethical considerations involved in crime scene investigation.

**Course Outcomes:** - Students will be:

**CO1- Understanding** the methodologies for investigating and sketching both indoor and outdoor crime scenes, emphasizing the importance of accuracy and detail in documentation.

**CO2 -Applying** effective crime scene photography techniques for indoor and outdoor environments, ensuring that key evidence and contextual elements are captured accurately.

**CO3- Analyzing** proper note-taking procedures during crime scene investigations, ensuring that all observations and actions are thoroughly documented along with analysis of the components of a camera and their functions in relation to crime scene photography, enhancing the quality and utility of visual evidence collected during investigations.

**CO5 Evaluating** proficiency in the packaging and forwarding of evidence, including the construction of envelopes using the druggist fold method and adherence to sealing procedures.

#### List of Experiments

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. Notes making.
5. Searching of crime scene.
6. Parts and working of camera.
7. Packaging and forwarding.
8. Envelop making and Druggist fold method.
9. Sealing procedure.

**Learning Experience:** This practical course will be a mix of lectures, interactive sessions, and hands-on

learning to deepen the understanding of forensic science, providing a hands-on opportunity to apply theoretical concepts in a real-world setting. Students will develop meticulous observation and attention to detail as they identify, document, and preserve evidence at crime scenes. They will also enhance their problem-solving skills by navigating the challenges of crime scene investigation and making informed decisions.

**Instruction Methods:**

Interactive sessions with role-plays, case studies, and hands-on practice of forensic assessment tools.

**Technology Use:**

Use of virtual simulations, and online platforms for tests and learning materials.

**Assessments:**

Evaluation through practical exams, case reports, scoring accuracy, and class participation.

**Support:** The course instructor will be available for additional guidance, and peer collaboration will be encouraged. Regular feedback will help students improve and achieve course outcomes

**Textbooks:**

1. Kathy Mirakovits, Gina Londino, The Basics of Investigating Forensic Science: A Laboratory Manual 2015.

**Reference Books**

Digital Photography for Crime Scene Investigators by David H. Garvin

**Open Educational Resources (OER)**

1. <https://lsc.cornell.edu/how-to-study/taking-notes/cornell-note-taking-system/>
2. <https://www.nationalgeographic.com/photography/article/digital-photography-tips>
3. <https://www.fbi.gov/how-we-can-help-you/more-fbi-services-and-information/identity-history-summary-checks>
4. <https://www.usps.com/ship/letters.htm>
5. <https://www.nist.gov/itl/ssd/software-quality-group/computer-forensics-tool-testing-program-cftt/digital-evidence>

**Examination Scheme:**

Evaluation components	Weightage
<b>Internal marks (Practical)</b>	
I. Conduct of experiment	10 Marks
II. Lab Record	10 Marks
III. Lab Participation	10 Marks
IV. Lab Project	20 Marks

<b>II. External Marks (practical):</b> End Term Examination	50 Marks
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	<b>Environmental Studies</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version 2.0</b>		<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>
<b>Category of Course</b>	<b>Value Added Course</b>				
<b>Total Contact Hours</b>	<b>30</b>				
<b>Pre-Requisites/ Co-Requisites</b>	<b>Basics of Environment</b>				

**Course Perspective:** This course on Environmental Sciences and Disaster Management provides a comprehensive understanding of environmental issues and disaster preparedness, crucial for students pursuing careers in environmental science, public policy, and emergency management. The curriculum covers critical topics such as land and water resources, pollution control, environmental policies, and disaster management strategies. Students will gain practical skills in assessing environmental impacts, managing resources sustainably, and preparing for and responding to various types of disasters. This knowledge is directly applicable in real-world scenarios, such as developing effective pollution control measures, implementing sustainable practices, and enhancing disaster response strategies. By integrating case studies and practical applications, the course equips students with the tools needed to address pressing environmental challenges and contribute to resilience and sustainability efforts globally.

### Course Outcomes

Students will be:

**CO1:** Understanding the types, causes, and effects of environmental pollution, and the key environmental laws in India.

**CO2:** Applying knowledge of environmental laws and policies and utilize the concepts of disaster preparedness,

**CO3:** Analysing the effects of human activities on the environment

**CO4:** Evaluating the effectiveness of existing environmental laws, governance frameworks, and disaster management practices in India

**CO5:** Creating innovative solutions for sustainable development and disaster management plans.

### Course Content

<b>Unit I:: Environment and Natural Resources</b>	<b>8 Hours</b>
Multidisciplinary nature of environmental sciences; Scope and importance; Need for public awareness. Land resources; land use change; Land degradation, soil erosion and desertification. Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state). Energy resources: Renewable and non- renewable energy sources, use of alternate energy sources, growing energy needs, case studies. Carbon Footprints.	
<b>Unit II: Environmental Pollution and Environmental Policies</b>	<b>: 7 Hours</b>

<p>Environmental pollution: types, causes, effects and controls; Air, water, soil and noise pollution nuclear hazards and human health risks; Solid waste management: Control measures of urban and industrial waste; Pollution case studies.</p> <p>Sustainability and sustainable development; Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture; Environment Laws: Environment Protection Act; Air (Prevention &amp; Control of Pollution) Act; Water (Prevention and control of Pollution) Act; wildlife Protection Act; Forest Conservation Act; Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context. Fundamentals and Application of ESG (Environment Social Governance).</p>	
<b>Unit III :</b>	<b>Introduction to Disasters : 8 Hours</b>
<p>Concept and definitions- Disaster, Hazard, vulnerability, resilience, risks. Different Types of Disaster: Causes, effects and practical examples for all disasters. Natural Disaster: such as Flood, Cyclone, Earthquakes, Landslides etc. Man-made Disaster: such as Fire, Industrial Pollution, Nuclear Disaster, Biological Disasters, Accidents (Air, Sea, Rail &amp; Road), Structural failures (Building and Bridge), War &amp; Terrorism etc.</p>	
<b>Unit IV :</b>	<b>Disaster Management : 7 Hours</b>
<p>Disaster Preparedness Plan, Prediction, Early Warnings and Safety Measures of Disaster, Role of Government, International and NGO Bodies in Disaster Preparedness. Reconstruction and Rehabilitation, Post Disaster effects and Remedial Measures Disaster Management Act, 2005: Disaster management framework in India before and after Disaster Management Act, 2005, Applications of AI and ML in Disaster Management and risk predictions.</p>	

### Learning Experience

This comprehensive course integrates lectures, interactive discussions, hands-on activities, and field experiences to provide a deep understanding of environmental science, pollution, disaster types, and management strategies.

### Instruction Methods:

1. **Lectures:** Core concepts will be presented through multimedia and problem-solving sessions.
2. **Interactive Sessions:** Includes Q&A segments, live quizzes, and discussions to enhance engagement and understanding.

**Technology Use:** The Learning Management System (LMS) will provide resources, recorded lectures, and discussion forums.

### Activities:

**Case Studies & Group Work:** Students will analyse real-world problems related to environmental and disaster issues, working collaboratively on projects.

**Field Visits:** Real-world observation of environmental and disaster management practices.

### Assessments:

1. **Formative:** Ongoing feedback through quizzes and online discussions.
3. **Summative:** Exams, presentations, and case study reports to evaluate overall understanding and application of course content.

**Support:**

Instructors will offer additional guidance and feedback, and peer collaboration will be encouraged to support student learning and achievement of course outcomes.

**Textbooks**

1. Content building programme (CBP) book on Disaster Management, Forum AS.
2. Kaushik and Kaushik, Environmental Studies, New Age International Publishers (P) Ltd. New Delhi.

**Reference Books** A. K. De, Environmental Chemistry, New Age International Publishers (P) Ltd. New Delhi.

2. S.E. Manahan, Environmental Chemistry, CRC Press.
3. S.S. Dara and D.D. Mishra, Environmental Chemistry and Pollution Control, S.Chand & Company Ltd, New Delhi.

**Open Educational Resources (OER)**

1. [OpenStax](#)
2. [Khan Academy](#)
3. [MIT OpenCourseWare](#)
4. [Coursera](#) and [edX](#)
5. [YouTube](#)
6. [Wikibooks](#)
7. [OER Commons](#)
8. [NOAA Education](#)
9. [UNEP Education](#)
10. [TED Talks](#)

**Evaluation Scheme:**

Evaluation components	Weightage
I. End Term Examination	100 Marks

<b>BSFSCB105</b>	<b>Cell Biology</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		3	0	0	3
<b>Category of Course</b>	Core				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** The interdisciplinary nature of cell biology also bridges the gap between basic sciences and applied fields like genetics, biotechnology, pharmacology, and bioinformatics. Through this course, students will develop critical observation and analytical skills, enabling them to visualize cells, perform basic laboratory experiments, and comprehend the intricate mechanisms that sustain life. By combining theoretical knowledge with hands-on practical sessions, this course aims to instill scientific curiosity and prepare students for more advanced studies and research in biological sciences.

**Course Outcome:** Students will be:

**CO1: Understanding** the structure and function of animal and plant cells.

**CO2: Applying** fundamental concepts of cell division, cell cycle regulation, and signal transduction to explain biological processes and experimental observations.

**CO3: Analyzing** the biochemical and ultrastructural organization of cellular components and interpret their roles in maintaining cell physiology and homeostasis.

**CO4: Evaluating** scientific data related to cell biology from laboratory and research studies to draw evidence-based conclusions on cell behavior and disease mechanisms.

<b>Course contents</b>	<b>:45 Hours</b>
<b>Unit I: Introduction to Cell Biology and Plasma Membrane</b>	<b>:10 Hours</b>
History and scope of cell biology, Cell theory, Overview: prokaryotic vs. eukaryotic cells, Comparison: animal vs. plant cells, Structure: Fluid Mosaic Model, Membrane proteins and carbohydrates, Transport mechanisms: Passive, Active, Endocytosis, Exocytosis	
<b>Unit II: Cytoplasm, Cytoskeleton and Cell Organelles</b>	<b>:12 Hours</b>
Cytosol and cytoplasmic streaming, Cytoskeleton: Microtubules, microfilaments, intermediate filaments, Cell motility and intracellular transport, Nucleus (Structure, nuclear pore, chromatin, nucleolus), Mitochondria (Structure, ATP synthesis), Chloroplasts: Structure and function (plant cells), Endoplasmic Reticulum (Rough and smooth), Golgi Apparatus (Protein packaging and transport), Lysosomes & Peroxisomes, Vacuoles and Tonoplast (Plant cells)	
<b>Unit III: Cell Wall, Extracellular Matrix, Cell Cycle and Cell Division</b>	<b>:12 Hours</b>
Phases of cell cycle (G1, S, G2, M), Mitosis and cytokinesis, Meiosis and gametogenesis, Checkpoints and cell cycle regulation, Types of signaling (autocrine, paracrine, endocrine), Receptors: Ion channel, G-protein coupled, enzyme-linked, Signal transduction pathways and second messengers	
<b>Unit IV: Cell Death and Aging and Techniques in Cell Biology</b>	<b>:11Hours</b>

Apoptosis vs. Necrosis, Role of caspases and Bcl-2 family, Telomeres and cellular senescence, Microscopy (Light, fluorescence, electron), Cell fractionation and centrifugation, Staining techniques, Immunocytochemistry and live cell imaging basics

**Learning Experience:** This course will be a mix of lectures, interactive sessions, and hands-on learning to deepen the understanding of both animal and plant cells through a variety of learning modes designed to foster critical thinking and conceptual clarity.

### **Instruction Methods:**

**Lectures:** Theoretical lectures, enhanced with visual aids such as animations and micrographs, will provide students with a clear understanding of complex cellular structures and processes. **Interactive Sessions:** Q&A segments, live quizzes, and discussions will engage students and reinforce learning.

### **Technology Use:**

**1. Online Platforms:** An LMS will provide resources, recorded lectures, and discussion forums for extended learning.

### **Assessments:**

**1. Formative:** Quizzes and online discussions will provide continuous feedback.

**2. Summative:** Exams, peer reviews, and presentations will evaluate overall understanding.

**Support:** The course instructor will be available for additional guidance, and peer collaboration will be encouraged. Regular feedback will help students improve and achieve course outcomes

### **Textbooks:**

1. Karp, G. (2013). *Cell and Molecular Biology: Concepts and Experiments* (7th ed.). Wiley.
2. Dee Unglaub Silverthorn. (2018). *Human Physiology: An Integrated Approach* (7th ed.). Pearson.

### **Reference Books**

1. Dee Unglaub Silverthorn. (2012). *Human Physiology: An Integrated Approach* (6th ed.). Pearson.
2. Verma, P.S., & Agarwal, V.K. (Latest Ed.). *Cell Biology, Genetics, Molecular Biology, Evolution & Ecology*. S. Chand Publishing.
3. Cooper, G.M., & Hausman, R.E. (2013). *The Cell: A Molecular Approach* (6th ed.). Sinauer Associates.

### **Open Educational Resources (OER)**

- 1) **OpenStax – Biology**  
<https://openstax.org/books/biology/pages/1-introduction>
- 2) **LibreTexts – Cell Biology**  
[https://bio.libretexts.org/Bookshelves/Cell\\_and\\_Molecular\\_Biology](https://bio.libretexts.org/Bookshelves/Cell_and_Molecular_Biology)
- 3) **NPTEL – Cell Biology (IIT Kanpur/IIT Delhi lectures)**  
<https://nptel.ac.in/courses/102103044>



- 4) **CK-12 – Biology FlexBook**  
<https://www.ck12.org/biology/>
- 5) **National Digital Library of India (NDLI)**  
<https://ndl.iitkgp.ac.in/>

**Examination Scheme:**

<b>Evaluation components</b>	<b>Weightage</b>
<b>Internal marks (Theory)</b> <b>I. continuous assessment (30 marks)</b> 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)	<b>30 Marks</b>
<b>II. internal marks (Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>BSFSEP105</b>	Elements of Physics	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		3	0	0	3

<b>Category of Course</b>	DSE
<b>Total Contact Hours</b>	45 Hours
<b>Pre-requisites/ Co-requisites</b>	--

**Course Perspective:** An Elements of Physics course provides a foundational understanding of the fundamental laws and principles governing the physical world. It explores concepts such as motion, forces, energy, matter, and waves, laying the groundwork for further studies in physics and related fields. Through lectures, laboratory experiments, and problem-solving exercises, students develop critical thinking skills and a deeper appreciation for the underlying structure of the universe.

**Course Outcome:** Students will be:

**CO1: Understanding** the fundamental nature of light, including Planck's quantum theory, the photoelectric effect, and the properties of photons and matter waves.

**CO2: Applying** kinetic energy and work, including the work-energy theorem and conservation of energy in mechanical systems.

**CO3: Analyzing** atomic physics concepts such as the Rutherford and Bohr models, quantum numbers, and the hydrogen spectrum to explain atomic structure.

**CO4: Evaluating** calculations involving radioactive decay, including mean life, half-life, and energy released during fission and fusion processes.

### Course contents

**Unit I:** Light's nature: Planck's quantum, Planck's constant and light as a collection of photons; Photoelectric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson-Germer experiment

**Unit II:** Kinetic energy and work

Energy, kinetic energy, work, work done by gravitational force, work done by spring force, power, work and potential energy, conservation of energy, work energy theorem.

**Unit III:** Atomic Physics

Rutherford model, Bohr atomic model, quantum numbers, Pauli's exclusion principle, hydrogen spectrum, - series (Lyman, Balmer, Paschen, Brackett and fund), vector atom model.

**Unit IV:** Radioactivity: stability of nucleus; Law of radioactive decay; Mean life and half-life; decay; decay energy released, spectrum and Pauli's prediction of neutrino; X-ray emission. Fission and fusion-mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons. Nuclear reactor: slow neutrons interacting with Uranium 235; Fusion and thermonuclear reactions

**Learning Experience:** A Basics of Physics course offers a comprehensive exploration of the fundamental principles of life. Through lectures, laboratory work, and hands-on activities, you'll gain a

deep understanding of cellular processes, genetics, evolution, and ecology. This course provides a strong foundation for further studies in biology or related fields and fosters a lifelong appreciation for the natural world.

#### Textbooks:

1. Amato, Joseph (December 1996). "The introductory calculus-based physics Textbook". *Physics Today* 49 (12): 46–51.
2. Thomas Brody (1993.) "The Philosophy Behind Physics" pp 18–24 (Chapter 2)

#### Reference Books:

1. OpenStax College Physics: <https://openstax.org/details/books/college-physics-2e/>
2. University Physics Volume 1, 2, and 3: <https://openstax.org/details/books/university-physics-volume-1/>.
3. College Physics for AP Courses: <https://openstax.org/details/books/college-physics-ap-courses-2e/>

#### Open Educational Resources (OER)

1. PhET Interactive Simulations: <https://www.colorado.edu/csl/programs/phet-interactive-simulations>
2. Khan Academy Physics: <https://www.khanacademy.org/science/physics>
3. MIT OpenCourseWare: <https://ocw.mit.edu/courses/physics/>

#### Examination Scheme:

Evaluation components	Weightage
<b>Internal marks (Theory)</b> <b>I. continuous assessment (30 marks)</b> 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)	<b>30 Marks</b>
<b>II. internal marks (Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>



## **SECOND SEMESTER**

<b>SCFS102</b>	Forensic Dermatoglyphics	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		3	0	0	3
<b>Category of Course</b>	Major				
<b>Total Contact Hours</b>	45Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** A Forensic Dermatoglyphics course provides a comprehensive understanding of the history, principles, and techniques involved in fingerprint analysis. You will delve into the biological significance of skin patterns, learn various fingerprint classification systems, and master the methods of lifting and developing latent fingerprints. This course equips you with the knowledge and skills necessary for identifying and analyzing fingerprints in criminal investigations, ensuring accurate and reliable forensic evidence.

**Course Outcome:** Students will be:

1. Understanding the historical development and significance of fingerprinting, including its origins, principles, and role in criminal investigations.
2. Applying the biological significance of skin patterns and the various types of fingerprints, including their class and individual characteristics, as well as methods for their collection, lifting, and preservation.
3. Analyzing classification systems for fingerprints, including Henry's system and Batley's Single Digit classification, to effectively categorize and organize fingerprint evidence using AFIS.
4. Performing techniques for the development and lifting of latent fingerprints, utilizing both physical methods (such as powder and iodine fuming) and chemical methods (such as ninhydrin and silver nitrate) in forensic applications.
5. Interpreting and present fingerprint evidence in a court setting, including the importance of photography and proper documentation in the judicial process.

<b>Course contents</b>
<b>Section I:</b> History and Development of Fingerprinting Origin & History of fingerprints, Principles of Fingerprint identification, Searching, location and significance of fingerprints in criminal investigation.
<b>Section II:</b> Introduction of Fingerprint and its characteristics Biological significance of skin pattern, Types of fingerprints, Fingerprint characteristics: class and individual, Collection, lifting and preservation of fingerprints, Photography of latent fingerprints and presentation of fingerprint evidence in court.
<b>Section III:</b> Classification of Fingerprints Henry's system of classification, Batley's Single Digit classification, Extension of Henry's system of classification. Primary, secondary, sub-secondary, major, Second sub-secondary, key and final

Classifications, AFIS

**Section IV: Fingerprint Developmental techniques**

Methods of lifting and developing latent fingerprints – Physical methods - Powder method (Black, silver, florescent, red, yellow), Iodine fuming etc. Chemical methods - Ninhydrin, Silver nitrate method.

**Learning Experience:** Through a combination of theoretical lectures, practical exercises, and case studies, you will gain hands-on experience in fingerprint collection, preservation, and analysis. You will learn to apply the principles of fingerprint identification to real-world scenarios, developing critical thinking and problem-solving skills. The course also emphasizes the importance of ethical considerations and quality control in forensic fingerprint analysis.

**Textbooks:**

1. Nath, S., Fingerprint Identification, CRC Press, 2<sup>nd</sup> edition, 2002.
2. Champhod, C., Fingerprint and other ridge skin impressions, CRC Press, 2004.
3. Bridges, B. C., Vollmar, A. Monir, M., Criminal Investigation, Practical Fingerprinting, Thumb Impression, Handwriting, Expert Testimony Opinion Evidence, The University Book Agency, Allahbad, 2000.
4. James, S. H. and Nordby, J. J. (Eds), Forensic Science - An Introduction to Scientific and Investigation Techniques, CRC Press, London, 2003.

**Suggested Reading:**

1. Nanda, B. B., and Tewari, R. K., Forensic Science in India. Select Publishers, New Delhi, 2001.
2. Saferstein, Richard, Criminalistics, An Introduction to Forensic Science, 6<sup>th</sup> Ed. Prentice-Hall, New Jersey, 1998.
3. Sharma, B. R., Forensic Science in Criminal Investigation and Trials (3<sup>rd</sup>Edn) Universal Law Publishing Co. Ltd. New Delhi, 2001.

**Open Educational Resources (OER)**

1. International Association for Identification (IAI): <https://www.theiai.org/>
2. National Institute of Standards and Technology (NIST): <https://www.nist.gov/>
3. Forensic Science Digital Library: <https://forensiclibrary.org/az/databases?v=137728>

**Examination Scheme:**

Evaluation components	Weightage
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>

<b>II. Internal marks (Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>SCFS104</b>	Questioned Document	L	T	P	C
<b>Version1.0</b>		3	0	0	3
<b>Category of Course</b>	Major				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** A Questioned Document Examination course provides a comprehensive understanding of the techniques used to analyze documents that may be disputed or questioned. It focuses on the scientific methods employed to determine the authenticity, origin, and authorship of documents.

**Course Outcome:** Students will be:

1. Understanding the definition and significance of questioned documents, including the types of cases encountered, and the procedures for their collection, handling, and presentation in forensic investigations.
2. Applying various types of documents such as charred, security, and counterfeit currency, utilizing appropriate examination equipment and techniques for accurate document analysis.
3. Analyzing principles of handwriting analysis to identify individual characteristics, distinguishing between authentic, forged, disguised, and traced signatures while considering external and internal factors affecting handwriting.
4. Performing comparative analysis of typewritten and computer-generated documents, including the detection of alterations and conducting ink analysis to ascertain document authenticity.
5. Interpreting findings from examinations of photocopies, printouts, and scanned documents to draw conclusions regarding their authenticity and integrity in forensic contexts.

<b>Course contents</b>
<b>Section I:</b> Introduction to Questioned Documents Definition: Documents, questioned documents and the type of cases encountered; Importance, nature and problems of documents, Location, collection, handling and presentation of documents, adequacy of exemplars and standards.
<b>Section II:</b> Document analysis Charred documents, security documents, torn documents, and Counterfeit currency. General Equipment for Examination: Hand lens, Camera, Compound Microscope, Stereo microscope, TLC, Transmitted light source, UV-IR radiation chamber and Oblique Light source, ESDA, VSC.
<b>Section III:</b> Handwriting Characteristics Identification – principle individual handwriting characteristics, external, internal and physical factors affecting handwriting or signature of a person, Authentic Signatures, forged signatures, disguised signatures, traced signatures, and their characteristics



#### **Section IV: Typewritten and Computer-generated documents**

Comparison of typewritten documents, common types of styles, detection of altered typewritten documents, and ink analysis. Working of photocopiers and printers, scanners, examination of photocopies/ Xerox, printouts and scanned documents.

**Learning Experience:** A Basics of Questioned Document course offers a comprehensive exploration of the fundamental principles of document examination. Through lectures, laboratory work, and hands-on activities, you'll gain a deep understanding of various techniques used to analyze questioned documents, such as handwriting analysis, paper and ink examination, and forgery detection. This course provides a strong foundation for further studies in forensic science or related fields and equips you with valuable skills for careers in law enforcement, private investigation, or document authentication.

#### **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, 2<sup>nd</sup> edition, CRC Press, Taylor & Francis group.

#### **Suggested Readings:**

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, 6<sup>th</sup> Ed. Prentice-Hall, New Jersey, 1998.

#### **Open Educational Resources (OER):**

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

#### **Examination Scheme:**

Evaluation components	Weightage
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>

<b>II. Internal marks (Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>SCFS108</b>	Fundamentals of Cell biology	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		3	0	0	3
<b>Category of Course</b>	DSE				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** Human Physiology (Biology-II) delves into the complex mechanisms that govern the functions of the human body. It provides a comprehensive understanding of how various systems work together to maintain life and health.

**Course Outcome:** Students will be:

1. Understand the structure and functions of the human physiology systems, including the nervous, respiratory, digestive, circulatory, and endocrine systems, focusing on their components and regulatory mechanisms.
2. Analyze the human skeletal system, including the types of bone tissue, factors affecting bone growth and maintenance, and the various types of joints and their movements.
3. Apply knowledge of odontology, including ossification processes, dental structure, types of teeth, and their arrangement within the human mouth.
4. Perform microscopy techniques, including light microscopy, phase contrast, fluorescence, and electron microscopy, while mastering sample preparation and analysis for each method.
5. Interpret data obtained from various biological techniques, including X-ray diffraction analysis and microscopy, to draw conclusions about biological structures and processes.

<b>Course contents</b>
<p><b>Section I:</b> Human physiology:</p> <p>Nervous system: introduction, central and peripheral nervous system, neurons and neuroglia, synaptic transmission, neurotransmitters</p> <p>Respiratory system: overview, upper and lower respiratory tract, gas exchange in the alveoli, neural and chemical regulation, functions</p> <p>Digestive system: Structure, mechanical and chemical digestion, absorption and elimination, accessory organs</p> <p>Circulatory system: Structure, components, cardiac cycle, Systemic and pulmonary circulation</p> <p>Endocrine system: Structure, major endocrine glands, types of hormone, mechanisms of hormone action, feedback mechanisms</p> <p><b>Section II:</b> Human skeletal system: Function of skeletal system, Types of Bone Tissue, Factors affecting bone growth and maintenance, types of joints and movement.</p>

**Section III:** Introduction odontology: Ossification, Dental structure of humans, types of teeth and arrangement.

**Section IV:** Techniques in Biology

Principles of microscopy; Light Microscopy; Phase contrast microscopy; Fluorescence microscopy; Confocal microscopy; Sample Preparation for light microscopy; Electron microscopy (EM)- Scanning EM and Scanning Transmission EM (STEM); Sample Preparation for electron microscopy; X-ray diffraction analysis.

**Learning Experience:** A Basics of Biology course offers a comprehensive exploration of the fundamental principles of life. Through lectures, laboratory work, and hands-on activities, you'll gain a deep understanding of cellular processes, genetics, evolution, and ecology. This course provides a strong foundation for further studies in biology or related fields and fosters a lifelong appreciation for the natural world.

**Textbooks:**

1. I.E. Celis Cell biology Academic Press 2<sup>nd</sup> Edition.
2. Robertis & Robertis Cell & Microbiology 8<sup>th</sup> Edition.
3. M.S. Leffel, A.D. Donnenberg & N.R. Rose Handbook of Human Immunology CRC press, 1997
4. Essentials of Human Genetics by S.M. Bhatnagar et al (1999) IV edition. Orient Longman.

**Suggested Readings:**

1. Basic Human Genetics by E.J. Manage and A.P. Manage (1997 India Reprint) Rastogi Publications, Meerut.
2. Mendelian inheritance in Man: Catalogues of Autosomal recessive and x-linked phenotypes. [12 editions – 1998] by McKusick, V.A. Johns Hopkins university press, Baltimore.
3. Principles and Practice of Medical Genetics, by Emery, A.E.H and D.L. Rimoim (Eds\_ (1990-2<sup>nd</sup> edition) Churchill Livingstone, Edinburgh.
4. Human Genetics by S.D. Gangane (2nd edition-Reprint 2001), B.L Churchill Livingstone Pvt. Ltd., New Delhi.
5. Genetics in Medicine by M.W. Thompson et al, 5th Edition, W.B. Saunders Company, London.

**Open Educational Resources (OER)**

1. <https://openstax.org/details/books/anatomy-and-physiology-2e/>
2. <https://oercommons.org/browse?f.keyword=human-biology>
3. <https://openstax.org/details/books/biology-2e/>

**Examination Scheme:**

Evaluation components	Weightage
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced	<b>30 Marks</b>

Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	
<b>II. Internal marks (Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>SCFS110</b>	Mechanics	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		3	0	0	3
<b>Category of Course</b>	DSE				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** A Mechanics course in Physics provides a comprehensive understanding of the fundamental principles that govern the motion of objects. It serves as a cornerstone for many other physics disciplines and engineering fields.

**Course Outcomes:** Students will be:

1. Understanding the principles of motion, including Newton's laws, dynamics of particles, conservation of momentum and energy, as well as the concepts of torque, angular momentum, and gravitation.
2. Applying the implications of the Special Theory of Relativity, including the constancy of the speed of light, postulates of relativity, length contraction, time dilation, and the relativistic addition of velocities.
3. Analyzing the principles of sound, including velocity, intensity measurement, and acoustics, to evaluate the performance of sound in various environments, such as auditoriums, and understand the production and applications of ultrasonic waves.
4. Performing calculations involving light behavior, including refraction through different lens types, analysis of aberrations, and phenomena such as interference, diffraction, and polarization in optical systems.

<b>Course contents</b>
<b>Section I:</b> Motion: Newton's Laws of motion. Dynamics of a system of particles. Centre of Mass. Momentum and Energy: Conservation of momentum. Work and energy, Conservation of energy, Angular velocity and angular momentum. Torque, Conservation of angular, Momentum, Gravitation, Newton's Law of Gravitation. Motion of a particle in a central force Field, Kepler's Laws.
<b>Section II:</b> Special Theory of Relativity: Constancy of speed of light. Postulates of Special Theory of Relativity. Length contraction. Time dilation. Relativistic addition of velocities
<b>Section III:</b> Sound: Velocity of sound, noise and sound intensity measurement, echo, reverberation, Sabine's Formula, absorption coefficient, acoustics of buildings and factors affecting acoustics of buildings. Sound distribution in an auditorium, introduction to ultrasonic, production of ultrasonic waves, applications of ultrasonics.
<b>Section IV:</b> Light: Refraction through thin layers, thick lens, thin lens and lens combinations, aberrations, interference in thin films, fringes in wedge shaped films, Newton's rings, total internal reflection, Diffraction and polarization, simple table spectrophotometer.

**Learning Experience:** This course offers a rich and engaging content, covering a wide range of topics

in classical mechanics, relativity, acoustics, and optics.

**Textbooks:**

1. Allied Physics – Prof. Dhanalakshmi and others.
2. Elements of Properties of Matter – D.S. Mathur, S. Chand & Co. (1999).
3. Modern Physics – R. Murugesan S. Chand & Co. (2004).
4. Electronic Principles and Applications – A.B. Bhattacharya, New Central Book Agency, Calcutta.
5. Introduction to Fiber optics by K. Thyagarajan and Ajay Ghatak, Cambridge, University Press (1999).

**Suggested Readings:**

1. Classical Mechanics by Herbert Goldstein, Charles Poole, and John Safko
2. Classical Dynamics of Particles and Systems by Stephen T. Thornton and Jerry D. Marion
3. Classical Mechanics by Louis N. Hand and Janet Finch

**Open Educational Resources (OER):**

1. <https://phet.colorado.edu/en/simulations/browse>
2. <https://academo.org/physics/>
3. <https://www.physicsclassroom.com/>
4. <https://www.coursera.org/specializations/introduction-to-mechanics>

**Examination Scheme:**

Evaluation components	Weightage
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks (Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>UCH102</b>	Chemistry of elements	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		3	0	0	3
<b>Category of Course</b>	Minor				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** This course covers periodic properties, bonding theories, and the chemistry of s-, p-, d-, and f-block elements. It explores periodic trends, bonding models like VSEPR and MO theory, and coordination chemistry, with a focus on element groups and their key compounds. The course provides a comprehensive understanding of element behavior and bonding.

**Course Outcome:** Students will be:

1. Understanding the periodic law and the current structure of the periodic table, including trends in atomic and ionic radii, ionization energy, electron affinity, and electronegativity across different blocks of elements.
2. Applying the chemistry of s-block and p-block elements, focusing on bonding types (ionic, covalent, and coordinate bonds), VSEPR theory, hybridization, allotropy, and the structures and properties of key compounds within these groups.
3. Analyzing the principles of valence bond theory and molecular orbital theory to predict the shapes, bond strengths, and energy characteristics of various inorganic molecules and coordination compounds.
4. Performing comparative studies of the properties of transition elements, including their oxidation states, magnetic behavior, and spectral characteristics, along with the coordination chemistry of d-block elements.
5. Interpreting the significance of Werner's coordination theory, the concept of effective atomic numbers, and the crystal-field theory in understanding the structure and properties of coordination compounds, including their isomerism and bonding characteristics.

<b>Course contents</b>
<p><b>Section I: Periodic Properties</b></p> <p>Periodic law and the present form of periodic table, Atomic and ionic radii, ionization energy, electron affinity and electronegativity – definition, trends in periodic table (in s, p, d &amp; f block elements). Comparative study of the elements including, diagonal relationships.</p> <p>Chemistry of s-block elements</p> <p>Ionic bond, Covalent bond, Coordinate bond. Valence shell electron pair repulsion (VSEPR) theory to <math>\text{NH}_3</math>, <math>\text{H}_3\text{O}^+</math>, <math>\text{SF}_4</math>, <math>\text{ClF}_3</math>, <math>\text{ICl}_2^-</math> and <math>\text{H}_2\text{O}</math>. Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions (<math>\text{BeF}_2</math>, <math>\text{BF}_3</math>, <math>\text{CH}_4</math>, <math>\text{PF}_5</math>, <math>\text{SF}_6</math>, <math>\text{IF}_7</math>, <math>\text{SO}_4^{2-}</math>, <math>\text{ClO}_4^-</math>). MO theory of heteronuclear (CO and NO) diatomic molecules, bond strength and bond energy, percentage ionic</p>



character from dipole moment and electronegativity difference.

## **Section II: Chemistry of p-block elements**

Boron family (13<sup>th</sup> group): Diborane – properties and structure (as an example of electron – deficient compound and multicentre bonding), Borazene – chemical properties and structure.

Carbon Family (14<sup>th</sup> group): Allotropy of carbon, Catenation,  $p\pi-d\pi$  bonding, carbides, fluorocarbons – general methods of preparations, properties and uses.

Nitrogen Family (15<sup>th</sup> group): Oxides – structures of oxides of N, P. oxyacids – structure and relative acid strengths of oxyacids of Nitrogen and phosphorus.

Oxygen Family (16<sup>th</sup> group): Oxyacids of sulphur – structures and acidic strength.

Halogen Family (17<sup>th</sup> group): Basic properties of halogen, hydro and oxyacids of chlorine – structure and comparison of acid strength.

Noble Gases (18<sup>th</sup> group): Basic properties of noble gases, physical properties and structure of important compounds of Xenon.

## **Section III: Chemistry of d-block elements**

Definition of transition elements, position in the periodic table, General characteristics & properties of d- block elements, Comparison of properties of 3d elements with 4d & 5d elements with reference only to ionic, oxidation state, magnetic and spectral properties.

### **Coordination Compounds**

Werner's coordination theory, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes. Limitations of valence bond theory, an elementary idea of crystal-field theory, crystal field splitting in octahedral and tetrahedral complexes, factors affecting the crystal-field parameters.

## **Section IV: Chemistry of f-block elements**

Lanthanides: General features and Electronic structure, oxidation states and ionic radii and lanthanide contraction.

Actinides: General features and chemistry of actinides, actinide contraction. Comparison of properties of Lanthanides and Actinides and with transition elements. Elementary idea about the transuranic elements.

**Learning Experience:** Chemistry II builds upon the foundational concepts introduced in Chemistry I, offering a more in-depth exploration of chemical principles and their applications. This course is designed to enhance your understanding of chemical reactions, atomic structure, bonding, and the properties of matter.

### **Textbook:**

1. J. R. Partington 1969 A History of Chemistry, Volume 2, , Macmillan.
2. Eding Darrel D, 1970 Introductory Chemistry.
3. Odian George, 1990 General, Organic and Biological Chemistry.

**Suggested Readings:**

1. Inorganic Chemistry by J. E. Huheey, E. A. Keiter, and R. L. Keiter.
2. Advanced Inorganic Chemistry by F. A. Cotton and G. Wilkinson
3. Inorganic Chemistry by D. F. Shriver, P. W. Atkins, and C. H. Langford
4. Inorganic Chemistry by Gary L. Miessler and Donald A. Tarr
5. Inorganic Chemistry by A. F. Wells

**Open Educational Resources (OER):**

1. <https://chem.libretexts.org/>
2. <https://openstax.org/details/books/chemistry-2e/>
3. <https://www.youtube.com/playlist?list=PLVaArxw9lrsl4oW6Nt9j5trOs9MWrJNbe>

**Examination Scheme:**

Evaluation components	Weightage
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks (Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>SCFS106</b>	Basics of Digital Forensics	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		2	0	0	2
<b>Category of Course</b>	Major				
<b>Total Contact Hours</b>	30 Hours				
<b>Pre-requisites/ Co-requisites</b>	---				

**Course Perspective:** The course "Basics of Digital Forensics" provides a foundational understanding of the principles and techniques used to investigate digital evidence. It equips learners with the knowledge and skills necessary to identify, collect, preserve, analyze, and present digital evidence in legal proceedings. The course covers various aspects of digital forensics, including computer forensics, network forensics, and mobile device forensics.

**Course Outcome:** Students will be:

1. Understanding the principles of cloud forensics, including the identification and investigation of security incidents, as well as the anti-forensic techniques employed in cloud environments.
2. Applying the processes for collecting electronic evidence in the cloud, including strategies for data recovery of deleted and overwritten information, and the role of ethical hacking in cloud forensics.
3. Analyzing knowledge of metadata and metadata logs in the analysis of various cloud storage models, such as OneDrive, Dropbox, and Google Drive, as well as different cloud service models (SaaS, PaaS, IaaS, and FaaS).
4. Performing forensic investigations involving AWS, utilizing case studies to illustrate practical applications and challenges in cloud forensic analysis.
5. Interpreting the fundamentals of operating systems, including batch and distributed operating systems, focusing on memory structure, process control, scheduling, synchronization, and memory management.

<b>Course contents</b>
<b>Section I: Introduction to Digital Forensics</b> Introduction, branches of digital forensics, fundamentals of digital forensics, Digital crimes and their types, benefits of forensics in digital crimes, digital forensics evidence, Collection and preservation of evidences, legal concerns and private issues.
<b>Section II: Digital crimes and evidence</b> Digital crimes and their types: targeting Computer systems and Mobiles- data diddling attacks, spyware, logic bombs, DoS, DDoS, APTs, virus, Trojans, ransomware, data breach., benefits of forensics in digital crimes, digital forensics evidence, Collection and preservation of evidences, legal concerns and private issues.

**Section III: Web Browsers**

Web Browsers: Cookies, Favourites or bookmarks, cache, session data and plugins. Email: Types of Email and protocols, Analysing the header details and tracking the email, Spoofed mails, H T M L and other internet protocols, internet history, e-mail and header interpretation

**Section IV: Advancements in computer forensics**

Tools used for computer forensics, Imaging/ extraction/analysis of computer devices, Disc forensics, Windows Registry Collection of electronic devices.

**Learning Experience:** The learning experience in this course is designed to be both theoretical and practical. Students will engage in hands-on exercises and simulations to gain practical experience in digital forensics techniques. They will learn about various forensic tools and software used in the field. Additionally, the course will explore real-world case studies to understand how digital evidence is collected, analyzed, and presented in court.

**Textbooks:**

1. Compute Crime and Computer Forensic by Dr. R.K. Tiwari
2. Introduction to Forensic Science in Crime Investigation By Dr.(Mrs.) Rukmani Krishnamurthy
3. Cyber Law in India by Farooq Ahmad- Pioneer Books
4. Information Technology Law and Practice by Vakul Sharma- Universal Law Publishing Co. Pvt. Ltd.
5. The Indian Cyber Law by Suresh T. Vishwanathan- Bharat Law House New Delhi
6. Guide to Cyber and E- Commerce Laws by P.M. Bukshi and R.K. Suri- Bharat Law House, New Delhi
7. Guide to Cyber Laws by Rodney D. Ryder- Wadhwa and Company, Nagpur
8. The Information technology Act, 2000- Bare Act- Professional Book Publishers, New Delhi.

**Suggested Reading:**

1. Digital Forensics: A Field Guide by Brian Carrier
2. Computer Forensics: Incident Response and Investigations by Rod V. McKown
3. Mobile Device Forensics by Jonathan Zdziarski

**Open Educational Resources (OER):**

1. Open Digital Forensics Survival Guide: <https://www.cyberdefensemagazine.com/>
2. Introduction to Digital Forensics: <https://nij.ojp.gov/library/publications/forensic-examination-digital-evidence-guide-law-enforcement>
3. Digital Forensics Course Materials: <https://dfrws.org/>

**Examination Scheme:**

Evaluation components	Weightage
Internal marks (Theory) I. Continuous assessment(30 marks)	30 Marks

All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	
<b>II. Internal marks (Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>VAC</b>	Indian constitution	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		2	0	0	2
<b>Category of Course</b>	VAC				
<b>Total Contact Hours</b>	30 Hours				
<b>Pre-requisites/ Co-requisites</b>	---				

**Course Perspective:** Indian Constitution is a foundational course that delves into the intricate framework of India's governance system. It offers a comprehensive understanding of the constitutional principles, rights, and duties that shape the nation. By exploring the historical context, philosophical underpinnings, and contemporary challenges, students gain valuable insights into the democratic values and legal framework that govern India.

**Course Outcome:** Students will be:

1. Understanding the historical background and significance of the Indian Constitution, including the role of Dr. B.R. Ambedkar in its formation from 1946 to 1949.
2. Applying the components of the Constitution, focusing on the Preamble, Fundamental Rights, Fundamental Duties, and Directive Principles of State Policy (Articles 12 to 51), to comprehend their content and significance.
3. Analyzing knowledge of important constitutional amendments, evaluating their impact and the procedures involved in amending the Constitution in the context of sustainable development in India.
4. Performing critical assessments of special rights established in the Indian Constitution for marginalized groups, including Dalits, backward classes, women, children, and religious and linguistic minorities.
5. Interpreting the implications of constitutional provisions on social justice and equity, particularly concerning the rights and protections afforded to various communities within Indian society.

<b>Course contents</b>
<b>Section I:</b> Introduction to Indian constitution Historical Background, Preamble and its Significance, Meaning of term Constitution; making of Indian Constitution 1946 to 1949 and role played by Dr. B.R. Ambedkar; salient features of Indian Constitution
<b>Section II:</b> Components and articles Preamble, fundamental rights, fundamental duties, and Directive Principles of State Policy – Their content and significance. (Article 12 to 51)
<b>Section III:</b> Constitutional amendments Important Constitutional Amendments and their Impact, Procedure for Amendments, Constitution and sustainable development in India

#### **Section IV: Special rights**

Special rights created in Indian constitution for dalits, backward class, women and children and religious and linguistic minorities.

**Learning Experience:** Indian Constitution is enriched through a combination of theoretical knowledge and practical applications. Students engage in discussions, debates, and case studies to analyze real-world scenarios and understand the implications of constitutional provisions. The course fosters critical thinking, legal reasoning, and a deep appreciation for the democratic process.

#### **Textbooks:**

1. "Introduction to the Constitution of India" by D.D. Basu
2. "Indian Polity" by M. Laxmikanth
3. "The Oxford Handbook of the Indian Constitution" edited by Sujit Choudhry, Madhav Khosla, and Pratap Bhanu Mehta

#### **Suggested Readings:**

1. Indian Constitutional Law by Durga Das Basu
2. Introduction to the Constitution of India by Granville Austin
3. The Constitution of India by V. N. Shukla

#### **Open Educational Resources (OER)**

1. National Council of Educational Research and Training (NCERT): <https://ncert.nic.in/>
2. India Knowledge Portal: <https://www.india.gov.in/>
3. National Legal Services Authority (NALSA): <https://nalsa.gov.in/>

#### **Examination Scheme:**

<b>Evaluation components</b>	<b>Weightage</b>
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks (Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>UCH152</b>	Practical-Chemistry II	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		0	0	2	1
<b>Category of Course</b>	Practical (Minor)				
<b>Total Contact Hours</b>	30 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** Chemistry Practical II is designed to provide students with hands-on experience in the identification and analysis of elements across the periodic table, focusing on s, p, d, and f block elements. Through various experimental techniques such as flame tests, spot tests, and spectroscopic methods, students will explore the properties and behavior of metals, including their reactions in different environments. The course emphasizes real-world applications, such as detecting heavy metals in water, preparing students for environmental and analytical chemistry challenges.

**Course Outcome:** Students will be:

1. Acquire a thorough understanding of the properties of s, p, d, f Block elements.
2. Learn about the chemistry of alkali metals and alkaline earth metals.
3. Explore the properties and compounds of main group and their roles in various chemical reactions.
4. Acquire skills in designing and performing synthetic reactions involving s,p,d,f block elements.
5. Recognize the environmental impact and considerations related to the chemistry of these elements and their compound.

#### **Course contents**

1. Identification of s, p, d, f Block Elements
2. Flame test for alkali and alkaline earth metals.
3. Spot tests for transition metals (d-block) and lanthanides (f-block).
4. Detection and quantification of lead, cadmium, and mercury in water samples using colorimetric and spectroscopic methods.
5. Study of the effect of pH on the solubility of heavy metals.

**Learning Experience:** Students will gain practical skills in qualitative and quantitative analysis through a series of laboratory experiments. The flame test for alkali and alkaline earth metals will enhance their understanding of element-specific flame colors, while spot tests will allow for the identification of transition metals and lanthanides. Working with colorimetric and spectroscopic methods to detect toxic metals like lead, cadmium, and mercury in water will expose students to modern environmental monitoring techniques. The study of pH effects on metal solubility will help solidify concepts in chemical equilibria.

#### **Textbooks:**

1. J. R. Partington 1969 A History of Chemistry, Volume 2, , Macmillan.



2. Eding Darrel D, 1970 Introductory Chemistry.
3. Odian George, 1990 General, Organic and Biological Chemistry.

**Suggested Reading:**

4. Vogel's Qualitative Inorganic Analysis by G. Svehla
5. Inorganic Chemistry by J.D. Lee
6. Advanced Inorganic Chemistry by F.A. Cotton, G. Wilkinson
7. Fundamentals of Analytical Chemistry by D.A. Skoog, D.M. West, F.J. Holler

**Open Educational Resources:**

1. MIT OpenCourseWare - Principles of Inorganic Chemistry
2. [Khan Academy - Chemistry](#)
3. ChemCollective Virtual Labs
4. LibreTexts - Analytical Chemistry

**Examination Scheme**

<b>Evaluation components</b>	<b>Weightage</b>
<b>Internal marks (practical)</b> I. Conduct of experiment II. Lab Record III. Lab Participation IV. Lab Project	<b>10 Marks</b> <b>10 Marks</b> <b>10 Marks</b> <b>20 Marks</b>
<b>II. External Marks (practical)</b> End Term Examination	<b>50 Marks</b>

<b>SEC079</b>	Forensic Practical II	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		0	0	4	2
<b>Category of Course</b>	Skill Enhancement Course				
<b>Total Contact Hours</b>	60 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

### Course Perspective:

The course offers a comprehensive introduction to the field of forensic science, focusing on the analysis and interpretation of fingerprints and questioned documents. Students will gain practical skills in fingerprint identification, development, and comparison, as well as document examination techniques. This knowledge will be invaluable in various forensic investigations, including criminal cases and civil disputes.

### Course Outcome: Students will be:

1. Observe and document fingerprint patterns and ridge characteristics using classification techniques and analysis tools for forensic identification.
2. Imitate the process of lifting, developing, and preserving latent fingerprints using powders, chemicals, and alternative light sources to maintain evidence integrity.
3. Perform practical exercises in fingerprint identification and comparison, including poroscopy and edgeoscopy, to match and individualize fingerprint evidence in forensic cases.
4. Adapt methods for analyzing questioned documents by examining handwriting, ink, paper, and alterations, using tools like magnifiers, microscopes, and VSC for document authenticity verification.
5. Evaluate and compare fingerprint and handwriting samples from questioned documents, identifying forgeries and providing forensic conclusions in practical case scenarios.

### Course contents

#### Fingerprints:

1. Prepare fingerprint card and identify the patterns.
2. Tape lifting of fingerprint.
3. Casting of foot prints/ fingerprint.
4. Ninhydrin method for fingerprint development.
5. Iodine fuming method for fingerprint development.
6. Silver nitrate method for fingerprint development.

#### Questioned Documents:

1. Handwriting analysis based on class and individual characteristics.
2. Examination of documents under different light sources- transmitted, oblique, UV.
3. Identification of genuine and fake currencies.
4. Identification features of security documents.

**Learning Experience:**

Students will have the opportunity to engage in hands-on activities that simulate real-world forensic scenarios. They will learn how to prepare fingerprint cards, identify different fingerprint patterns, and employ various techniques for fingerprint development, including tape lifting, casting, ninhydrin, iodine fuming, and silver nitrate methods. In addition, students will analyze handwriting samples to determine class and individual characteristics, examine documents under different light sources, and identify genuine and fake currencies. Through these practical experiences, students will develop critical thinking skills and a deep understanding of forensic science methodologies.

**Textbooks:**

1. Thomas Kubic, Nicholas Petraco Forensic Science Laboratory Manual and Workbook, Third Edition 2009.
2. A. I. Vogel, Textbook of Practical organic Chemistry including Qualitative organic analysis.
3. Kathy Mirakovits, Gina Londino, The Basics of Investigating Forensic Science: A Laboratory Manual 2015.
4. Washington state patrol Forensic Laboratory services: Crime Laboratory: Technical & Training Manuals.

**Suggested Readings:**

1. "Forensic Science: An Introduction" by Richard Saferstein
2. "Fundamentals of Forensic Science" by James E. O'Hara and Richard E. Babich
3. "Handbook of Forensic Science" edited by Richard Saferstein

**Open Educational Resources:**

1. National Institute of Justice: <https://nij.ojp.gov/>
2. The Open University: <https://www.open.edu/openlearn/>
3. Forensic Science Education Resources: <https://www.justice.gov/archives/dag/forensic-science>

**Examination Scheme**

Evaluation components	Weightage
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<b>Internal marks (practical)</b> I. Conduct of experiment II. Lab Record III. Lab Participation IV. Lab Project	<b>10 Marks</b> <b>10 Marks</b> <b>10 Marks</b> <b>20 Marks</b>
<b>II. External Marks (practical)</b> End Term Examination	<b>50 Marks</b>

### **THIRD SEMESTER**

<b>SCFS201</b>	Forensic Ballistics and Explosives	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		3	0	0	3
<b>Category of Course</b>	Major				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ requisites</b>	<b>Co---</b>				

**Course Perspective:** Forensic ballistics and explosives is a specialized field that combines the principles of physics, chemistry, and criminalistics to investigate firearms and explosives related crimes. This course delves into the examination of firearms, ammunition, and explosive devices, providing students with the knowledge and skills necessary to analyze evidence and reconstruct crime scenes. By studying the dynamics of projectiles, the chemistry of explosives, and the techniques used to identify and classify firearms and explosives, students gain a comprehensive understanding of this critical area of forensic science.

**Course Outcome:** Students will be:

1. Understanding the classification, parts, and forensic importance of firearms and ammunition, including the Indian Arms Act.
2. Applying the range of fire through the examination of muzzle patterns, GSR analysis, and the characteristics of firearm injuries such as entrance and exit wounds.
3. Analyzing techniques for reconstructing the sequence of events in shooting incidents and the presentation of ballistic evidence in court.
4. Performing identification of various types of explosives, including high and low explosives, and differentiate between black powder, smokeless powder, and dynamite.
5. Interpreting the characteristics of ammunition and cartridge cases, focusing on class and individual characteristics for identification purposes.

<b>Course contents</b>
<b>Section I: Firearms &amp; Ammunition</b> Definition, Indian Arms Act, Forensic Importance; Nature of firearms, parts of a firearm, classification of firearm, Types, Bullet comparisons, cartridge case examination, class and individual characteristics of identification
<b>Section II: Range of Fire</b> Muzzle pattern, scorching, blackening, tattooing, wad distribution, pellet patterns, GSR analysis, and primer residues, Entrance wound, exit wound and internal wound, evaluation of firearm injuries.
<b>Section III: Analysis and Reconstruction</b> Reconstruction of the sequence of events in a shooting case. Presentation of evidence in the court. accidental firing

#### **Section IV: Explosives**

Introduction to explosives, definition, High explosives and low explosives, difference and classification, Identifying the explosives, Black and smokeless powder identification, dynamite identification, identifying other explosives, reconstructing the destructive devices.

**Learning Experience:** in forensic ballistics and explosives involves a combination of theoretical knowledge and practical skills. Students will engage in classroom lectures, laboratory exercises, and potentially fieldwork to gain hands-on experience. They will learn about the various types of firearms, ammunition, and explosives, as well as the techniques used to examine and analyze evidence. Additionally, students may have the opportunity to visit forensic laboratories or crime scenes to observe real-world applications of their studies. Through a combination of theoretical and practical learning, students will develop the expertise necessary to contribute to investigations involving firearms and explosives.

#### **Textbooks:**

1. Nath, S., Fingerprint Identification, CRC Press, 2<sup>nd</sup> edition, 2002.
2. Champhod, C., Fingerprint and other ridge skin impressions, CRC Press, 2004.
3. Bridges, B. C., Vollmar, A. Monir, M., Criminal Investigation, Practical Fingerprinting, Thumb Impression, Handwriting, Expert Testimony Opinion Evidence, The University Book Agency, Allahbad, 2000.
4. James, S. H. and Nordby, J. J. (Eds), Forensic Science - An Introduction to Scientific and Investigation Techniques, CRC Press, London, 2003.
5. Nanda, B. B., and Tewari, R. K., Forensic Science

#### **Suggested Readings:**

1. Forensic Ballistics: Theory and Practice by James Henry Beveridge
2. The Encyclopedia of Explosives and Related Compounds by George G. Sumner
3. Forensic Science: An Introduction by Richard Saferstein

#### **Examination Scheme:**

<b>Evaluation components</b>	<b>Weightage</b>
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks (Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>



<b>SCFS203</b>	Forensic Biology and Serology	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		3	0	0	3
<b>Category of Course</b>	Major				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** Forensic Biology and Serology is a specialized field that bridges the gap between biology and the legal system. This course delves into the application of biological principles in criminal investigations, focusing on the analysis of biological evidence such as blood, semen, saliva, and hair. Students will gain a deep understanding of the techniques used to identify and analyze these materials, as well as the legal implications of their findings. The course will cover topics such as DNA profiling, bloodstain pattern analysis, and serological testing, equipping students with the knowledge and skills necessary for a successful career in forensic science.

**Course Outcome:** Students will be:

1. Understanding the characteristics and forensic significance of various body fluids, including semen, saliva, urine, and sweat.
2. Applying blood evidence collection, preservation, and packing methods, along with ABO and Rh blood group determination techniques.
3. Analyzing species of origin analysis using spectrophotometric and immunological methods for blood identification.
4. Performing DNA fingerprinting techniques, including STR, VNTR, and SNP analysis, and explore the applications of PCR and CODIS in forensic science.
5. Interpreting the forensic significance of semen, including its composition, functions, and methods for identification and individualization.

<b>Course contents</b>
<p><b>Section I:</b> Introduction and analysis of Body Fluids</p> <p>Introduction to various body fluids, their nature and characteristics and Forensic analysis of Semen, Saliva, Urine, Sweat etc.</p>
<p><b>Section II:</b> Blood and its analysis</p> <p>The nature of blood, collection, preservation and packing of blood evidence, procedures and precautions. ABO system, Rh system; Techniques for the determination of blood groups; Identification of bloodstains by microscopic methods, Catalytic tests, crystal tests, bloodstain patterns.</p> <p>Species of Origin analysis: Application of Spectrophotometric method and immunological methods (Ring, Precipitin, reverse agglutination, normal/mixed agglutination).</p>



**Section III:** DNA fingerprinting Short tandem repeats (STR), Variable number of tandem repeats (VNTR), single nucleotide polymorphism (SNP), Applications of PCR in forensics, DNA fingerprinting, CODIS, DNA footprinting.

**Section IV:** Semen and its analysis

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

**Learning Experience:** Forensic Biology and Serology is both challenging and rewarding. Students will engage in hands-on laboratory exercises, where they will learn to collect, preserve, and analyze biological evidence. They will also have the opportunity to study real-world case studies and learn about the ethical considerations involved in forensic investigations. By combining theoretical knowledge with practical experience, students will develop a strong foundation in forensic biology and serology.

**Textbooks:**

1. Eckert, W.G., & James S.H., Interpretation of bloodstain evidence at crime scene, CRC Press, Florida, 1989.
2. James, S.H. and Nordby, J.J. (Eds.), Forensic Science - An introduction to Scientific and investigative Techniques, CRC Press, London, 2003.
3. Saferstein, R. (1998). Criminalistics, An Introduction to Forensic Science, 6<sup>th</sup> Ed. 6<sup>th</sup> Ed. Prentice –Hall
4. Kirk, P.L., Introduction in crime investigation (2<sup>nd</sup>), John Willey and, New York, 1974.

**Suggested Readings:**

1. Forensic Biology by Mark Benecke
2. Introduction to Forensic Biology by David E. Buffington
3. Forensic Serology by Richard Saferstein

**Open Educational Resources (OER):**

1. OpenStax College Biology (<https://openstax.org/books/biology/pages/1-introduction>)
2. Khan Academy Biology (<https://www.khanacademy.org/science/biology>)
3. National Institutes of Health (NIH) Genetics Home Reference (<https://ghr.nlm.nih.gov/>)

**Examination scheme:**

Evaluation components	Weightage

<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>SCFS205</b>	Cyber forensics II	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>
<b>Category of Course</b>	Major				
<b>Total Contact Hours</b>	30 Hours				
<b>Pre-requisites/ Co-requisites</b>	---				

**Course Perspective:** Cyber Forensics II delves into the advanced techniques and tools used to investigate digital crimes. This course builds upon the foundational knowledge acquired in Cyber Forensics I, providing in-depth understanding of forensic methodologies, evidence analysis, and legal implications. Students will explore real-world case studies, learn to handle complex digital crime scenes, and develop the skills necessary to become proficient cyber forensic investigators.

**Course Outcome:** Students will be:

1. Understanding mobile technologies, including ATM, WAP, GSM, TDMA, CDMA, SIM, and IMEI functionalities.
2. Applying Bluetooth functions and security issues across different mobile phone generations and operating systems like Android and iOS.
3. Analyzing knowledge of mobile attacks (e.g., phone phreaking, Man-in-the-Middle) and assess security vulnerabilities in wireless networks.
4. Performing mobile forensic investigations, including proper seizure techniques and evidence extraction methods from SIM cards and memory dumps.
5. Interpreting findings from mobile forensic analyses using appropriate toolkits, focusing on evidence extraction and mobile location tracking.

<b>Course contents</b>
<b>Section I:</b> Mobile Forensics: Overview of Mobile Forensics, Seizure and Preservation of mobile phones and PDA. Types of Evidence present in mobile phones - Files present in SIM card, external memory dump, and evidences in memory card. Mobile phone evidence extraction process, Data Acquisition Methods – Physical, File System, Logical and Manual Acquisition. Mobile Forensic Investigation Toolkit. Tracking of mobile phone location.
<b>Section II:</b> Mobile attacks Phone Phreaking, Call tampering, Wireless Hack Walkthrough and Man-in-the-Middle-attacks. Overview of WEP attack. Attacks on WEP, WPA and WPA-2 Encryption, fake hotspots. Wireless Public KeyInfrastructure. Securing WLAN, WEP Decryption script.
<b>Section III:</b> Functions of Bluetooth and security issues Various Generation of Mobile Phone Technologies. Understanding of the mobile phone operating systems – Android, iOS, Windows. Understanding of SQLite Databases

**Section IV: Mobile Technologies**

Introduction to Mobile Technologies - Asynchronous Transfer Mode (ATM), Wireless Application Protocol (WAP). Cellular technologies - Advanced Mobile Phone System (AMPS), Imode, Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA) and Global System for Mobile Communications (GSM) and relative strengths. Subscriber Identity Module (SIM), International Mobile Equipment Identity (IMEI).

**Learning Experience :** Cyber Forensics II is both challenging and rewarding. Students will engage in hands-on exercises, simulations, and practical labs to solidify their understanding of forensic concepts. The course will emphasize problem-solving, critical thinking, and the ability to analyze complex digital evidence. Through a combination of lectures, discussions, and group projects, students will develop a comprehensive understanding of the field and prepare for a successful career in cyber forensics.

**Textbooks**

1. Digital Forensics: Investigating Computer Crime by Brian K. Kruse
2. Computer Forensics: Incident Response Essentials by Rod V. Rasmussen

**Suggested Readings**

1. Computer Forensics: A Field Guide by John Sammon
2. The Art of Computer Forensics by Brian K. Kruse and Michael C. Kruse

**Open Educational Resources (OER) Links**

1. Open Digital Forensics Survival Guide: <https://www.sans.org/white-papers/ultimate-guide-getting-started-digital-forensics-incident-response/>
2. Cybersecurity and Digital Forensics Online Course: <https://www.coursera.org/specializations/computerforensics>
3. Digital Forensics and Incident Response: <https://nvlpubs.nist.gov/nistpubs/legacy/sp/nistspecialpublication800-86.pdf>

**Examination scheme:**

Evaluation components	Weightage
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>

<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>
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<b>SCFS207</b>	Biochemistry and Health Aspects	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Category of Course</b>	DSE				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	---				

**Course Perspective:** Biochemistry, the study of chemical processes within living organisms, provides a fundamental understanding of life's intricacies. This course delves into the molecular basis of biological functions, exploring topics such as enzymes, metabolism, biomolecules, and their roles in health and disease.

**Course Outcome:** Students will be:

1. Understanding the basic concepts of food, nutrition, and health, including the classification and biochemical roles of macro and micronutrients, along with their dietary sources.
2. Applying the functions of food groups and the principles of a balanced diet, including the causes of food spoilage and adulteration, while evaluating nutritional needs across different life stages such as infancy, adolescence, and elderly.
3. Analyzing knowledge of nutritional biochemistry by classifying carbohydrates, lipids, and proteins based on their structures, properties, and significance, including the importance of various vitamins and minerals in human health.
4. Performing assessments of major nutritional deficiency diseases and lifestyle-related diseases, identifying their causes, symptoms, and preventative strategies, while also evaluating government programs aimed at addressing these health issues.
5. Interpreting the implications of social health problems such as smoking, alcoholism, and AIDS on nutrition and public health, and recommend dietary treatments for common ailments like cold, cough, and gastrointestinal issues, emphasizing food hygiene and water purification methods.

<b>Course contents</b>
<b>Section I:</b> Introduction, Basic concept of food , nutrition and health, Components of food-nutrients (Macro and micronutrients): their biochemical role and dietary sources
<b>Section II:</b> Functions of Food, Food groups and the concept of a balanced diet. Causes of food spoilage; Food adulteration Nutrition through the life cycle- Physiological considerations, nutrient needs and dietary pattern for various groups- adults, pregnant and nursing mothers, infants, preschool and school children, adolescents and elderly.
<b>Section III:</b> Nutritional Biochemistry, Carbohydrates, Lipids, Proteins - Definition, Classification, Structure and properties Significance of acid value, iodine value and saponification value of lipids; Essential and Non-essential amino acids; Enzymes Definition, Classification, Properties; Coenzymes Vitamins- Fat-soluble and Water-soluble vitamins; their Structure and properties Minerals- Iron, calcium, phosphorus, iodine, selenium and zinc: their properties

**Section IV:** Health aspects, Major nutritional deficiency diseases- Protein Energy Malnutrition, Vitamin A deficiency, Iron deficiency anemia, Iodine deficiency disorders, their causes, symptoms, treatment, prevention and government programs, if any.

Life style related diseases- hypertension, diabetes mellitus, and obesity- their causes and prevention through dietary/lifestyle modifications.

Social health problems- smoking, alcoholism, drug dependence and Acquired Immuno Deficiency Syndrome (AIDS).

Common ailments- cold, cough, fevers, diarrhea, constipation- their causes and dietary treatment.

Food hygiene; Potable water- sources and methods of purification Food and Water borne infections

### Learning Experience

Through engaging lectures, practical experiments, and group discussions, students will gain hands-on experience in biochemical techniques and develop critical thinking skills. The course fosters a deep appreciation for the complexity and beauty of biological systems and their relevance to human health and well-being.

### Textbooks

1. Lehninger Principles of Biochemistry by David L. Nelson and Michael M. Cox
2. Biochemistry by Jeremy M. Berg, John L. Tymoczko, Lubert Stryer, and Gregory J. Gatto Jr.

### Suggested Readings

1. Biochemistry by Robert H. Devlin
2. Principles of Biochemistry by Albert L. Lehninger

### Open Educational Resources (OER) Links

1. Khan Academy Biochemistry <https://support.khanacademy.org/hc/en-us/community/posts/209558837-Biochemistry>
2. OpenStax Biology <https://openstax.org/details/books/biology-2e/>
3. MIT OpenCourseWare Biochemistry <https://ocw.mit.edu/courses/7-05-general-biochemistry-spring-2020/>

### Examination scheme:

Evaluation components	Weightage
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>

<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>



<b>UCH103</b>	<b>Physical chemistry</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		3	0	0	3
<b>Category of Course</b>	Minor				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** Chemistry III (Physical Chemistry) delves into the fundamental principles governing the behavior of matter and energy. This course provides a solid foundation in thermodynamics, equilibrium, and the states of matter. By understanding these concepts, students can better analyze and predict the outcomes of chemical reactions and processes.

**Course Outcome:** Students will be:

1. Understanding the principles of chemical equilibrium, including the derivation of the equilibrium constant and free energy, as well as the application of Le Chatelier's principle in predicting the effects of changes in concentration, temperature, and pressure on chemical systems.
2. Applying the Nernst distribution law and its thermodynamic derivation, including modifications for solute dissociation and association, to evaluate its applications in determining hydrolysis constants and extraction processes.
3. Analyzing the concepts of states of matter, including the characteristics of solids, liquids, and gases, as well as the significance of crystal structures and defects, to explain the behavior of materials under different conditions.
4. Performing calculations involving the laws of thermodynamics, including the First, Second, and Third Laws, to determine the absolute entropies of substances and analyze energy transformations in chemical reactions.
5. Interpreting the critical phenomena associated with gases, including critical pressure, temperature, and volume, by deriving the van der Waals equation of state and understanding its implications for real gas behavior and phase transitions.

#### **Course contents**

##### **Section I: Chemical equilibrium**

Equilibrium constant and free energy, concept of chemical potential, thermodynamic derivation of law of chemical equilibrium, temperature dependence of equilibrium constant, Vant'sHoff reaction isochoric, VantHoff reaction isotherm, Le- chatelier's principle and its application, Clapeyron equation and Clausius-clapeyron equation and its application.

**Section II: Distribution law**

Nernst distribution law- thermodynamics derivation, modification of distribution law when solute undergoes dissociation, association and chemical combination. Applications of distribution law: distribution of degree of hydrolysis and hydrolysis constant of aniline hydrochloride.

determination of equilibrium constant of potassium tri-iodide complex and process of extraction

**Section III: States of matter**

Solid state: crystal, types of crystals, crystal defects, Bragg's law. Metallic bond and its characteristics.

Liquid crystals: difference between solid, liquids and liquid crystals, types of liquid crystals.

Applications of liquid crystals.

Liquid state: properties of liquids- surface tension, viscosity and their determination.

Gaseous state: derivation of real gases from ideal behavior. Derivation of vander wall's equation of state, explanation of behavior and real gas using vander wall's equation.

Critical phenomenon: critical pressure, critical temperature, critical volume and the determination of PV isotherms of real gases, continuity of states, isotherms of vander wall's equation.

**Section IV: Laws of Thermodynamics:** Introduction of thermodynamics; Statement of First, second, Third Law of thermodynamics and calculation of absolute entropies of substances

**Learning Experience:** Physical chemistry is a theoretical subject, but practical demonstrations and experiments can enhance understanding. Students might conduct experiments to measure equilibrium constants, determine distribution coefficients, analyze crystal structures, and study the properties of liquids and gases. These hands-on experiences reinforce the theoretical concepts and provide valuable problem-solving skills.

**Textbooks:**

1. Physical Chemistry by Atkins and de Paula
2. Physical Chemistry by Castellan
3. Physical Chemistry by Daniels and Alberty

**Suggested Readings:**

1. Thermodynamics by Callen
2. Statistical Thermodynamics by McQuarrie and Simon

**Open Educational Resources (OER):**

1. OpenStax Chemistry ([invalid URL removed])
2. MIT OpenCourseWare: 5.60 Thermodynamics, Kinetics, and Statistical

**Examination scheme:**

Evaluation components	Weightage

<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>SCFS209</b>	Electricity and magnetism	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		3	0	0	3
<b>Category of Course</b>	DSE				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	---				

**Course Perspective:** Electricity and Magnetism is a fundamental branch of physics that explores the interactions between electric charges and magnetic fields. This course delves into the concepts of electric charge, electric fields, electric potential, electric current, magnetic fields, and electromagnetic induction. By understanding these concepts, students can grasp the underlying principles behind various electrical and magnetic phenomena, from the simple operation of a light bulb to complex technologies like electric motors and generators

**Course Outcome:** Students will be:

1. Understanding the concepts of electric fields and electric potentials, including the application of Gauss's Law to various charge distributions and the relationship between potential and electric field in electrostatics.
2. Applying the electrostatic energy of systems of charges, including the capacitance of conductors and parallel-plate capacitors, to assess energy storage capabilities in electrical systems.
3. Analyzing the principles of magnetic fields, including Biot-Savart's Law and Ampere's Circuital Law, to determine the magnetic forces acting on charges and current-carrying wires in various configurations.
4. Performing calculations related to the magnetic properties of matter, including magnetization, magnetic susceptibility, and the B-H curve, to explore material behavior in magnetic fields.

<b>Course contents</b>
<b>Section I:</b> Electric Field and Electric Potential Electric field lines, Electric flux, Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry. Electrostatic Potential. Laplace's and Poisson equations Potential and Electric Field of a dipole. Force and Torque on a dipole.
<b>Section II</b> Electrostatics: Electrostatic energy of system of charges. Electrostatic energy of a charged sphere. Conductors in an electrostatic Field. Surface charge and force on a conductor. Capacitance of a system of charged conductors, Parallel-plate capacitor. Capacitance of an isolated conductor
<b>Section III:</b> Magnetic Field: Magnetic force between current elements and definition of Magnetic, Field B. Biot- Savart's Law and its simple applications: straight wire and circular loop. Ampere's Circuital Law. Magnetic Force on (1) point charge (2) current carrying wire (3) between current elements.

**Section IV:** Magnetic Properties of Matter: Magnetization vector (M). Magnetic Intensity (H), Magnetic Susceptibility and permeability. Relation between B, H, M, Ferromagnetism, B-H curve and hysteresis, Electromagnetic Induction: Faraday's Law. Lenz's Law. Self Inductance and Mutual Inductance. Energy stored in a Magnetic Field.

**Learning Experience:** Electricity and Magnetism involves a combination of theoretical understanding and practical application. Students will engage in problem-solving activities, laboratory experiments, and demonstrations to reinforce their knowledge and develop critical thinking skills. Through interactive learning methods, students will gain a deeper appreciation for the real-world applications of electricity and magnetism, from power generation and transmission to medical imaging and electronics.

**Textbooks:**

1. Allied Physics – R. Murugesan S. Chand & Co. First Edition (2005).
2. Allied Physics – Dr. K. Thangaraj, Dr. D. Jayaraman Popular Book Department, Chennai.
3. Allied Physics – Prof. Dhanalakshmi and others.
4. Elements of Properties of Matter – D.S. Mathur, S. Chand & Co. (1999).
5. Heat and Thermodynamics – N. Brijlal and Subramaniam S. Chand & Co.
6. A Textbook of Sound – by M. Narayanamoorthy and other National Publishing Companies (1986).
7. Modern Physics – R. Murugesan S. Chand & Co. (2004)

**Suggested Readings:**

1. University Physics by Young and Freedman
2. Physics by Halliday, Resnick, and Walker
3. Fundamentals of Physics by Halliday, Resnick, and Walker

**Open Educational Resources (OER):**

1. OpenStax College Physics - <https://openstax.org/details/books/college-physics-2e/>
2. MIT OpenCourseWare - 8.02 Electricity and Magnetism - <https://ocw.mit.edu/courses/8-02-physics-ii-electricity-and-magnetism-spring-2007/>
3. Khan Academy - Electricity and Magnetism <https://www.khanacademy.org/science/hs-physics/x215e29cb31244fa1:types-of-interactions/x215e29cb31244fa1:electric-and-magnetic-fields/a/electric-and-magnetic-fields>

**Examination scheme:**

Evaluation components	Weightage
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>

<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>AEC</b>	New Age Life Skills-I	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		3	0	0	3
<b>Category of Course</b>	AEC				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ requisites</b>	<b>Co--</b>				

**Course Perspective:** The New Age Life Skills course is designed to equip students with the essential skills and knowledge needed to thrive in today's dynamic and ever-evolving world. This course goes beyond traditional academic subjects to focus on developing essential life skills that are crucial for personal and professional success. By exploring effective communication, personality development, mindset and resilience, and enhancing spoken skills, students will gain valuable insights and practical tools to navigate challenges, build relationships, and achieve their goals.

**Course Outcome:** Students will be:

1. Understanding the principles of effective verbal and non-verbal communication skills, including appropriate language, tone, body language, and active listening techniques to enhance interpersonal interactions.
2. Applying personal etiquette, attitude, self-esteem, and public speaking skills to foster a professional image and effective communication in various contexts.
3. Analyzing strategies for developing a growth mindset and resilience to overcome obstacles, enhancing adaptability in personal and professional situations.
4. Performing techniques to improve spoken skills, including vocabulary enhancement, pronunciation, and effective speech delivery, to communicate ideas clearly and confidently.
5. Interpreting feedback and self-reflection to cultivate confidence, assertiveness, and effective storytelling abilities, contributing to overall personal development and communication proficiency.

<b>Course Content</b>
<b>Section I:</b> Effective Communication Skills: Content Summary: Verbal Communication Skills: speaking clearly, using appropriate language and tone, and expressing ideas effectively, Non-Verbal Communication Skills: Body Language Facial Expressions, Posture, Eye Contact, and Gestures, Active Listening Skills: Understanding and Reporting to Other's Messages, Interpersonal Skills: Building Rapport, Empathy, and Resolving Conflicts
<b>Section II:</b> Personality development: Etiquettes and Manners, Attitude, Self Esteem & Self Reliance, Public Speaking, Work Habits, Presentation Skills/Techniques
<b>Section III:</b> Mindset and Resilience: Knowing and experiencing self, Developing a growth mindset, Strategies for overcoming obstacles and setbacks, Cultivating Resilience and Adaptability
<b>Section IV:</b> Enhancing Spoken Skills: Vocabulary & Pronunciation improvement, Verbal Ability Qs & Ans, Delivery of speech, Motivation, Assertiveness, Confidence building, Story narration, Book review.

**Learning Experience:** This course offers a comprehensive theoretical knowledge with practical application. Students will engage in a variety of activities, including group discussions, role-plays, presentations, and case studies, to develop their skills and confidence. Through interactive exercises and real-world examples, students will learn how to apply the concepts and techniques learned in the classroom to their own lives. The course will also foster a supportive and collaborative learning environment where students can share their experiences and learn from each other.

**Textbooks:**

1. The 7 Habits of Highly Effective People by Stephen Covey
2. How to Win Friends and Influence People by Dale Carnegie
3. Mindset: The New Psychology of Success by Carol S. Dweck
4. The Power of Positive Thinking by Norman Vincent Peale

**Suggested Readings:**

1. Emotional Intelligence by Daniel Goleman
2. Grit: The Power of Passion and Perseverance by Angela Duckworth
3. The Art of Public Speaking by Dale Carnegie
4. The Power of Habit by Charles Duhigg

**Open Educational Resources (OER):**

1. <https://oercommons.org/>
2. MIT OpenCourseWare: <https://ocw.mit.edu/>
3. TED Talks: <https://www.ted.com/>
4. Khan Academy: <https://www.khanacademy.org/>

**Examination scheme:**

Evaluation components	Weightage
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>



<b>UCH153</b>	Practical-Chemistry III	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		0	0	2	1
<b>Category of Course</b>	Practical (Minor)				
<b>Total Contact Hours</b>	30 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

### Course Perspective:

In Chemistry Practical III, students will explore the dynamics of chemical reactions and physical properties of liquids through hands-on experiments. This course emphasizes understanding key concepts like equilibrium constants, thin-layer chromatography, and the influence of temperature on viscosity and surface tension. By conducting these experiments, students will not only gain practical laboratory skills but also learn to interpret results using analytical techniques.

### Course Outcome: Students will be:

1. Understanding the principles and methodology involved in determining the equilibrium constant for the reaction between acetic acid and ethanol to form ethyl acetate, demonstrating knowledge of chemical equilibria.
2. Perform thin-layer chromatography (TLC) of a mixture of organic compounds, accurately applying techniques to separate and analyze components based on their affinities for the stationary and mobile phases.
3. Calculate R<sub>f</sub> values and interpret results to evaluate the distribution of compounds between the stationary and mobile phases, enhancing skills in chromatographic analysis.
4. Examine the effect of temperature on the viscosity of liquids to understand the relationship between temperature and molecular interactions in liquid systems.
5. Investigate the effect of temperature and concentration on surface tension, enabling an understanding of intermolecular forces and their influence on physical properties of liquids.

### Course contents

1. Determination of the equilibrium constant for the reaction between acetic acid and ethanol to form ethyl acetate.
2. Thin-layer chromatography (TLC) of a mixture of organic compounds.
3. Calculation of R<sub>f</sub> values and interpretation based on the distribution of compounds between the stationary and mobile phases.
4. Study of the effect of temperature on the viscosity of liquids.
5. Study of the effect of temperature and concentration on surface tension.

### Learning Experience:

Students will develop proficiency in performing chemical experiments, analyzing data, and interpreting results. Through experiments such as determining the equilibrium constant and studying chromatography, students will gain insights into reaction mechanisms and molecular behavior.

Additionally, understanding the impact of temperature on viscosity and surface tension will provide an experiential learning opportunity that bridges theory and practical application.

#### **Textbooks and Suggested Reading:**

1. Vogel's **Textbook** of Practical Organic Chemistry – B.S. Furniss, A.J. Hannaford, P.W.G. Smith
2. Organic Chemistry Laboratory Manual – Raj K. Bansal
3. Experimental Physical Chemistry – Arthur Halpern, George McBane
4. Introduction to Chromatography – Bob Fried

#### **Open Educational Resources:**

1. [Khan Academy - Chromatography](#)
2. MIT OpenCourseWare - Chemical Equilibrium
3. ChemCollective - Virtual Lab
4. LibreTexts - Surface Tension and Viscosity

#### **Examination Scheme**

<b>Evaluation components</b>	<b>Weightage</b>
<b>Internal marks (practical)</b> I. Conduct of experiment II. Lab Record III. Lab Participation IV. Lab Project	<b>10 Marks</b> <b>10 Marks</b> <b>10 Marks</b> <b>20 Marks</b>
<b>II. External Marks (practical)</b> End Term Examination	<b>50 Marks</b>

<b>SEC080</b>	Forensic Practical III	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		0	0	4	2
<b>Category of Course</b>	Skill Enhancement Course				
<b>Total Contact Hours</b>	60 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** This integrated course aims to provide students with a comprehensive understanding of forensic biology, serology, and ballistics, equipping them with essential practical skills for analyzing biological and ballistic evidence encountered in criminal investigations. The curriculum combines theoretical knowledge with hands-on experience, allowing students to explore various aspects of forensic science critical for solving crimes and supporting the justice system.

**Course Outcomes:** Students will be:

1. Analyzing different blood stain patterns and firearms found at crime scenes to infer the events leading to their formation.
2. Performing preliminary tests for analysis of biological and ballistic evidence to establish the relationship between victim, suspect and the crime.
3. Analyzing proper techniques for the collection, preservation, and packing of biological and ballistic evidence to ensure evidence integrity.
4. Determining the relevance of various evidence using specific identification techniques the identification of gunshot residue (GSR) to link suspects to the discharge of firearms.

<b>Course contents</b>
<p>Forensic Biology and Serology</p> <ol style="list-style-type: none"> <li>1. Analyse different blood stain pattern found at crime scene.</li> <li>2. Perform preliminary tests for blood.</li> <li>3. To identify blood samples by confirmatory chemical tests.</li> <li>4. To identify the given stain as semen</li> <li>5. To prepare slides of scale pattern of human hair</li> <li>6. To examine human hair for cortex and medulla.</li> </ol> <p>Forensic Ballistics and Explosives</p> <ol style="list-style-type: none"> <li>1. To classify the firearms and their firing mechanisms</li> <li>2. To know the characteristics of ammunition</li> <li>3. Collection, preservation and packing of exhibits.</li> <li>4. To perform chemical tests of powder residues (Walker's Test) around gunshot holes in fabrics.</li> <li>5. Restoration of erased serial numbers on firearms.</li> <li>6. Photography and sketching of crime scene involving firearms.</li> <li>7. To perform chemical tests for the identification of GSR.</li> </ol>

**Learning Experience:** Through practical sessions, students will gain hands-on experience in collecting, preserving, and analyzing biological evidence. They will learn to identify different bloodstain patterns, perform preliminary and confirmatory tests for blood, and analyze hair samples for morphological characteristics. Additionally, students will explore the techniques used to identify semen and prepare slides of scale patterns.

**Textbooks:**

1. Thomas Kubic, Nicholas Petraco Forensic Science Laboratory Manual and Workbook, Third Edition 2009.
2. A. I. Vogel, **Textbook** of Practical organic Chemistry including Qualitative organic analysis.
3. Kathy Mirakovits, Gina Londino, The Basics of Investigating Forensic Science: A Laboratory Manual 2015.
4. Washington state patrol Forensic Laboratory services: Crime Laboratory: Technical & Training Manuals.

**Suggested Readings:**

1. Forensic Science: An Introduction by David R. Ashbaugh
2. Criminalistics: An Introduction to Forensic Science by Richard Saferstein
3. Introduction to Forensic Science by Richard Saferstein
4. Forensic Biology by Richard Saferstein
5. Forensic Serology: Fundamentals and Applications by David E. R. Houck
6. Forensic Biology and Serology by Dr. Harsh Sharma, Dr. Kusum Singal, Rakesh Mia, Vijay Panchal
7. Fingerprint Analysis by David R. Ashbaugh
8. The Science of Fingerprints by Brian Innes
9. Bloodstain Pattern Analysis: A Primer by Tom Bevel
10. Bloodstain Pattern Analysis: A Comprehensive Guide by Henry Lee and Richard Saferstein
11. Forensic Hair Examination by Gary Gabor
12. Forensic Ballistics by Vincent J. Gennaro
13. Forensic Firearms Examination by James E. O'Hara
14. Forensic Science: An Introduction by David R. Ashbaugh

**Open Educational Resources (OER)**

1. <https://www.theiai.org/>.
2. <https://nij.ojp.gov/>.
3. <https://www.ascld.org/>.
4. <https://nij.ojp.gov/>
5. <https://www.aafs.org/>
6. <https://www.ascld.org/>.
7. <https://nij.ojp.gov/>
8. <https://nij.ojp.gov/>

**Examination Scheme:**

<b>Evaluation components</b>	<b>Weightage</b>
<b>Internal marks (practical)</b> I. Conduct of experiment II. Lab Record III. Lab Participation IV. Lab Project	<b>10 Marks</b> <b>10 Marks</b> <b>10 Marks</b> <b>20 Marks</b>
<b>II. External Marks (practical)</b> End Term Examination	<b>50 Marks</b>

<b>SIFS001</b>	Summer Internship-I	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version 1.0</b>		0	0	0	2
<b>Category of Course</b>	Internship				
<b>Total Contact Hours</b>					
<b>Pre-Requisites/Co-Requisites</b>	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.

**Evaluation Scheme:**

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

## **FOURTH SEMESTER**

<b>SCFS202</b>	<b>Forensic Physics and Biometric System</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		3	0	0	3
<b>Category of Course</b>	Major				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** Forensic physics and biometric systems delve into the scientific analysis of physical evidence and biometric data used in criminal investigations. This course equips students with the knowledge and skills to examine various physical materials such as glass, paint, soil, and fibers, as well as biometric data like fingerprints, facial features, and iris patterns. By understanding the principles of forensic physics and biometrics, students can contribute to criminal investigations by providing valuable evidence and insights.

**Course Outcome:** Students will be:

1. Understanding the metric system and the role of biometrics in personal identification, including various techniques and technologies such as fingerprint technology, face recognition, iris recognition, retina geometry, and hand geometry.
2. Applying prevalent physical evidence types, including soil, glass, fiber, hair, and liquids, to assess their significance in forensic investigations and the methods used for their examination.
3. Analyzing analytical techniques in glass examination, focusing on the composition of glass, analytical and chemical examination methods, and the comparison of glass fragments and fractures to establish links to crime scenes.
4. Performing forensic paint examinations by investigating paint chemistry, identifying types of paints and their compositions, and employing methods to analyze household and automobile paints.
5. Interpreting the composition and properties of soil, including organic and inorganic components, and apply density gradient techniques and mineral/chemical analysis methods for effective soil examination in forensic contexts.

<b>Course contents</b>
<b>Section I:</b> The Metric System, Introduction to the metric system, Biometrics in Personal Identification: Introduction, Concepts of Biometric Authentication, Role in person Identification, Techniques and Technologies (Finger Print Technology, Face Recognition, IRIS, Retina Geometry, Hand Geometry). Introduction to prevalent physical evidences (soil, glass, fibre, hair and liquids).
<b>Section II:</b> Glass and paint Examination, Glass: Composition (organic and inorganic elements), Analytical and chemical examination, Comparing glass fragments, glass fractures.
<b>Section III:</b> Forensic Paint Examination, Paint: Introduction to paint chemistry, types of paints and their composition, forensic examination of paints (household and automobile).



**Section IV:** Soil examination, Composition of soil (organic and inorganic), Properties (Colour, density, size distribution of soil particles), Collection and preservations of soil, Mineral and chemical analysis of soil, Density gradient techniques. Definition, composition, types, physical and chemical analysis of concrete and cement.

#### **Learning Experience:**

Students in this course will have the opportunity to engage in practical exercises that reinforce the theoretical concepts. They will learn to identify and analyze various physical evidence, such as glass fragments, paint samples, and soil specimens. Additionally, students will explore biometric technologies and techniques, including fingerprint analysis, facial recognition, and iris scanning. Through hands-on experience, students will develop the skills necessary to apply forensic principles to real-world investigations.

#### **Textbooks:**

1. Heard, B. J., Handbook of Firearm and Ballistics, Wiley & Sons, Chichester, England, 1997.
2. James, S. H., and Nordby, J. J., Forensic Science; an Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.
3. Saferstein, Richard, Criminalistics, an Introduction of Forensic Science, 6<sup>th</sup> Ed. Prentice-Hall, New Jersey, 1998.
4. Sharma, B.R., Forensic Science in Criminal Investigation and Trials (3<sup>rd</sup> Ed) Universal Law Publishing Co. Ltd., New Delhi, 2001.

#### **Suggested Readings:**

1. Forensic Science: An Introduction by David R. Ashbaugh
2. Criminalistics: An Introduction to Forensic Science by Richard Saferstein
3. Introduction to Forensic Science by Richard Saferstein
4. Forensic Physics by R. K. Saksena
5. Biometrics: Concepts, Techniques and Applications by Anil K. Jain, Arun Ross, and Kang Li

#### **Open Educational Resources (OER):**

1. National Institute of Justice (NIJ): <https://nij.ojp.gov/>
2. American Society of Crime Laboratory Directors (ASCLD): <https://www.asclld.org/>
3. International Association for Identification (IAI): <https://www.theiai.org/>

**Open Educational Resources (OER) Commons:** <https://oercommons.org/>

#### **Examination Scheme:**

Evaluation components	Weightage
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five	<b>30 Marks</b>

components to be evaluated)	
<b>II. Internal marks (Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>SCFS204</b>	Forensic Anthropology	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		3	0	0	3
<b>Category of Course</b>	Major				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** Forensic anthropology is a specialized field that applies anthropological techniques to the identification of human remains in legal contexts. This course equips students with the knowledge and skills necessary to analyze skeletal remains, determine individual characteristics such as age, sex, and race, and assist in the identification of victims of crime, accidents, or disasters. By understanding the principles of forensic anthropology, students can contribute to criminal investigations and provide closure to families of the deceased.

**Course Outcome:** Students will be:

1. Understanding the definition, scope, and applications of Forensic Anthropology, including its significance in personal identification and its interplay with related sciences and contemporary issues.
2. Applying the methods used for identifying sex and estimating age from various bones, such as the humerus, radius, ulna, fibula, tibia, femur, pelvic bone, and foot and hand, and assess their reliability in forensic contexts.
3. Analyzing techniques for race and height determination using long bones, exploring their medico-legal implications and the establishment of partial and complete identity from skeletal remains.
4. Performing a morphological analysis of the human skull to determine age, race, and sex, while understanding the forensic significance and implications of these identifications in legal contexts.
5. Interpreting the medico-legal implications of skeletal material identification, considering the ethical issues and challenges faced in forensic anthropology practice.

<b>Course contents</b>
<b>Section I:</b> Introduction to Forensic Anthropology: Definition, scope and application of Forensic Anthropology; and related sciences., importance and need and issues related to personal identification
<b>Section II:</b> Identification from bones: Attribution of Sex, Estimation of Age (humerus, radius, ulna, fibula, tibia, femur, pelvic bone, foot and hand).
<b>Section III:</b> Height and race determination Race and height determination from long bones and their medico legal implication. Establishment of Partial and Complete identity of skeletal material and dead bodies.

**Section IV:** Identification from Human skull, Morphology of human skull, determining the age, race and sex of the skull and its medicolegal implications.

**Learning Experience:** The practical component of the forensic anthropology course provides students with hands-on experience in analyzing human skeletal remains. Students will learn to identify bones, estimate age, sex, and race from skeletal features, and apply their knowledge to case scenarios. Through practical exercises, students will develop the skills and confidence needed to become proficient forensic anthropologists.

**Textbooks:**

1. Krogman, W. M. and M. Y. Iscan: Human Skeleton in Forensic Medicine.
2. Modi: A Text Book of Medical Jurisprudence & Toxicology.
3. Nath, S.: Forensic Anthropology
4. Stewart, T. D.: Essentials of Forensic Anthropology.

**Suggested Readings:**

1. Forensic Anthropology: A Comprehensive Guide by William M. Bass III and Jon Jefferson
2. Forensic Anthropology: A Guide to the Identification of Human Remains by Clyde Snow and Larry A. Downs
3. Gray's Anatomy: The Anatomical Basis of Medicine and Surgery
4. Grant's Atlas of Anatomy

**Open Educational Resources:**

1. National Museum of Natural History, Smithsonian Institution: <https://humanorigins.si.edu/>
2. American Academy of Forensic Sciences: <https://www.aafs.org/>

**Examination Scheme:**

Evaluation components	Weightage
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks (Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>UCH104</b>	Analytical chemistry-I	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		3	0	0	3
<b>Category of Course</b>	Minor				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	---				

**Course Perspective:** Analytical chemistry is a fundamental branch of chemistry that focuses on the identification, separation, and quantification of matter. This course provides students with the theoretical knowledge and practical skills to analyze various substances using a wide range of analytical techniques. By understanding the principles of analytical chemistry, students can contribute to fields such as environmental science, forensic science, pharmaceutical research, and quality control.

**Course Outcome:** Students will be:

1. Understanding the principles of ultraviolet (UV) absorption spectroscopy, including Beer's Lambert law, molar absorptivity, and the significance of electronic transitions, chromophores, and auxochromes in the context of conjugated compounds.
2. Applying the principles and instrumentation of atomic absorption spectrometry (AAS) and mass spectrometry (MS), focusing on techniques, interference, background correction methods, and the quantitative analysis of samples.
3. Analyzing knowledge of infrared (IR) and nuclear magnetic resonance (NMR) spectroscopy, exploring their theoretical foundations, instrumentation, and practical applications in the analysis of forensic science samples.
4. Performing calibration and utilize various types of volumetric glassware in chemical analysis, identifying sources of error and understanding their implications on experimental accuracy and precision.
5. Interpreting the principles and applications of thermal analysis and distillation techniques, including the operation of hot air ovens, incubators, hot plates, and magnetic stirrers, while discussing their roles in chemical experimentation and analysis.

<b>Course contents</b>
<b>Section I: Ultraviolet (UV) absorption spectroscopy</b> Absorption laws (Beer's Lambert law), molar absorptivity, presentation and analysis of UV spectra, types of electronic transitions, effect of conjugation. Concept of chromophore and auxochrome. UV spectra of conjugated enes and enons. Woodward rules. Applications of UV spectroscopy in structure elucidation of simple organic compounds.
<b>Section II: AAS &amp; MS</b> Atomic absorption spectrometry: Principle, Instrumentation and techniques, interference in AAS, background correction methods, quantitative analysis. Introduction to Mass Spectrometry- principles, instrumentation and applications.

**Section III: IR and NMR Spectroscopy**

Introduction – Properties of light, interaction of matter and light - Electromagnetic spectrum – Infrared (IR) spectroscopy, theory, instrumentation and its application in forensic Science –Nuclear magnetic resonance (NMR) spectroscopy, theory, instrumentation and its application in forensic science.

**Section IV:** Volumetric glassware, their types, calibration and use of volumetric glassware in chemical analysis, source of error in volumetric glassware, Thermal Analysis- principles of thermal analysis, types and its application, Distillation Units Principle of distillation, types of distillation units (simple, fractional, steam, Vacuum, Zone), role of Raoult's law and Daltons Law, procedure involved in distillation, application in chemistry, Hot air oven and Incubators- Principle of hot air oven and incubators, their applications in chemistry, maintenance and calibrations of hot air oven and incubators.

Hot Plates and Magnetic Stirrers- Principle and mechanics of hot plate and magnetic stirrer, types, their application in chemistry, , maintenance and calibrations.

**Learning Experience:** Through a combination of theoretical concepts and practical applications, you'll gain a hands-on understanding of analytical chemistry techniques. You'll have the opportunity to perform experiments in the laboratory, analyze data, and solve problems related to spectroscopic analysis, thermal analysis, and volumetric measurements. This course is designed to foster critical thinking, problem-solving skills, and a deep appreciation for the role of analytical chemistry in scientific research and real-world applications.

**Textbooks:**

1. Jacobson, B.H.E., Ray, Sidney, Attridge G. G., The Manual of Photography; Focal Press, London, 1988.
2. Baker, D.R., Capillary – Electrophoresis, New York, 1995.
3. Chapmen, J.R., Practical Organic Mass spectrometry, A Guide for Chemical and Biochemical Analysis, Wiley, New York, 1993.
4. Lide, D.R., Handbook of Chemistry & Physics C.R.C. 75<sup>th</sup> ed. CRC Press Washington D.C., 1994.

**Suggested Readings:**

1. Dollisth, F.R., Fateley, W. G. & Bentley, F. F., Characteristic Roman frequencies of organic compounds, Wiley, New York, 1974.
2. Friebolin, H. Berik, One & Two Dimensional NMR spectroscopy; Weinheim Germany, VCH 1991.
3. Stout G.H., &Jensten, L.H., X-ray Structure Determination – A practical Guide, 2<sup>nd</sup> Ed., Wiley, New York, 1989.
4. Gchristian, Gray D and Fredric J. Feldman, Atomic Absorption Spectroscopy; Wiley-Interscience, London, 1970.

**Open Educational Resources (OER)**

1. MIT OpenCourseWare: <https://ocw.mit.edu/>
2. Khan Academy: <https://www.khanacademy.org/science/chemistry>

3. Chemistry LibreTexts: <https://chem.libretexts.org/>

**Examination Scheme:**

<b>Evaluation components</b>	<b>Weightage</b>
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks (Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>SCFS210</b>	Wave and optics	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		3	0	0	3
<b>Category of Course</b>	DSE				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** This course provides a deep dive into the fundamental concepts of geometrical optics, oscillations, waves, and modern optics, including lasers and fiber optics. You'll learn about the laws of reflection and refraction, the properties of waves, the production and applications of lasers, and the principles of diffraction and holography. Through lectures, practical experiments, and problem-solving exercises, you'll gain a comprehensive understanding of the role of waves and optics in various fields of science and technology.

**Course Outcome:** Students will be:

1. Understanding the fundamental principles of geometrical optics, including Fermat's principle, the laws of reflection and refraction at a plane interface, and their applications in thick lenses, Ramsden eyepieces, and Huygens eyepieces.
2. Applying the characteristics and production of lasers, exploring the different types of lasers, their properties, and applications, as well as the principles of light propagation through optical fibers, including angle of acceptance, numerical aperture, and losses.
3. Analyzing knowledge of wave phenomena by describing the types of waves, including transverse and longitudinal waves, electromagnetic waves, and the electromagnetic spectrum, as well as deriving the wave equation and explaining concepts such as sound waves, intensity, and the Doppler effect.
4. Performing calculations and experiments related to Fraunhofer diffraction, including the analysis of single slit, double slit, and diffraction grating, as well as determining the resolving power of telescopes and gratings.

<b>Course contents</b>
<b>Section I:</b> Geometrical optics: Fermat's principle, reflection and refraction at plane interface, Application to thick lenses, Ramsden and Huygens eyepiece Oscillations: Simple harmonic motion. Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages. Damped oscillations
<b>Section II:</b> Laser & Fiber Optics Production of LASER, Types of LASER, Properties and applications of LASER, Optical fibres, Propagation of light through optical fibre, Angle of acceptance and numerical aperture, losses, Solar cells.
<b>Section III:</b> Waves: Types of waves, transverse and longitudinal waves, electromagnetic waves and electromagnetic spectrum, wavelength and frequency, speed of traveling wave, the wave equation, sound waves, speed of sound, intensity and sound level, the Doppler effect, shock waves, X Rays



(continuous and characteristic), Spectra- Absorption and emission. Bragg's Law and X-ray diffraction.

**Section IV:** Fraunhofer diffraction: Single slit, double slit & nth slits, Diffraction grating.

Resolving Power of a telescope Resolving power of grating

Holography: Principle of Holography. Recording and Reconstruction Method. Theory of Holography as Interference between two Plane Waves

**Learning Experience:** Through a combination of theoretical concepts and practical applications, you'll gain a hands-on understanding of wave phenomena and optical systems. You'll have the opportunity to perform experiments with lenses, lasers, and optical fibers, analyze data, and solve problems related to wave propagation, diffraction, and interference. This course is designed to foster critical thinking, problem-solving skills, and a deep appreciation for the fundamental principles of waves and optics.

**Textbooks:**

1. Allied Physics – R. Murugesan S. Chand & Co. First Edition (2005).
2. Allied Physics – Dr. K. Thangaraj, Dr. D. Jayaraman Popular Book Department, Chennai.
3. Allied Physics – Prof. Dhanalakshmi and others.
4. Elements of Properties of Matter – D.S. Mathur, S. Chand & Co. (1999).

**Suggested Readings:**

1. Modern Physics – R. Murugesan S. Chand & Co. (2004).
2. Electronic Principles and Applications – A.B. Bhattacharya, New Central Book Agency, Calcutta.
3. Introduction to Fiber optics by K. Thyagarajan and Ajay Ghatak, Cambridge, University Press (1999).

**Open Educational Resources (OER)**

1. MIT OpenCourseWare: <https://ocw.mit.edu/>
2. Khan Academy: <https://www.khanacademy.org/science/physics>
3. Physics LibreTexts: <https://phys.libretexts.org/>

**Examination Scheme:**

Evaluation components	Weightage
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks (Theory):</b> Mid Term Examination	<b>20 Marks</b>

<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>
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<b>SCFS208</b>	Molecular biology	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		3	0	0	3
<b>Category of Course</b>	DSE				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** This course provides a deep dive into the fundamental processes of molecular biology, focusing on DNA replication, transcription, translation, and the role of genes in cellular functions. You'll learn about the structure and function of DNA and RNA, the mechanisms of gene expression, and the relationship between genes and cellular processes such as cell death and cancer. Through lectures, practical experiments, and case studies, you'll gain a comprehensive understanding of the molecular basis of life.

**Course Outcome:** Students will be:

1. Understanding the historical perspectives and foundational experiments that led to the discovery of DNA as genetic material, including the contributions of Miescher, Griffith, Avery, and the Hershey-Chase experiment, as well as the structure and types of DNA.
2. Applying the processes of DNA replication in prokaryotes and eukaryotes, focusing on the mechanisms of bidirectional and semi-conservative replication, RNA priming, and the enzymes involved in replicating linear double-stranded DNA.
3. Analyzing knowledge of transcription and translation in both prokaryotic and eukaryotic systems by detailing the roles of various types of RNA, RNA polymerases, and the features of the genetic code, including the processes of initiation, elongation, and termination.
4. Performing an examination of chromosome structure, types of chromosomes, and the mechanisms of mutation, including the concepts of spontaneous and induced mutations and the role of mutagens, as well as the functions of the Lac and Tryptophan operons.
5. Interpreting the mechanisms of apoptosis and its pathways, evaluating its role in human diseases, the significance of stem cells in tissue maintenance, and the relationship between the cell cycle, cancer, and the impact of telomere shortening and carcinogens in cancer development.

### Course contents

#### Section I: Genetic material

DNA: Miescher to Watson and Crick- historic perspective, Griffith's and Avery's transformation experiments, Hershey-Chase bacteriophage experiment, DNA structure, types of DNA, types of genetic material.

DNA replication (Prokaryotes and eukaryotes): bidirectional replication, semi-conservative, semi-discontinuous RNA priming,  $\theta$  (theta) mode of replication, replication of linear, ds-DNA, replicating the 5' end of linear chromosome including replication enzymes

**Section II: Transcription (Prokaryotes and Eukaryotes)**

Types of structures of RNA (mRNA, tRNA, rRNA), RNA polymerase- various types; initiation, elongation and termination of RNA chains.

Translation (Prokaryotes and eukaryotes): features of genetic code and deciphering, universality of genetic code and exceptions in some systems.

Charging of tRNA, aminoacyl tRNA synthetases. Proteins involved in initiation, elongation and termination of polypeptides

**Section III: Chromosome and Mutation**

Discovery, morphology and structural organization, Types of chromosomes; Supernumerary chromosomes, Mutations: Definition, Types: spontaneous and induced, Mutagens.

Lac operon and Tryptophan operon in Prokaryotes and Eukaryotes

**Section IV: Apoptosis (Cell Death) & Cell Renewal**

Mechanism of apoptosis, Intrinsic and extrinsic pathways. Role of apoptosis in human diseases Stem Cells and Maintenance of adult tissues.

Cancer; Relationship of the cell cycle to cancer, Genes and Cancer, Telomere shortening and Human Cancer. Chemicals and Radiations as carcinogen

**Learning Experience:** Through a combination of theoretical concepts and practical applications, you'll gain a hands-on understanding of molecular biology techniques. You'll have the opportunity to perform experiments in the laboratory, analyze data, and solve problems related to DNA, RNA, and protein synthesis. This course is designed to foster critical thinking, problem-solving skills, and a deep appreciation for the complexity and beauty of biological processes.

**Textbooks:**

1. M.S. Leffell, A.D. Donnenberg & N.R. Rose Handbook of Human Immunology CRC press, 1997
2. Essentials of Human Genetics by S.M. Bhatnagar et al (1999) IV edition. Orient Longman.
3. Basic Human Genetics by E.J. Manage and A.P. Manage (1997 India Reprint) Rastogi Publications, Meerut.
4. Mendelian inheritance in Man: Catalogues of Autosomal recessive and x-linked phenotypes. [12 editions – 1998] by McKusick, V.A. Johns Hopkins university press, Baltimore.

**Suggested Readings:**

1. Molecular Biology of the Cell by Alberts, Johnson, Lewis, Raff, Roberts, and Walter
2. Principles of Genetics by D. Peter Snustad and Michael J. Simmons
3. Genetics: From Genes to Genomes by Benjamin Lewin
4. Principles and Practice of Medical Genetics, by Emery, A.E.H and D.L. Rimoim (Eds\_ (1990-2nd edition) Churchill Livingstone, Edinburgh.
5. Human Genetics by S.D. Gangane (2nd edition-Reprint 2001), B.L Churchill Livingstone Pvt. Ltd., New Delhi.
6. Genetics in Medicine by M.W. Thompson et al, 5th Edition, W.B. Saunders Company, London.

### Open Educational Resources (OER)

1. Khan Academy: <https://www.khanacademy.org/science/biology>
2. MIT OpenCourseWare: <https://ocw.mit.edu/>
3. National Institutes of Health (NIH) Genome Education: <https://www.genome.gov/>
4. Molecular Biology of the Cell Online: <https://www.ncbi.nlm.nih.gov/books/NBK21053/>

### Examination Scheme:

Evaluation components	Weightage
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks (Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>SCFS206</b>	Digital Forensics	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		2	0	0	2
<b>Category of Course</b>	Major				
<b>Total Contact Hours</b>	30 Hours				
<b>Pre-requisites/ requisites</b>	<b>Co---</b>				

**Course Perspective:** Digital forensics is a specialized field that involves the preservation, identification, extraction, documentation, and interpretation of digital evidence. This course equips students with the knowledge and skills to investigate digital crimes, analyze computer systems, and recover data. By understanding the principles of digital forensics, students can contribute to criminal investigations and protect digital assets

**Course Outcome:** Students will be:

1. Understanding the fundamental concepts of Windows system artifacts, including the file system, registry, event logs, shortcut files, executables, alternate data streams, hidden files, and slack space, as well as their significance in forensic investigations.
2. Applying the architecture and function of computer networks, including LAN, MAN, WAN, and the roles of routers, switches, hubs, repeaters, bridges, gateways, and modems, while evaluating internet protocols, internet history, and email header interpretation.
3. Analyzing knowledge of Mac OS X and Linux system artifacts by examining system startup services, network configurations, hidden directories, user artifacts, ownership and permissions, and logs for forensic analysis.
4. Performing an assessment of cybercrimes targeting computer systems and mobile devices, including data diddling, spyware, DoS and DDoS attacks, and various online scams and frauds, while exploring the procedures for crime reporting and the role of cyber police stations.
5. Interpreting the functionalities of web browsers and email systems by examining cookies, session data, cache, email types and protocols, header details, spoofed emails, and other internet protocols to understand their impact on cybersecurity and digital forensics.

<b>Course contents</b>
<p><b>Section I: Windows system Artifacts</b></p> <p>Windows system Artifacts: File system, Registry, Event logs, Shortcut Files, Executables, Alternate data streams (ADS), Hidden files, Slack space.</p> <p>Computer Networks: LAN, MAN, WAN, Router, Switch, Hub, Repeater, Bridge, Gateway, Modem</p> <p>HTML and other internet protocols, internet history, e-mail and header interpretation.</p>
<p><b>Section II: Mac OS X Systems and Linux System Artifacts</b></p> <p>Mac OS X Systems and artifacts: System start up and services, Network configuration, Hidden directories, System logs and user artifacts.</p> <p>Linux file system : Ownership and Permissions, Hidden files, User accounts and logs</p>
<p><b>Section III: Cloud Forensic</b></p> <p>Introduction of cloud forensics, Identification and conducting cloud forensic investigations and security incidents, anti-forensic techniques used in the cloud</p>
<p><b>Section IV: Data collection and Analysis</b></p> <p>Seize electronic evidence present in the cloud, Data recovery strategies for deleted and overwritten data, Ethical hacking to cloud forensics, Malicious Code and circumventing Virtual Machines, Resource Pooling</p> <p>Metadata and Metadata Logs, Analysis on cloud storage models including OneDrive, Dropbox, and Google Drive and cloud services in SaaS, PaaS, IaaS, and FaaS, AWS case study, forensic investigation involving AWS.</p>

**Learning Experience:** The practical component of this course will provide students with hands-on experience in analyzing various digital artifacts. Students will learn to examine Windows, Mac OS X, and Linux systems, including their file systems, registries, event logs, network configurations, and user artifacts. They will also explore cybercrimes, such as data diddling attacks, spyware, viruses, ransomware, and online scams. Additionally, students will gain insights into web browsers and email analysis, including cookies, cache, session data, and header interpretation.

**Textbooks:**

1. Digital Forensics: Investigating Computer Crimes by Brian K. Kruse
2. Computer Forensics: Incident Response Essentials by Rod V. Coleman
3. The Digital Evidence Handbook by Mark J. Ayers

**Suggested Readings:**

1. Real-World Digital Forensics by Brian K. Kruse
2. Digital Forensics: A Field Guide by Michael C. Mandia
3. Computer Forensics: A Comprehensive Guide by Brian K. Kruse

**Open Educational Resources (OER):**

1. Open Digital Forensics Survival Guide: <https://www.sans.org/white-papers/ultimate-guide-getting-started-digital-forensics-incident-response/>
2. Digital Forensics Research Group: <https://www.lib.umd.edu/research/oss/publishing-and-digital-projects/repository-services/drum>
3. National Institute of Justice: <https://nij.ojp.gov/>

**Examination scheme:**

Evaluation components	Weightage
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>



<b>AEC</b>	Communication Skills-I	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version 1.0</b>		3	0	0	3
<b>Category of Course</b>	AEC				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** The course on Communication Skills aims to equip students with essential tools to communicate effectively in both academic and professional environments. By exploring various forms, processes, and principles of communication, students will develop a comprehensive understanding of how to navigate interpersonal, intrapersonal, and organizational communication barriers. The course also emphasizes practical applications, including academic writing, technology-enabled communication, and verbal communication in public speaking and group settings.

**Course Outcome:** Students will be:

1. Understanding the fundamental concepts of communication, including its importance, forms, types, and the principles of effective communication, while recognizing barriers to effective communication in interpersonal, intrapersonal, and organizational contexts.
2. Applying various academic writing techniques, including précis writing, letter and résumé structures, proposal writing, and the components of a research paper, while emphasizing the significance of proper citations and avoiding plagiarism.
3. Analyzing technology-enabled communication tools to enhance communication tasks, including the effective use of emails, message construction tools, and virtual communication mediums for gathering and sharing information.
4. Performing effective verbal communication skills through public speaking practices, including structuring presentations, overcoming stage fright, and utilizing non-verbal cues to enhance interpersonal communication and group discussions.
5. Interpreting the dynamics of group communication by evaluating roles and responsibilities within group discussions and applying effective conversational techniques to foster productive interactions.

<b>Course Content</b>
<b>Section I:</b> Introduction to Communication: Importance of Communication Skills, Meaning, Forms & Types of Communication; Process of Communication; Principles of Effective Communication/7Cs, Barriers in Communication (Interpersonal, Intrapersonal and Organizational)
<b>Section II:</b> Academic Writing: Précis (Summary – Abstract – Synopsis – Paraphrase – Précis: Methods), Letter & Résumé (Letter Structure & Elements – Types of letter: Application & Cover - Acknowledgement – Recommendation – Appreciation – Acceptance – Apology – Complaint –Inquiry). Writing a proposal and synopsis. Structure of a research paper. Citations and plagiarism.
<b>Section III:</b> Technology-Enabled Communication: Using technology in communication tasks, E-mails, tools for constructing messages, Computer tools for gathering and collecting information; Different

virtual medium of communication.

**Section IV:** Verbal Communication: Public speaking fundamentals, Overcoming stage fright, Structuring a speech or presentation, Non-verbal cues in interpersonal communication, Effective conversational techniques, Dynamics of group communication, Roles and responsibilities in group discussions

**Learning Experience:** Students will experience a multifaceted approach to communication, starting with foundational concepts such as the importance, forms, and types of communication, followed by hands-on practice in academic writing, résumé development, and using communication tools. The integration of technology-enabled communication skills will enable students to construct, gather, and deliver messages through virtual mediums. Additionally, they will gain confidence in verbal communication, public speaking, and group dynamics, with a special focus on overcoming stage fright and non-verbal communication cues. Through interactive group discussions, students will sharpen their ability to contribute effectively in various conversational and organizational contexts.

**Textbooks:**

1. Language through Literature (forthcoming) ed. Dr. Gauri Mishra, Dr Ranjana Kaul, Dr Brat Biswas
2. Fluency in English Part II Oxford University Press, 2006
3. Business English, Pearson, 2008.

**Suggested Readings**

1. "Business Communication: Process and Product" by Mary Ellen Guffey, Dana Loewy
2. "Essentials of Business Communication" by Rajendra Pal, J. S. Korlahalli
3. "Effective Technical Communication" by M Ashraf Rizvi
4. "The Quick and Easy Way to Effective Speaking" by Dale Carnegie

**Open Educational Resources (OER)**

1. MIT Open Course Ware: Introduction to Communication
2. Open **Textbook** Library: Communication in the Real World
3. OER Commons: Communication Studies Resources

**Examination scheme:**

Evaluation components	Weightage
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>

<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>VAC</b>	Instrumentation for forensics	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		2	0	0	2
<b>Category of Course</b>	VAC				
<b>Total Contact Hours</b>	30 Hours				
<b>Pre-requisites/ Co-requisites</b>	---				

**Course Perspective:** This course offers a comprehensive study of advanced instrumental techniques that are integral to forensic investigations. It covers core topics such as electrophoresis, chromatography, immunological techniques, and PCR, focusing on their principles, instrumentation, and forensic applications. By integrating theoretical knowledge with real-world scenarios, the course aims to equip students with essential forensic science tools and methods for evidence analysis.

**Course Outcome:** Students will be:

1. Understanding the fundamental principles and techniques of electrophoresis, including the various factors that affect its performance and its instrumentation, as well as the forensic applications of different electrophoresis methods such as paper, gel, capillary, and immuno-electrophoresis.
2. Applying the principles and classifications of chromatography, and evaluate the instrumentation and forensic applications of various chromatographic techniques, including paper chromatography, thin-layer chromatography, liquid chromatography, and gas chromatography.
3. Analyzing immunological techniques such as Radioimmunoassay (RIA) and Enzyme Linked Immuno Sorbent Assay (ELISA) by understanding their basic principles, procedures, and applications in forensic analysis.
4. Performing Polymerase Chain Reaction (PCR) techniques, including Conventional PCR, Real-time PCR (qPCR), and other specialized methods, demonstrating proficiency in the procedures and recognizing their significance in forensic applications.
5. Interpreting the results obtained from electrophoresis, chromatography, immunological techniques, and PCR, drawing meaningful conclusions regarding the presence and characterization of substances in forensic investigations

**Section I:** Electrophoresis: Introduction, Basic Principles, Various factors affecting Electrophoresis, Instrumentation & Forensic Applications of Various Electrophoresis Techniques: Paper Electrophoresis, Gel Electrophoresis, Two-Dimensional Electrophoresis, Capillary Electrophoresis, Immuno Electrophoresis, Isoelectric Focusing.

**Section II:** Chromatographic Techniques: Definition and Concept of Chromatography, Classification of Chromatography, Basic principle, theory, Instrumentation and Forensic Applications of Paper chromatography, Thin layer chromatography, liquid chromatography, and gas chromatography

**Section III:** 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.

**Section IV:** 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:** Throughout this course, students will gain hands-on experience in key forensic techniques such as electrophoresis and chromatography, enabling them to separate and analyze complex biological and chemical samples. Laboratory sessions will allow students to apply theoretical principles in practical settings, mastering tools like capillary electrophoresis, gas chromatography, and PCR. The focus on real-life forensic cases will foster critical thinking, helping students understand the impact of instrumentation on crime scene investigation and evidence interpretation.

#### **Textbooks:**

1. Baker, D.R., Capillary – Electrophoresis, New York, 1995.
2. Chapmen, J.R., Practical Organic Mass spectrometry, A Guide for Chemical and Biochemical Analysis, Wiley, New York, 1993.
3. Lide, D.R., Handbook of Chemistry & Physics C.R.C. 75<sup>th</sup> ed. CRC Press Washington D.C., 1994.

**Suggested Readings:**

1. Forensic Science: Fundamentals and Investigations by Anthony J. Bertino.
2. Principles of Instrumental Analysis by Douglas A. Skoog, F. James Holler, and Stanley R. Crouch.
3. Forensic DNA Typing by John M. Butler.
4. Chromatography and Electrophoresis by Richard J. Lewis.

**Open Educational Resources (OER) Links:**

1. [Open Forensic Science Resources](#)
2. MIT OpenCourseWare - Forensic Science
3. NPTEL Forensic Science Lectures

**Examination scheme:**

<b>Evaluation components</b>	<b>Weightage</b>
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>UCH154</b>	Practical Chemistry-IV	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		0	0	2	1
<b>Category of Course</b>	Practical (Minor)				
<b>Total Contact Hours</b>	30 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** The Chemistry Practical III course focuses on developing essential laboratory skills through hands-on experiments in spectroscopy, distillation, and titration techniques. Students will explore quantitative analysis methods, such as UV-Vis spectroscopy for concentration determination, and learn to record and interpret IR spectra for identifying organic compounds. Additionally, they will gain proficiency in separating liquid mixtures via simple and fractional distillation, alongside titration methods to analyze acid-base and redox systems. This course integrates theory with practical applications to enhance students' analytical skills and scientific reasoning.

**Course Outcome:** Students will be:

1. Understanding the principles of UV-Vis spectroscopy and its application in the determination of concentration for various solutions.
2. Applying and interpret the IR spectra of organic compounds to identify functional groups and understand their chemical structure.
3. Analyzing separation techniques such as simple and fractional distillation to effectively separate a mixture of two liquids, exemplified by ethanol and water.
4. Performing titration experiments to accurately determine the concentration of acids, bases, and redox-active species in various solutions.
5. Interpreting the results from titration and distillation processes to draw conclusions about the chemical properties and concentrations of the analyzed substances.

#### **Course contents**

1. : Determination of Concentration Using UV-Vis Spectroscopy
2. Recording and interpretation of IR spectra for organic compounds
3. Separation of a mixture of two liquids (e.g., ethanol and water) using simple and fractional distillation.
4. Titration experiments to determine the concentration of acids, bases, and redox-active species.

#### **Learning Experience:**

Students will engage in immersive laboratory sessions that foster a deep understanding of core analytical techniques. Through UV-Vis spectroscopy, they will quantify substances with precision, while the IR spectroscopy experiment will provide them with insights into molecular structure identification. The distillation experiments will demonstrate the principles of liquid separation, encouraging hands-on manipulation of laboratory apparatus. Titration exercises will further enhance their abilities to determine concentrations and reactivity of chemicals, building a solid foundation for future chemical analysis and research applications.

**Textbooks:**

1. Jacobson, B.H.E., Ray, Sidney, Attridge G. G., The Manual of Photography; Focal Press, London, 1988.
2. Baker, D.R., Capillary – Electrophoresis, New York, 1995.
3. Chapman, J.R., Practical Organic Mass spectrometry, A Guide for Chemical and Biochemical Analysis, Wiley, New York, 1993.
4. Lide, D.R., Handbook of Chemistry & Physics C.R.C. 75<sup>th</sup> ed. CRC Press Washington D.C., 1994.
5. Dollisth, F.R., Fateley, W. G. & Bentley, F. F., Characteristic Roman frequencies of organic compounds, Wiley, New York, 1974.
6. Friebolin, H. Berik, One & Two Dimensional NMR spectroscopy; Weinheim Germany, VCH 1991.
7. Stout G.H., & Jensten, L.H., X-ray Structure Determination – A practical Guide, 2<sup>nd</sup> Ed., Wiley, New York, 1989.
8. Gchristian, Gray D and Fredric J. Feldman, Atomic Absorption Spectroscopy; Wiley-Interscience, London, 1970.

**Suggested Reading:**

1. Spectrometric Identification of Organic Compounds by Robert M. Silverstein, Francis X. Webster
2. Vogel's **Textbook** of Quantitative Chemical Analysis by J. Mendham et al.
3. Physical Chemistry: A Molecular Approach by Donald A. McQuarrie and John D. Simon
4. Principles of Instrumental Analysis by Douglas A. Skoog, F. James Holler, Stanley R. Crouch

**Open Educational Resources (OER):**

1. UV-Vis Spectroscopy Tutorial - LibreTexts
2. IR Spectroscopy - Khan Academy
3. Distillation Principles - MIT OpenCourseWare
4. Titration Experiments - Chemistry LibreTexts

**Examination Scheme:**

Evaluation components		Weightage			
<b>Internal marks (practical)</b> I. Conduct of experiment II. Lab Record III. Lab Participation IV. Lab Project		<b>10 Marks</b> <b>10 Marks</b> <b>10 Marks</b> <b>20 Marks</b>			
<b>II. External Marks (practical)</b> End Term Examination		<b>50 Marks</b>			
<b>SEC081</b>	Forensic Practical IV	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		0	0	4	2
<b>Category of Course</b>	Skill Enhancement Course				
<b>Total Contact Hours</b>	60 Hours				



<b>Pre-requisites/ requisites</b>	<b>Co-</b>	--
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**Course Perspective:** The practical aspect of Forensic Anthropology and Forensic Physics aims to develop hands-on skills crucial for forensic investigations. Through direct interaction with human skeletal remains and trace evidence, students will gain essential knowledge in identification, examination, and interpretation of forensic materials. This will build their competency in real-world forensic casework, ensuring they can apply theoretical knowledge to practical scenarios in both anthropological and physical evidence contexts.

**Course Outcome:** Students will be:

1. Observing and following proper safety protocols and calibration procedures for instruments used in evidence examination and analysis, ensuring adherence to a working manual for effective operation.
2. Imitating established techniques for the collection, preservation, and labeling of trace evidence, including maintaining the chain of custody, creating covering letters, sealing samples, and taking control samples from materials like bones, glass, soil, and paint.
3. Practicing the examination of different layers of paint chips to interpret their composition and significance in forensic investigations, as well as determining the specific gravity of glass pieces and conducting density gradient analysis of soil samples for forensic purposes.
4. Interpreting results from physical matching of broken glass fragments to aid in criminal investigations and support conclusions in forensic analysis.

#### **Course contents**

##### **Forensic Anthropology**

1. Identification of human skeleton system.
2. Identification of various bones (Pelvic and skull bones).
3. Estimation of height using long bones.
4. Determination of sex from skull, pelvis and mandibular bone. Determination of age using skull

##### **Forensic Physics**

1. Safety, working manual and calibration of the instruments used for evidence examination and analysis.
2. Collection, preservation and labeling, chain of custody, covering letter, sample seal and taking control samples of trace evidence like glass, soil and paint samples.
3. Examination of different layers in a paint chip.
4. Determination of specific gravity of glass pieces and its interpretation.
5. Density gradient analysis of soil samples and its interpretation.
6. Physical matching of broken glass fragments.

#### **Learning Experience**

In Forensic Anthropology, students will work with skeletal systems to learn identification techniques, sex determination, and age estimation from bones, providing them with the ability to handle forensic evidence for human identification. In Forensic Physics, students will focus on evidence collection, preservation, and examination of trace materials like glass, soil, and paint. These labs foster critical

thinking, problem-solving, and precise scientific methodologies, enhancing their ability to perform meticulous analysis and contribute effectively to forensic investigations.

#### **Textbooks:**

1. Thomas Kubic, Nicholas Petraco Forensic Science Laboratory Manual and Workbook, Third Edition 2009
2. Laboratory Protocols CIMMYT Applied Molecular Genetics Laboratory Third Edition
3. A. I. Vogel **Textbook** of Practical organic Chemistry including Qualitative organic analysis

#### **Suggested Readings:**

1. Kathy Mirakovits, Gina Londino, The Basics of Investigating Forensic Science: A Laboratory Manual 2015
2. Washington state patrol Forensic Laboratory services: Crime Laboratory: Technical & Training Manuals Isolation and identification of Drugs by E.G.C. Clark.
3. Krogman, W.M., & Iscan, M.Y. (1986). The Human Skeleton in Forensic Medicine. Charles C. Thomas Publisher.
4. Byers, S.N. (2016). Introduction to Forensic Anthropology: A **Textbook**. Routledge.

#### **Open Educational Resources (OER) Links:**

1. Open Textbook Library - Introduction to Physical Anthropology
2. MIT OpenCourseWare - The Human Skeleton
3. Open Textbook Library - General Physics
4. Saylor Academy - Introduction to Forensic Science

#### **Examination Scheme:**

<b>Evaluation components</b>	<b>Weightage</b>
<b>Internal marks (practical)</b> I. Conduct of experiment II. Lab Record III. Lab Participation IV. Lab Project	<b>10 Marks</b> <b>10 Marks</b> <b>10 Marks</b> <b>20 Marks</b>
<b>II. External Marks (practical)</b> End Term Examination	<b>50 Marks</b>

### **FIFTH SEMESTER**

<b>SCFS301</b>	Forensic Medicine	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		3	0	0	3
<b>Category of Course</b>	Major				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** Forensic Medicine offers a deep understanding of the medical principles involved in legal investigations, focusing on postmortem changes, asphyxial deaths, and injuries. Students will learn to interpret medical evidence, differentiate between types of deaths, and apply forensic techniques to real-life scenarios. It blends medicine and law to ensure justice through scientific inquiry.

**Course Outcomes:** Students will be:

1. Understanding the physiological changes that occur after death, including immediate, early, and late changes, and their significance in estimating the time of death, along with the medico-legal aspects surrounding causes of death.
2. Applying the various types and stages of asphyxial deaths, including important terms such as hypoxia and anoxia, and recognize the signs and symptoms associated with each type, including hanging, strangulation, suffocation, and drowning.
3. Analyzing the procedures for conducting ante and post-mortem examinations during autopsies, emphasizing the collection, preservation, and packaging of viscera, as well as assessing and determining the time and cause of death.
4. Performing detailed examinations of injuries caused by blunt and sharp forces, distinguishing between abrasions, bruises, lacerations, incised wounds, stab wounds, and punctured wounds, while considering their dimensions, causes, and medico-legal implications.
5. Interpreting the mechanisms of wound production and healing, and determine the age of injuries through comprehensive analysis of both ante-mortem and post-mortem injuries and their associated medico-legal aspects.

<b>Course contents</b>
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**Section I: Changes after Death**

Immediate change, Early changes (Rigor mortis-postmortem hypostasis-Body cooling), Estimation of time of Death, Late Changes- (Decomposition, Adipocere, Mummification)

Medico-legal aspects of death. Causes of death.

**Section II: Asphyxial Deaths**

Important Terms in Asphyxial deaths (Hypoxia, Anoxia, Anoxic anoxia, Anemic anoxia, Histotoxic anoxia), Types and stages of Asphyxia, Signs of asphyxia deaths., stages of asphyxia deaths

Types of Asphyxial deaths- Hanging and its types, Strangulation, Suffocation, Smothering, Drowning and its classification.

**Section III: Autopsy and introduction to wounds**

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.

**Section IV: Injuries due to Blunt and sharp forces**

Abrasions, Bruises, Lacerations; causes, dimensions, ante – mortem & post – mortem injuries and its medico - legal aspects, Incised, Stab, Punctured wounds - causes, dimensions, ante – mortem& post – morteminjuries ante – mortem& post – mortem injuries.

**Learning Experience:** Students will gain hands-on knowledge of forensic practices through case studies and lab simulations. The course encourages critical thinking in determining the causes and times of death, analyzing wound patterns, and conducting autopsies. Discussions on medico-legal aspects of death and injury provide real-world context, while practical exercises in evidence collection and preservation enhance the Learning Experience.

**Textbooks:**

1. Modi's Medical Jurisprudence and Toxicology, 23<sup>rd</sup> Edition, by K. Mathiharan & Amrit K. Patnaik, Third reprint, 2009, LexisNexis, Butterworth, New Delhi
2. Essentials of forensic medicine, Dr. K. S. Narayan Reddy.

**Suggested Readings:**

1. Forensic Medicine and toxicology, JB Mukherjee, Vol I & II.

2. Keith Simpson's , Forensic Medicine.
3. Gleister's Medical Jurisprudence and Toxicology, Churchill Livingstone Dental Anatomy Atlas, Whitaker

### **Open Educational Resources (OER)**

1. Forensic Medicine by NCBI
2. Medico-legal Death Investigation System by CDC
3. Forensic Science and Medicine Journal

### **Examination scheme:**

<b>Evaluation components</b>	<b>Weightage</b>
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>SCFS303</b>	Forensic Chemistry and Toxicology	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		3	0	0	3
<b>Category of Course</b>	Major				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** The course "Forensic Chemistry and Toxicology" provides an in-depth understanding of chemical and toxicological aspects relevant to forensic investigations. It emphasizes analytical methods for the identification and quantification of chemical substances in criminal investigations, particularly in cases involving poisoning, arson, and drug abuse. The course also covers the legal framework, scientific techniques, and casework applications that are essential for forensic practitioners.

**Course Outcomes:** Students will be:

1. Remembering the qualitative chemical tests in Forensic Chemistry and toxicology.
2. Understanding medico-legal aspects of alcoholic substances, petroleum products, and drugs of abuse.
3. Applying ethical and professional standards in analysis and reporting.
4. Analyzing contaminants in petroleum products and alcohols.
5. Evaluating the Classification, characterization of NDPS and develop analytical skills in forensic chemical analysis.

<b>Course contents</b>
<p><b>Section I: Forensic Chemistry</b></p> <p>Introduction, Colour &amp; Spot test, microcrystal tests, inorganic and organic analysis. Analysis of Beverages: alcoholic and nonalcoholic beverages, country made liquor, illicit liquors, detection and estimation of ethanol. Breathe alcohol analyzer. Analysis of trace evidence – cosmetics dyes, pigments, clues of trap cases.</p> <p>Fire and Arson- Chemistry of Fire, Combustion reaction, Fire Triangle, Fire Tetrahedron, Conditions for fire, Backdraft, Accelerants &amp; types of accelerants, Combustible and Flammable liquids, Flash point, Fire point, Ignition point, Auto Ignition point, vapour density, vapour pressure, Fire extinguisher. Arson: Legal Definition, Arson motives, Degrees of Arson, Forensic and legal Concepts, Determining</p>

origin and cause; Fire patterns, Collection/Preservation of Arson Evidences, Extraction of samples from debris.

**Section II: Analysis of Petroleum Products:**

Analysis of petrol, kerosene, diesel, lubricants by BIS methods and ASTM methods. Detection of adulterants of Gasoline, Diesel and Engine oils. - including parameters like-Flash point, distillation range, density, kinematic -viscosity, smoke point, aniline point. Commodity Act & Petroleum Act. Arson Investigation: chemistry of fire, fire pattern, Extraction of fire accelerants from fire debris

**Section III: Forensic Toxicology:** Introduction and scope of forensic toxicology, classification of poisons, legal aspects of poisoning, types of poisoning. sign and symptoms of common poisons.

Drug of Abuse: classification of drugs, drug of abuse in sports. Narcotic drugs and psychotropic substances such as cocaine, cannabis, barbiturates, benzodiazepines, amphetamine, opium, designer drugs. NDPS act.

**Section IV: General studies and Analysis of vegetable poisons:** Abrus, Dhatura, Marking nuts, Nux-vomica, Oleander and Aconite. Snake venoms and insect poisons, Irrespirable gases, food poisoning

Insecticides and Metallic Poisons: types of agriculture poisons, Organo-phosphorous compound, organochlorinated compound, carbamates, pyrethroids, aluminium phosphite and zinc phosphite. arsenic, mercury, phosphorous: poisoning characteristics and analysis.

**Learning Experience:** Students will engage in both theoretical learning and practical applications. The course will offer hands-on training in various analytical techniques like spot tests, microcrystal tests, and chromatographic methods for analyzing trace evidence, beverages, and petroleum products. The study of poisons, drugs of abuse, and fire accelerants will provide a comprehensive foundation in forensic toxicology and chemistry. Through case studies, interactive lab sessions, and analytical method demonstrations, students will develop the necessary skills to handle forensic cases, interpret toxicological results, and present their findings in legal contexts.

**Textbooks:**

1. Modi's Medical Jurisprudence and Toxicology, 23<sup>rd</sup> Edition, by K. Mathiharan & Amrit K. Patnaik, Third reprint, 2009, LexisNexis, Butterworth, New Delhi
2. Essentials of forensic medicine, Dr. K. S. Narayan Reddy.

**Suggested Readings:**

1. Forensic Medicine and toxicology, JB Mukherjee, Vol I & II.
2. Keith Simpson's , Forensic Medicine
3. Gleister's Medical Jurisprudence and Toxicology, Churchill Livingstone Dental Anatomy Atlas, Whitaker.
4. Forensic Chemistry by Suzanne Bell
5. Casarett and Doull's Toxicology: The Basic Science of Poisons by Curtis D. Klaassen
6. Clark's Analysis of Drugs and Poisons by Anthony C. Moffat, M. David Osselton, Brian Widdop
7. The Essentials of Forensic Medicine and Toxicology by K.S. Narayan Reddy

**Open Educational Resources (OER) Links:**

1. NPTEL - Forensic Chemistry
2. [PubChem - Forensic Toxicology Resources](#)
3. National Institute of Justice - Fire and Arson Investigations
4. Open Textbook Library - Introduction to Chemistry

**Examination scheme:**

Evaluation components	Weightage
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>



<b>SIFS001</b>	Communication Skills - II	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version 1.0</b>		3	0	0	3
<b>Category of Course</b>	AEC				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** This course on Communication Skills aims to develop students' linguistic and communicative competence by enhancing their vocabulary, improving their personality traits for effective interaction, and understanding the role of media in communication. It also emphasizes practical business communication strategies, crucial for professional environments. The subject provides a comprehensive framework for mastering both verbal and non-verbal communication in various contexts.

**Course Outcome:** Students will be:

1. Understanding the principles of vocabulary building, including word formation through prefixes and suffixes, identifying common errors, and distinguishing between homonyms, homophones, antonyms, synonyms, and phrasal verbs.
2. Applying the importance of etiquette and manners in personality development, assessing the impact of attitude, self-esteem, and self-reliance on personal and professional interactions.
3. Analyzing effective public speaking and presentation skills, including body language techniques such as posture, gesture, eye contact, and facial expressions, to enhance communication in various contexts.
4. Performing critical evaluations of media communication, exploring the role of media, media effects theories, and the impact of digital media on interpersonal and mass communication.
5. Interpreting strategic communication principles in business settings, focusing on corporate communication, public relations, crisis management, and the creation of user manuals, technical reports, and white papers, while incorporating usability testing and feedback.

<b>Course Content</b>
<b>Section I:</b> Building Vocabulary: Word Formation (by adding suffixes and prefixes); Common Errors; Words Often Confused; One word substitution, Homonyms and Homophones; Antonyms & Synonyms,

Phrasal Verbs, Idioms & Proverbs (25 each); Commonly used foreign words (15 in number)
<b>Section II:</b> Personality Development: Etiquettes & Manners; Attitude, Self-esteem & Self-reliance; Public Speaking; Work habits (punctuality, prioritizing work, bringing solution to problems), Body Language: Posture, Gesture, Eye Contact, Facial Expressions; Presentation Skills/ Techniques.
<b>Section III:</b> Media and Communication: Role of media in communication, Media effects theories (e.g., agenda-setting, framing, cultivation theory), impact of digital media on communication
<b>Section IV:</b> Business Communication: Strategic communication in business contexts, Corporate communication and public relations, Crisis communication and management, Creating user manuals, technical reports, and white papers, usability testing and feedback incorporation in documentation

**Learning Experience:** Students will engage in dynamic activities to expand their vocabulary and correct common language errors, thus refining their written and spoken communication. Personality development exercises will help build confidence, improve public speaking, and master body language. By exploring the influence of media and practicing strategic business communication, learners will acquire skills that are essential in both professional and personal life. The course provides a balance of theoretical knowledge and practical applications, ensuring students can communicate effectively in different settings.

**Textbooks:**

1. Language through Literature (forthcoming) ed. Dr. Gauri Mishra, Dr Ranjana Kaul, Dr Brat Biswas
2. Fluency in English Part II Oxford University Press, 2006
3. Business English, Pearson, 2008.

**Open Educational Resources (OER)**

1. MIT OpenCourseWare: Introduction to Media Studies
2. OpenLearn: Communication, Media, and Society
3. Saylor Academy: Business Communication
4. OER Commons: Communication Skills

**Examination scheme:**

Evaluation components	Weightage

<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>SCFS309</b>	Thermal Physics	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		3	0	0	3
<b>Category of Course</b>	DSE				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** The course offers an in-depth exploration of thermodynamics and kinetic theory, focusing on foundational laws and principles that govern energy transformations. It bridges classical and modern physics, linking theory with real-world applications in gases and thermodynamic processes. Students will gain a comprehensive understanding of entropy, thermodynamic potentials, and the behavior of real gases.

**Course Outcome:** Students will be:

1. Understanding the foundational principles of thermodynamics, including the First and Second Laws, thermodynamic variables, equilibrium, and the concepts of temperature, work, heat, and internal energy.
2. Applying the concept of entropy and its implications in thermodynamic processes, including Clausius's theorem, entropy changes in reversible and irreversible processes, and the principles of the Third Law of Thermodynamics.
3. Analyzing the kinetic theory of gases to explain molecular behavior, including the distribution of velocities, molecular collisions, and the Maxwell-Boltzmann law, as well as specific heats and degrees of freedom in ideal gases.
4. Performing calculations related to the behavior of real gases, focusing on deviations from the ideal gas equation and understanding critical constants, Boyle temperature, and the Van der Waals equation of state.

<b>Course contents</b>
<b>Section I:</b> Introduction to Thermodynamics: First & Second Law of Thermodynamics: Thermodynamic, Variables & Equilibrium, Concept of Temperature, Work & Heat, Internal Energy, Applications of First Law
<b>Section II:</b> Entropy & Thermodynamic Potentials: Concept of Entropy, Clausius Theorem. Second Law of Thermodynamics in terms of Entropy. Principle of Increase of Entropy. Entropy Changes in Reversible and Irreversible processes with examples. Entropy of the Universe. Principle of Increase of

Entropy. Temperature–Entropy diagrams. Third Law of Thermodynamics

**Section III:** Kinetic Theory of Gases: Distribution of Velocities, Molecular Collisions, Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas and its Experimental Verification. Degrees of Freedom. Law of Equipartition of Energy (No proof required). Specific heats of Gases, Mean Free Path, Collision Probability.

**Section IV:** Real Gases: Behavior of Real Gases: Deviations from the Ideal Gas Equation. Critical Constants. Continuity of Liquid and Gaseous State. Vapour and Gas. Boyle Temperature. Van der Waal's Equation of State for Real Gases

**Learning Experience:** Through this course, students will engage in both theoretical discussions and practical problem-solving related to thermodynamics and gas laws. By applying concepts such as the laws of thermodynamics, entropy, and the kinetic theory of gases, students will explore phenomena like heat transfer, energy distribution, and real gas behavior. The course will enhance critical thinking by challenging students to analyze reversible and irreversible processes, understand the universe's entropy, and evaluate deviations in ideal gas behavior. Hands-on experiments and simulations will enrich the learning process.

**Textbooks:**

1. Allied Physics – Prof. Dhanalakshmi and others.
2. Elements of Properties of Matter – D.S. Mathur, S. Chand & Co. (1999).
3. Modern Physics – R. Murugesan S. Chand & Co. (2004).

**Suggested Readings:**

1. Electronic Principles and Applications – A.B. Bhattacharya, New Central Book Agency, Calcutta.
2. Introduction to Fiber optics by K. Thyagarajan and Ajay Ghatak, Cambridge, University Press (1999).]

**Open Educational Resources (OER)**

1. MIT OpenCourseWare - Thermodynamics
2. [Khan Academy - Thermodynamics](#)
3. NPTEL - Thermodynamics and Statistical Physics

**Examination scheme:**

Evaluation components	Weightage

<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>UCH105</b>	Inorganic and Organic chemistry-II	L	T	P	C
<b>Version1.0</b>		3	0	0	3
<b>Category of Course</b>	Minor				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	---				

**Course Perspective:** This course explores the intricate relationship between matter and energy, as well as the structure, properties, and reactions of organic compounds. You'll delve into topics such as thermodynamics, kinetics, quantum mechanics, and organic reaction mechanisms.

**Course Outcome:** Students will be:

1. Understanding the fundamental principles of metallurgy, including the use of Ellingham diagrams for predicting the feasibility of metal oxide reduction using carbon and various methods for purifying metals.
2. Applying the structures and properties of nitrogen hydrides and oxoacids of phosphorus, sulfur, and chlorine, along with their halides and oxohalides.
3. Analyzing the concepts of nomenclature and aromaticity to classify and differentiate between aromatic, anti-aromatic, and non-aromatic compounds, using Huckel's rule.
4. Performing calculations to determine the rate constants and half-life for first, second, third, and zero-order reactions, applying methods to assess the order of reactions in various chemical processes.
5. Interpreting the effects of temperature on reaction rates using the Arrhenius equation and evaluate the concept of activation energy in the context of chemical kinetics.

<b>Course contents</b>
<b>Section I:</b> General Principles of Metallurgy: Ellingham diagrams for reduction of metal oxides using carbon as reducing agent. Hydrometallurgy, Methods of purification of metals (Al, Pb, Ti, Fe, Cu, Ni, Zn): electrolytic, oxidative refining, Kroll process, Parting process, van Arkel-de Boer process and Mond's process.
<b>Section II:</b> Hydrides of nitrogen: (NH <sub>3</sub> , N <sub>2</sub> H <sub>4</sub> , N <sub>3</sub> H, NH <sub>2</sub> OH) Oxoacids of P, S and Cl. Halides and oxohalides: PCl <sub>3</sub> , PCl <sub>5</sub> , SOCl <sub>2</sub> and SO <sub>2</sub> Cl <sub>2</sub>

**Section III:** Arenes and Aromaticity: Nomenclature of benzene derivatives. Aromatic nucleus and side chain, Aromaticity: Huckel rule, aromatic ions, aromatic, anti-aromatic and non-aromatic compounds.

**Section IV:** Chemical kinetics: Rate of reaction - Definition of order and molecularity. Derivation of rate constants for first, second, third and zero order reactions and examples. Derivation for time half change. Methods to determine the order of reactions. Effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy.

**Learning Experience:** Through lectures, laboratory experiments, and problem-solving exercises, you'll gain a strong foundation in the theoretical concepts of physical and organic chemistry. You'll also develop practical skills in conducting experiments, analyzing data, and applying your knowledge to real-world problems.

**Textbooks:**

4. Allied Chemistry – Prof. Mathur and others.
5. Elements of Properties of Matter – D.S. Mathur, S. Chand & Co. (1999).
6. Modern Chemistry – S. Chand & Co. (2006).

**Suggested Readings:**

1. Electronic Principles and Applications – A.B. Bhattacharya, New Central Book Agency, Calcutta.
2. Introduction to Fiber optics by K. Thyagarajan and Ajay Ghatak, Cambridge, University Press (1999).]

**Open Educational Resources (OER)**

1. Khan Academy: <https://www.khanacademy.org/science/organic-chemistry>
2. MIT OpenCourseWare: <https://ocw.mit.edu/courses/chemistry/>
3. Chemistry LibreTexts: <https://chem.libretexts.org/>

**Examination scheme:**

Evaluation components	Weightage
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>



<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>
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<b>SCFS307</b>	Immunology	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		3	0	0	3
<b>Category of Course</b>	DSE				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** The subject Immunology and Metabolism integrates core principles of dilute solutions, electrochemistry, and liquid properties to explore how these scientific concepts apply to biological systems. The course emphasizes the physical and chemical properties of solutions and electrolytes, providing foundational knowledge for understanding physiological processes such as metabolism and immune responses at a molecular level.

**Course Outcome:** Students will be:

1. Understanding the historical perspectives and foundational theories of immunology, including the distinction between innate and adaptive immune responses.
2. Applying the properties and functions of antigens, immunoglobulins, and the Major Histocompatibility Complex (MHC), including their roles in immune system function.
3. Analyzing knowledge of carbohydrate and lipid metabolism pathways to explain energy production and storage in biological systems, including glycolysis and  $\beta$ -oxidation.
4. Performing a detailed examination of protein metabolism processes, including transamination, deamination, and the urea cycle, to understand nitrogen balance and excretion.
5. Interpreting the mechanisms of enzyme action, kinetics, and regulation, focusing on oxidative phosphorylation and the electron transport chain in cellular respiration.

<b>Course contents</b>
<b>Section I:</b> Overview of Immune System: Historical perspective of Immunology, Early theories of Immunology, Innate, Adaptive (cell mediated and humoral) - Passive: Artificial and Natural Immunity, Active: Artificial and Natural Immunity, Cells and Organs of the Immune System; Haematopoiesis, Cells of the immune system
<b>Section II:</b> Antigens, Immunoglobins, and MHC Organs of the Immune system: Primary and Secondary lymphoid organs, Lymphatic system Antigens; Properties of antigens, Adjuvants and Haptens

Immunoglobulins; Basic structure, classes and function, Polyclonal sera, Monoclonal antibodies Major Histocompatibility Complex; Structure and functions Antigen Processing and Presentation; Endogenous pathway and exogenous pathway of antigen
<b>Section III: Carbohydrate &amp; Lipid Metabolism</b> Carbohydrates: Glycolysis, Citric acid cycle, Pentose phosphate pathway, Gluconeogenesis, Glycogen metabolism. Lipid: Biosynthesis and $\beta$ -oxidation of palmitic acid
<b>Section IV: Protein Metabolism &amp; Enzymes</b> Transamination, Deamination and Urea cycle. Enzymes; Introduction, kinetics, mechanism of action, inhibition, allosteric enzymes and Regulation Oxidative Phosphorylation: Electron transport chain, Oxidative phosphorylation and ATP synthase

**Learning Experience:** Students will gain both theoretical knowledge and practical insights into the properties and behaviors of solutions and electrolytes, fostering their ability to apply this understanding to complex biological systems. Through laboratory experiments and theoretical exploration, learners will engage with key concepts such as osmotic pressure, electrolyte dissociation, and the physical behavior of liquids under different conditions. This experience will equip students with critical thinking and problem-solving skills, enhancing their understanding of how chemical principles underlie metabolic and immunological functions.

#### **Textbooks:**

1. M.S. Leffell, A.D. Donnenberg & N.R. Rose Handbook of Human Immunology CRC press, 1997
2. Essentials of Human Genetics by S.M. Bhatnagar et al (1999) IV edition. Orient Longman.
3. Basic Human Genetics by E.J. Manage and A.P. Manage (1997 India Reprint) Rastogi Publications, Meerut.
4. Mendelian inheritance in Man: Catalogues of Autosomal recessive and x-linked phenotypes. [12 editions – 1998] by McKusick, V.A. Johns Hopkins university press, Baltimore.
5. P. Atkins, Physical Chemistry (10th edition), Oxford University Press
6. J. D. Lee, Concise Inorganic Chemistry, Oxford University Press

#### **Suggested Readings:**

1. Principles and Practice of Medical Genetics, by Emery, A.E.H and D.L. Rimoim (Eds\_ (1990-2<sup>nd</sup> edition) Churchill Livingstone, Edinburgh.
2. Human Genetics by S.D. Gangane (2nd edition-Reprint 2001), B.L Churchill Livingstone Pvt.
3. F. Alberts et al., Molecular Biology of the Cell, Garland Science
4. D. Voet and J. G. Voet, Biochemistry, Wiley

**Open Educational Resources (OER):**

1. MIT OpenCourseWare - Physical Chemistry: <https://ocw.mit.edu>
2. Khan Academy - Chemistry of Solutions: <https://www.khanacademy.org/science/chemistry>

**Examination scheme:**

Evaluation components	Weightage
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>SCFS303</b>	Cyber Forensics III	L	T	P	C
<b>Version1.0</b>		2	0	0	2
<b>Category of Course</b>	Major				
<b>Total Contact Hours</b>	30 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** Cyber Forensics III offers a comprehensive exploration into the critical aspects of data privacy, social media forensics, and relevant IT laws. The course delves into the complexities of data protection regulations like GDPR and PIPEDA, highlighting their global impact and practical application. By examining social media's role in modern criminal activities and evidence collection methods, the course bridges theoretical knowledge with real-world practices. Students will also engage with Indian IT laws, understanding their provisions and penalties related to cyber crimes, equipping them with essential legal and technical insights.

**Course Outcome:** Students will be:

1. Understanding the concepts of data privacy, data protection, and security, including key regulations such as the Personal Data Protection Bill and GDPR.
2. Applying the security issues and challenges associated with big data and social media, identifying potential risks and impacts on individuals and organizations.
3. Analyzing forensic techniques to collect and analyze evidence from social media platforms, utilizing various methods and tools for intelligence gathering.
4. Performing a critical analysis of the provisions under the IT Act 2000, exploring its implications for cyber-crime and the penalties for offenses.
5. Interpreting the impact of social media on crime trends, business practices, and societal changes, evaluating emerging trends and their implications for forensic investigations.

<b>Course contents</b>
<b>Section I: Data privacy and security</b> Defining data, meta-data, big data, non- personal data. Data protection, Data privacy and data security, Personal Data Protection Bill and its compliance, Data protection principles, Big data security issues and challenges, Data protection regulations of other countries- General Data Protection Regulations(GDPR),2016 Personal Information Protection and Electronic Documents Act (PIPEDA).,

Social media- data privacy and security issues.

### **Section II: Social media forensics I**

Introduction to Social Media, Security Issues in Social Media, Types of crimes of Social Media – Cyberbullying, Online Grooming, Cyberstalking. Social Media and its impact on Business, Politics, Law and Revolutions, Emerging Trends in social media.

### **Section III: Social media forensic II**

Sources for social media evidence, Types of Data Available on Social Networking Sites, Different evidence collection methods from social networking sites, Intelligence gathering from Social Media- Tools and technique for intelligence gathering– indirect method, direct method with login, direct method without login.

### **Section IV: VAPT [Vulnerability Assessment and Penetration testing]**

Introduction to Vulnerability Assessment and its Life Cycle, Introduction to Unknown Vulnerability Assessment, Vulnerability Scanner.

## **Learning Experience**

Throughout the Cyber Forensics III course, students will engage with a blend of theoretical frameworks and practical applications, providing a well-rounded understanding of contemporary cyber forensics issues. Students will explore data privacy and security principles, including global regulations and challenges related to big data. This course will immerse students in the nuances of social media forensics, focusing on emerging trends, types of crimes, and evidence collection methods.

## **Textbooks and Suggested Readings**

1. "Cyber Forensics: From Data to Digital Evidence" by Eoghan Casey
2. "Digital Forensics and Cyber Crime: 7th International Conference, DFIC 2015" by M. H. (Ed.) L. T. N. A. H. J. K. N. E. P. O. S. P. (Ed.)
3. "Computer Forensics: Principles and Practices" by John Sammons

## **Open Educational Resources (OER)**

1. Digital Forensics and Incident Response - OER Commons
2. [Introduction to Cyber Forensics](#) - Coursera (Audit free)
3. Open Access Journal of Computer Forensics - JSTOR (Open Access)

**Examination scheme:**

<b>Evaluation components</b>	<b>Weightage</b>
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>UCH155</b>	Practical Chemistry-V	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		0	0	2	1
<b>Category of Course</b>	Practical (Minor)				
<b>Total Contact Hours</b>	30 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** Chemistry Practical V provides a hands-on approach to foundational principles in physical chemistry. The experiments help students understand critical concepts like colligative properties (freezing point depression, boiling point elevation), surface tension, viscosity, potentiometric and conductometric titrations. This course enhances students' skills in measuring and analyzing data, enabling them to determine molecular weights and compare physical properties of various substances. These practical emphasize accuracy in experimental techniques and the interpretation of results.

**Course Outcome:** Students will be:

1. Understanding the principles of colligative properties by measuring the depression in freezing point to determine the molecular weight of a non-volatile solute.
2. Applying the elevation in boiling point of a solution to calculate the molecular weight of a non-volatile solute.
3. Analyzing techniques to compare the surface tension and viscosity of different liquids, such as water, ethanol, and glycerol, at various temperatures.
4. Performing potentiometric titration of a strong acid with a strong base and plot the corresponding titration curve for analysis.
5. Interpreting the results of conductometric titration of a strong acid with a strong base to understand the behavior of ionic species in solution.

**Course contents**



1. Measurement of the depression in freezing point of a solution to determine the molecular weight of a non-volatile solute.
2. Measurement of the elevation in boiling point of a solution to determine the molecular weight of a non-volatile solute.
3. Comparison of surface tension and viscosity of different liquids (e.g., water, ethanol, glycerol) at various temperatures.
4. Potentiometric titration of a strong acid with a strong base and plotting the titration curve.
5. Conductometric titration of a strong acid with a strong base (e.g., HCl vs NaOH).

### **Learning Experience:**

Students will actively engage in laboratory experiments, applying theoretical knowledge to real-world measurements. They will work with various instruments such as potentiometers and conductometers, gaining expertise in titration techniques. Experiments like freezing point depression and boiling point elevation allow students to explore molecular interactions in solutions. By comparing the surface tension and viscosity of different liquids, students will develop a deeper understanding of intermolecular forces and temperature effects. The practicals foster critical thinking and analytical skills, preparing students for future challenges in experimental chemistry.

### **Textbook:**

1. Benjamin, D. M., Forensic Pharmacology. In Forensic Science Handbook (vol – 3), Saferstein, R. (Ed.), Prentice-Hall, Englewood Cliffs, New Jersey, 1993.

### **Suggested Reading:**

1. Vogel's **Textbook** of Quantitative Chemical Analysis by J. Mendham, R. C. Denney, J. D. Barnes, and M. J. K. Thomas
2. Practical Physical Chemistry by A.M. James & F.E. Prichard
3. Advanced Practical Physical Chemistry by J.B. Yadav

### **Open Educational Resources:**

1. MIT OpenCourseWare - Chemistry
2. [Khan Academy - Chemistry](#)
3. ChemCollective Virtual Labs

## Examination Scheme

Evaluation components	Weightage
<b>Internal marks (practical)</b> I. Conduct of experiment II. Lab Record III. Lab Participation IV. Lab Project	<b>10 Marks</b> <b>10 Marks</b> <b>10 Marks</b> <b>20 Marks</b>
<b>II. External Marks (practical)</b> End Term Examination	<b>50 Marks</b>

<b>SEC082</b>	Forensic Practical V	L	T	P	C
<b>Version1.0</b>		0	0	4	2
<b>Category of Course</b>	Practical (Major)				
<b>Total Contact Hours</b>	90 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** This practical course provides a comprehensive introduction to the techniques used in forensic chemistry. Through a series of experiments, you'll gain practical experience in analyzing common drugs of abuse, determining physical properties, and identifying various cations and anions. This course is designed to equip you with the skills needed to contribute to forensic investigations and understand the scientific principles behind forensic analysis.

**Course Outcomes:** Students will be:

1. Understanding the principles and techniques of color/spot tests for common drugs of abuse.
2. Applying the boiling and melting points of various substances to assess their properties.
3. Analyzing analytical methods to evaluate phenolphthalein in trap cases for forensic investigations.
4. Performing the analysis of cations, including Arsenic, Copper, Lead, Zinc, Barium, and Aluminium, using appropriate techniques.
5. Interpreting the results of anion analysis for Nitrate, Phosphates, Oxalate, Chloride, Iodide, and Sulphates in forensic samples.

<b>Course contents</b>
<ol style="list-style-type: none"> <li>1. Colour/spot tests for common drugs of abuse</li> <li>2. Determination of boiling and melting points.</li> <li>3. Analysis of phenolphthalein in trap cases.</li> <li>4. Analysis of Cations (Arsenic, Copper, Lead, Zinc, Barium, Aluminium )</li> <li>5. Analysis of Anions (Nitrate, Phosphates, oxalate, chloride, iodide, sulphates)</li> </ol>

**Learning Experience:**By conducting experiments on color/spot tests for common drugs of abuse, determining boiling and melting points, analyzing phenolphthalein in trap cases, and identifying cations and anions, you'll develop a strong foundation in forensic chemistry. This hands-on approach will allow you to apply theoretical knowledge to real-world scenarios and gain practical skills that are essential for forensic scientists.

#### **Textbooks:**

1. Thomas Kubic, Nicholas Petraco Forensic Science Laboratory Manual and Workbook, Third Edition 2009
2. Laboratory Protocols CIMMYT Applied Molecular Genetics Laboratory Third Edition.
3. Vogel **Textbook** of Practical organic Chemistry including Qualitative organic analysis

#### **Suggested Readings:**

1. Kathy Mirakovits, Gina Londino, The Basics of Investigating Forensic Science: A Laboratory Manual 2015
2. Washington state patrol Forensic Laboratory services: Crime Laboratory: Technical & Training Manuals Isolation and identification of Drugs by E.G.C. Clark

#### **Open Educational Resources (OER)**

1. **Open Educational Resources (OER) Commons:** <https://oercommons.org/>
2. Khan Academy: <https://www.khanacademy.org/>
3. MIT OpenCourseWare: <https://ocw.mit.edu/>

#### **Examination Scheme:**

<b>Evaluation components</b>	<b>Weightage</b>
<b>Internal marks (practical)</b> I. Conduct of experiment II. Lab Record III. Lab Participation IV. Lab Project	<b>10 Marks</b> <b>10 Marks</b> <b>10 Marks</b> <b>20 Marks</b>
<b>II. External Marks (practical)</b> End Term Examination	<b>50 Marks</b>

	Summer Internship-II	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version 1.0</b>		0	0	0	0
<b>Category of Course</b>	Internship				
<b>Total Contact Hours</b>					
<b>Pre-Requisites/Co-Requisites</b>	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:**

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

## SIXTH SEMESTER

<b>SCFS302</b>	Entrepreneurial skills in Forensic Science	L	T	P	C
<b>Version1.0</b>		3	0	0	3
<b>Category of Course</b>	Major				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** This course equips you with the knowledge and skills to combine your passion for forensic science with entrepreneurial thinking. You'll learn how to identify business opportunities, develop innovative products or services, and navigate the challenges of starting and running a forensic science-related enterprise.

**Course Outcome:** On completion of this course, student will be able to:

1. Understanding the financial aspects of starting and managing a forensic science business, including budgeting, forecasting, and funding strategies.
2. Developing effective communication skills necessary for pitching ideas, negotiating contracts, and cultivating relationships with clients and stakeholders.
3. Applying strategic planning techniques to set goals, define strategies, and allocate resources efficiently within a forensic science business context.
4. Identifying and managing inherent risks in forensic science entrepreneurship, focusing on legal, financial, and operational challenges.
5. Evaluating market trends and opportunities in forensic science to identify niche areas for entrepreneurial ventures.

<b>Course contents</b>
<b>Section I: Foundations of Entrepreneurship</b> Introduction, Definition and characteristics of entrepreneurship, role of entrepreneurship in economic development and forensic science, overview of different types of entrepreneurs, basic principles and disciplines within forensic science, and current trends and technological advancements.
<b>Section II: Market Research and Business Planning</b> Conducting market research for forensic services, understanding the forensic science market and customer needs, analyzing market needs and trends, tools and techniques for effective market research,

evaluating the feasibility of business ideas, risk assessment and mitigation strategies, financial feasibility and projections,

### **Section III: Legal, Ethical, and Operational Considerations**

Licensing and certification requirements, regulatory compliance and standards, intellectual property considerations, ethical dilemmas and decision-making in forensic science, ensuring integrity and accuracy in forensic services, building trust with clients and stakeholders, Legal aspects of starting a forensic science business

### **Section IV: Innovation, Funding, and Business Growth**

Emerging technologies and their business applications, innovating forensic techniques for market needs, staying competitive through continuous improvement, sources of funding for forensic science startups, preparing financial statements and budgets, and financial management and sustainability.

**Learning Experience:** Through a mix of theoretical lectures, practical exercises, and case studies, you'll gain a deep understanding of forensic science principles, business fundamentals, and entrepreneurial mindset. You'll also have opportunities to develop your leadership, communication, and problem-solving skills.

### **Textbooks:**

1. "Innovation and Entrepreneurship" by Peter F. Drucker (Chapter on innovation in technology-driven industries)
2. Forensic Science: An Introduction" by Richard Saferstein (Chapter on recent technological advancements in forensic science)
3. "Marketing for Dummies" by Jeanette McMurtry (Chapter on marketing niche services)
4. "Forensic Science: An Introduction to Scientific and Investigative Techniques" by Stuart H. James and Jon J. Nordby (Chapter on marketing forensic services)

### **Suggested Readings:**

1. The Innovator's Dilemma by Clayton M. Christensen
2. Blue Ocean Strategy by W. Chan Kim and Renée Mauborgne

### **Open Educational Resources (OER) Links:**

1. Coursera: <https://www.coursera.org/learn/forensic-science>



2. EdX: <https://www.edx.org/>
3. MIT OpenCourseWare: <https://ocw.mit.edu/>
4. Khan Academy: <https://www.khanacademy.org/>

**Examination scheme:**

<b>Evaluation components</b>	<b>Weightage</b>
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>SCFS304</b>	Forensic Psychology	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		3	0	0	3
<b>Category of Course</b>	Major				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	Basic Knowledge of punishments				

**Course Perspective:** Forensic psychology explores the application of psychological principles to the legal system. You'll delve into topics such as criminal profiling, eyewitness testimony, jury selection, and the evaluation of mental disorders in legal contexts. This course provides a unique blend of theoretical knowledge and practical applications, preparing you for a career in forensic psychology or related fields.

**Course Outcome:** Students will be:

1. Understanding the intersection of forensic psychology and the law, including ethical issues, mental competency assessments, and the role of psychological factors in criminal behavior.
2. Analyse psychological assessment tools and deception detection methods, including polygraphs and advanced techniques like Brain Electrical Oscillation Signature Profiling.
3. Analyzing principles of polygraphy and narco-analysis in forensic investigations, ensuring adherence to legal and ethical standards.
4. Performing psychological assessments and interviews using various techniques to evaluate mental disorders and inform legal proceedings.
5. Interpreting the implications of forensic psychological findings on criminal profiling, eyewitness testimony, and the relationship between genetics and criminal behavior.

<b>Course content</b>
<b>Section I:</b> Basics: 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.
<b>Section II :</b> Psychological Assessment: Psychological Assessment Tools, Detection of deception, Various methods for detection of deception, Interview, Non-verbal detection, statement assessment, Hypnosis, Psychological assessment, voice stress analyzer, Polygraph, thermal imaging, Brain Electrical Oscillation Signature Profiling, Functional Magnetic Resonance study, Current research in

detection of deception/truth finding mechanisms
<b>Section III:</b> Polygraph: Historical aspects of Polygraph, Principles of polygraph, physiological aspects, operational aspects, Question formulation techniques, Interviewing technique procedure, The Art-Polygraph, Legal and Ethical aspects, Human rights of individual.
<b>Section IV:</b> 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:** Through lectures, case studies, and practical exercises, you'll gain a comprehensive understanding of the psychological factors that influence criminal behavior, the legal system, and the administration of justice. You'll also have the opportunity to develop critical thinking, research skills, and ethical decision-making abilities.

#### **Textbooks:**

1. Forensic Science in Criminal Investigation & Trials – B.R.Sharma.
2. The Hand Book of Forensic Psychology – Weiner Hass
3. Hand Book of Forensic Psychology – O' Donohue Levensky s

#### **Suggested Readings:**

1. Brain Experience – C.R.Mukun
2. Criminal Profilling – B.Turvey
3. Investigative Forensic Hypnosis – J. Niehans
4. Art & Science of the Polygraph Techniques – J.A.Matte
5. 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>

#### **Examination scheme:**

<b>Evaluation components</b>	<b>Weightage</b>
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>UCH106</b>	Physical and Organic chemistry	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		3	0	0	3
<b>Category of Course</b>	Minor				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** This course explores the intricate relationship between matter and energy, as well as the structure, properties, and reactions of organic compounds. You'll delve into topics such as thermodynamics, kinetics, quantum mechanics, and organic reaction mechanisms.

**Course Outcome:** Students will be:

1. Understanding the general principles of metallurgy, including Ellingham diagrams and methods of metal purification like electrolytic, oxidative refining, and specialized processes.
2. Analyse the properties and structures of nitrogen hydrides and oxoacids of phosphorus, sulfur, and chlorine, along with halides and oxohalides.
3. Analyzing the Huckel rule to determine aromaticity in arenes and differentiate between aromatic, anti-aromatic, and non-aromatic compounds.
4. Performing calculations for rate constants in chemical kinetics for various reaction orders and determine reaction order using experimental methods.
5. Interpreting the effects of temperature on reaction rates through the Arrhenius equation and activation energy concepts.

<b>Course contents</b>
<b>Section I:</b> General Principles of Metallurgy: Ellingham diagrams for reduction of metal oxides using carbon as reducing agent. Hydrometallurgy, Methods of purification of metals (Al, Pb, Ti, Fe, Cu, Ni, Zn): electrolytic, oxidative refining, Kroll process, Parting process, van Arkel-de Boer process and Mond's process.
<b>Section II:</b> Hydrides of nitrogen: (NH <sub>3</sub> , N <sub>2</sub> H <sub>4</sub> , N <sub>3</sub> H, NH <sub>2</sub> OH) Oxoacids of P, S and Cl. Halides and oxohalides: PCl <sub>3</sub> , PCl <sub>5</sub> , SOCl <sub>2</sub> and SO <sub>2</sub> Cl <sub>2</sub>
<b>Section III:</b> Arenes and Aromaticity: Nomenclature of benzene derivatives. Aromatic nucleus and side chain, Aromaticity: Huckel rule, aromatic ions, aromatic, anti-aromatic and non-aromatic compounds.

**Section IV:** Chemical kinetics: Rate of reaction - Definition of order and molecularity. Derivation of rate constants for first, second, third and zero order reactions and examples. Derivation for time half change. Methods to determine the order of reactions. Effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy.

**Learning Experience:** Through lectures, laboratory experiments, and problem-solving exercises, you'll gain a strong foundation in the theoretical concepts of physical and organic chemistry. You'll also develop practical skills in conducting experiments, analyzing data, and applying your knowledge to real-world problems.

**Textbooks:**

4. Allied Chemistry – Prof. Mathur and others.
5. Elements of Properties of Matter – D.S. Mathur, S. Chand & Co. (1999).
6. Modern Chemistry – S. Chand & Co. (2006).

**Suggested Readings:**

1. Electronic Principles and Applications – A.B. Bhattacharya, New Central Book Agency, Calcutta.
2. Introduction to Fiber optics by K. Thyagarajan and Ajay Ghatak, Cambridge, University Press (1999).]

**Open Educational Resources (OER)**

1. Khan Academy: <https://www.khanacademy.org/science/organic-chemistry>
2. MIT OpenCourseWare: <https://ocw.mit.edu/courses/chemistry/>
3. Chemistry LibreTexts: <https://chem.libretexts.org/>

**Examination scheme:**

Evaluation components	Weightage
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>

<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>SCFS310</b>	Solid state physics	L	T	P	C
<b>Version1.0</b>		3	0	0	3
<b>Category of Course</b>	DSE				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** Solid State Physics provides a comprehensive exploration of the properties and behavior of condensed matter. You'll delve into the quantum mechanical principles underlying solids, from crystal structures to electronic properties.

**Course Outcome:** Students will be:

1. Understanding the principles of elementary lattice dynamics, including lattice vibrations and phonons in linear monoatomic and diatomic chains.
2. Analyse dielectric and ferroelectric properties of materials, focusing on concepts like electric susceptibility, polarizability, and plasma oscillations.
3. Analyzing the classical and quantum mechanical theories to explore the magnetic properties of matter, including diamagnetic, paramagnetic, and ferromagnetic materials.
4. Performing investigations into superconductivity, examining critical temperature, critical magnetic field, and the Meissner effect in type I and type II superconductors.

<b>Course contents</b>
<b>Section I:</b> Elementary Lattice Dynamics: Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains; Acoustical and Optical Phonons, Qualitative Description of the Phonon Spectrum in Solids.
<b>Section II:</b> Dielectric and Ferroelectric Properties of Materials: Electric Susceptibility. Polarizability Clausius Mosotti Equation. Classical Theory of Electric Polarizability. Langevin-Debye equation. Plasma Oscillations, Plasma Frequency, Plasmons, Structural phase transition, Classification of crystals.
<b>Section III:</b> Magnetic Properties of Matter: Dia-, Para-, Ferri- and Ferromagnetic Materials. Classical Langevin Theory of dia and Paramagnetic Domains. Quantum Mechanical Treatment of Paramagnetism.



**Section IV:** Superconductivity and Elementary band theory: Critical Temperature. Critical magnetic field. Meissner effect. Type I and type II Superconductors, London's Equation and Penetration Depth. Isotope effect. Band Gap, Conductor, Semiconductor (P and N type) and insulator.

**Learning Experience:** Through lectures, problem-solving exercises, and laboratory experiments, you'll gain a hands-on understanding of solid-state physics concepts. This course will equip you with the knowledge and skills needed for research in materials science, condensed matter physics, and related fields.

**Textbooks:**

1. Allied Physics – Prof. Dhanalakshmi and others.
2. Elements of Properties of Matter – D.S. Mathur, S. Chand & Co. (1999).
3. Modern Physics – R. Murugesan S. Chand & Co. (2004).
4. Electronic Principles and Applications – A.B. Bhattacharya, New Central Book Agency, Calcutta.

**Suggested Readings:**

1. The Quantum Theory of Matter by Feynman
2. Quantum Mechanics by Griffiths

**Open Educational Resources (OER):**

1. MIT OpenCourseWare: Solid State Physics I (<https://ocw.mit.edu/courses/8-231-physics-of-solids-i-fall-2006/pages/>)
2. Khan Academy: Solid State Physics (<https://www.khanacademy.org/science/physics>)
3. National Physical Laboratory (NPL) Open Access Repository (<https://eprintspublications.npl.co.uk/>)

**Examination scheme:**

Evaluation components	Weightage
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>

<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>
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<b>SCFS308</b>	Biotechnology and microbiology	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		3	0	0	3
<b>Category of Course</b>	DSE				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** This course explores the intersection of biology and technology, focusing on the application of living organisms and their components to create products and processes. You'll delve into the fascinating world of microorganisms, their characteristics, and their role in various industries and ecosystems.

**Course Outcome:** Students will be:

1. Understanding the epidemiology of infectious diseases, focusing on their transmission and prevention strategies.
2. Applying the roles of microorganisms in food and industrial microbiology contexts.
3. Analyzing various molecular techniques used in gene manipulation and explore their applications.
4. Performing detailed studies on genes at the molecular level, including DNA, RNA, replication, mutations, and DNA repair mechanisms.
5. Interpreting the applications of biotechnology, including the use of transgenic plants and animals in medicine, vaccines, and gene therapy.

<b>Course contents</b>
<p><b>Section I: Applications of Biotechnology</b></p> <p>Molecular diagnosis of genetic diseases (Cystic fibrosis, Huntington's disease and Sickle cell anemia), Recombinant vaccines, Recombinant DNA in medicines (Recombinant insulin and Human growth hormone), Gene therapy (ADA and Cystic fibrosis) and Stem Cells, Bioremediation, Production and applications of transgenic plants (biotic, abiotic and improvement of nutritional quality) and transgenic animals (generation of medicines and hormones), Ethics and regulation of GM organisms.</p>
<p><b>Section II: Molecular manipulation</b></p> <p>Introduction to the concept of Recombinant DNA Technology, Cloning vectors, Restriction and modifying enzymes, Transformation techniques (microbial, plants and animals), Construction and screening of DNA libraries, Southern, Northern and Western blotting, DNA sequencing (Maxam-</p>

Gilbert and Sanger methods), and DNA microarrays.

### **Section III: Food and industrial microbiology**

Microbiology of fermented food and food-borne diseases, food preservation, Micro-organism as food (e.g. SCP), Major products of industrial microbiology-antibiotics, amino acids, organic acids, vitamins, pharmaceuticals.

### **Section IV: Human diseases**

Epidemiology of infectious disease, transmission, prevention and control of human diseases- Tuberculosis, Amoebiasis, Dengue, Malaria, Filariasis, Japanese encephalitis

**Learning Experience:** Through a combination of lectures, laboratory experiments, and hands-on projects, you'll gain practical skills in techniques such as DNA manipulation, fermentation, and microbial culturing. You'll also explore the ethical and societal implications of biotechnology and learn about the latest advancements in this rapidly evolving field.

### **Textbooks:**

1. M.S. Leffell, A.D. Donnenberg & N.R. Rose Handbook of Human Immunology CRC press, 1997
2. Essentials of Human Genetics by S.M. Bhatnagar et al (1999) IV edition. Orient Longman.
3. Basic Human Genetics by E.J. Manage and A.P. Manage (1997 India Reprint) Rastogi Publications, Meerut.
4. Mendelian inheritance in Man: Catalogues of Autosomal recessive and x-linked. phenotypes. [12 editions – 1998] by McKusick, V.A. Johns Hopkins university press, Baltimore.

### **Suggested Readings:**

1. Principles and Practice of Medical Genetics, by Emery, A.E.H and D.L. Rimoim (Eds\_ (1990-2<sup>nd</sup> edition) Churchill Livingstone, Edinburgh.
2. Human Genetics by S.D. Gangane (2nd edition-Reprint 2001), B.L Churchill Livingstone Pvt.

### **Open Educational Resources (OER)**

1. OpenStax Biology: <https://openstax.org/details/books/biology-2e/>
2. Khan Academy Biology: <https://www.khanacademy.org/science/biology>

3. MIT OpenCourseWare Biology: <https://ocw.mit.edu/courses/7-016-introductory-biology-fall-2018/>

**Examination scheme:**

<b>Evaluation components</b>	<b>Weightage</b>
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>SCFS306</b>	Advanced Digital Forensics	L	T	P	C
<b>Version1.0</b>		2	0	0	2
<b>Category of Course</b>	Major				
<b>Total Contact Hours</b>	30 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** This advanced course delves into the complexities of modern digital investigations, equipping you with the skills to analyze intricate digital artifacts and extract crucial evidence. You'll explore advanced forensic tools, techniques, and methodologies used in a wide range of digital crime investigations, from cybercrime to intellectual property theft.

**Course Outcome:** Students will be:

1. Understanding the essential concepts, algorithms, protocols, tools, and methodologies employed in computer forensics.
2. Analyse multiple sources of evidence to focus investigations effectively.
3. Analyzing cryptographic techniques and knowledge of symmetric cryptosystems and hashing algorithms to address security issues.
4. Performing the analysis and interpretation of digital evidence using various computer forensic tools and techniques.
5. Interpreting and document findings from computer forensic investigations to present them effectively.

<b>Course contents</b>
<p><b>Section 1: Cyber Security</b></p> <p>Cyber security increasing threat landscape, Cyber security terminologies- Cyberspace, attack, attack vector, attack surface, threat, risk, vulnerability, exploit, exploitation, hacker., Non-state actors, Cyber terrorism, Protection of end user machine, Critical IT and National Critical Infrastructure, Cyberwarfare, Case Studies.</p>
<p><b>Section II: Tools and technologies</b></p> <p>Computer Virus: Definition, types of viruses, Characteristics of viruses, virus and trojan infections, different types of attack, internet research and investigative tools, Anti-virus software.</p> <p>Password policy, Security patch management, Data backup, Downloading and management of third party software, Device security policy, Cyber Security best practices, Significance of host firewall and</p>

Ant-virus, Management of host firewall and Anti-virus, Wi-Fi security, Configuration of basic security policy and permissions.

### **Section III: Cryptography**

Introduction to Cryptography, Symmetric and Asymmetric Cryptosystem Encryption Techniques—Substitutional Cipher and Transpositional Ciphers. Types of keys – Public Key and Private Key. Advanced Encryption Techniques and Security Issues. Various types of attacks including Cipher Text-Only attack, Known-Plaintext Attack, Chosen-Plaintext Attack, Chosen-Cipher text Attack.

### **Section IV: Symmetric Cryptosystem**

Symmetric Cryptosystem – AES, DES, RC4, Blowfish. Asymmetric Cryptosystems – RSA, DSA, Elliptic Curve cryptography. Introduction to Cryptanalysis – Differential and Linear Cryptanalysis. Hashing Algorithms – MD5, SHA-1, SHA-2, SHA-3, One-Way Hash, Hash Message Authentication Code.

**Learning Experience:** Through hands-on labs, case studies, and expert guidance, you'll gain practical experience in analyzing various digital devices, including computers, mobile phones, and network infrastructure. You'll learn to identify hidden data, recover deleted files, and interpret digital evidence in a court-admissible manner.

### **Textbooks:**

1. Digital Forensics: A Field Guide by Brian K. Kruse and Jason J. W. Kirk
2. Computer Forensics: Incident Response Essentials by Rod V. Rasmussen
3. Advanced Digital Forensics: Techniques and Tools by Brian K. Kruse and Jason J. W. Kirk

### **Suggested Readings:**

1. The Art of Computer Forensics by Brian K. Kruse
2. Digital Evidence by Michael C. Mandia and Jack A. Grasso
3. Computer Forensics: A Comprehensive Guide by James C. O'Reilly

### **Open Educational Resources (OER):**

1. Open Digital Forensics Survival Guide:  
<https://oercommons.org/courseware/lesson/78295/student/?section=1>
2. Digital Forensics and Incident Response: <https://dokumen.pub/hands-on-incident-response-and-digital-forensics-9781780174204-1780174209.html>

**Examination scheme:**

<b>Evaluation components</b>	<b>Weightage</b>
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>



<b>UCH156</b>	Practical Chemistry-VI	L	T	P	C
<b>Version1.0</b>		0	0	2	1
<b>Category of Course</b>	Practical (Minor)				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

### Course Perspective:

In Chemistry Practical III, students explore fundamental concepts in physical and organic chemistry through hands-on experiments. By studying Ellingham diagrams, students learn to predict the feasibility of metal oxide reduction using carbon. The course introduces methods to experimentally identify benzene derivatives and classifies aromaticity.

### Course Outcome: Students will be:

1. Understanding how to use Ellingham diagrams to predict the feasibility of reducing metal oxides with carbon as a reducing agent.
2. Analyse common benzene derivatives through experimental identification using physical and chemical methods.
3. Analyzing principles of aromaticity to differentiate between aromatic, anti-aromatic, and non-aromatic compounds in experimental studies.
4. Performing titration methods to measure the rate constant for the hydrolysis of esters, such as ethyl acetate.
5. Interpreting the effect of temperature on reaction rates through investigations, exemplified by the decomposition of hydrogen peroxide.

### Course contents

1. Study of Ellingham diagrams to predict the feasibility of reduction of metal oxides using carbon as a reducing agent.
2. Experimental identification of common benzene derivatives using physical and chemical methods.
3. Experimental study of aromatic, anti-aromatic, and non-aromatic compounds.
4. Measurement of the rate constant for the hydrolysis of an ester (e.g., ethyl acetate) using titration methods.
5. Investigation of the effect of temperature on the rate of reaction for a specific reaction (e.g., decomposition of hydrogen peroxide).

**Learning Experience:** Students engage in experimental techniques, enhancing their problem-solving and analytical skills. The study of Ellingham diagrams equips them to predict metallurgical processes, while identifying benzene derivatives fosters an understanding of organic compound properties. Investigating aromaticity clarifies concepts of molecular stability, while kinetic experiments on ester hydrolysis and reaction rates develop quantitative analytical skills. Overall, this practical course bridges theory with laboratory experience, promoting active learning and scientific inquiry.

**Textbooks:**

1. Allied Chemistry – Prof. Mathur and others.
2. Elements of Properties of Matter – D.S. Mathur, S. Chand & Co. (1999).
3. Modern Chemistry – S. Chand & Co. (2006).
4. Electronic Principles and Applications – A.B. Bhattacharya, New Central Book Agency, Calcutta.
5. Introduction to Fiber optics by K. Thyagarajan and Ajay Ghatak, Cambridge, University Press (1999).]

**Suggested Readings:**

1. "Vogel's Textbook of Practical Organic Chemistry" by Brian S. Furniss et al.
2. "Physical Chemistry: A Molecular Approach" by Donald A. McQuarrie and John D. Simon
3. "Inorganic Chemistry" by J.D. Lee
4. "Reaction Kinetics" by Keith J. Laidler

**Open Educational Resources:**

1. [Khan Academy – Chemistry](#)
2. MIT OpenCourseWare – Chemistry
3. LibreTexts Chemistry Library

**Examination Scheme**

Evaluation components	Weightage

<b>Internal marks (practical)</b> I. Conduct of experiment II. Lab Record III. Lab Participation IV. Lab Project	<b>10 Marks</b> <b>10 Marks</b> <b>10 Marks</b> <b>20 Marks</b>
<b>II. External Marks (practical)</b> End Term Examination	<b>50 Marks</b>

<b>SEC083</b>	Forensic Practical-VI	L	T	P	C
<b>Version1.0</b>		0	0	2	1
<b>Category of Course</b>	Practical (Major)				
<b>Total Contact Hours</b>	90 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** This course provides a hands-on introduction to psychological assessment techniques, focusing on personality assessment. You'll learn about various personality theories, research methods, and the practical application of assessment tools. Through laboratory exercises, you'll gain experience administering, scoring, and interpreting different personality tests.

#### **Course Outcome:**

1. Understand ethical guidelines in psychological experiments and apply them in forensic psychology.
2. Apply experimental data in forensic psychology to draw valid conclusions.
3. Analyze research findings in forensic psychology to identify patterns and implications.
4. Evaluate research findings and methodologies in forensic psychology.
5. Create and conduct experiments in forensic psychology, and effectively communicate research findings.

<b>Course contents</b>
<ol style="list-style-type: none"> <li>1. Type A/ Type B personality Test</li> <li>2. Social Problem Scale</li> <li>3. Eysenck's Personality Questionnaire</li> <li>4. Raven's Standard Progressive Matrices.</li> <li>5. Bhatia's Performance Scale of Intelligence.</li> <li>6. Buss Perry- Aggression Scale</li> <li>7. Parenting Scale</li> <li>8. Free Association Test</li> </ol>

**Learning Experience:** By conducting practical assessments like the Type A/Type B Personality Test, Social Problem Scale, Eysenck's Personality Questionnaire, Raven's Standard Progressive Matrices, Bhatia's Performance Scale of Intelligence, Buss Perry-Aggression Scale, Parenting Scale, and Free Association Test of Controlled Drugs, you'll develop essential skills in psychological assessment and research. You'll also learn about the ethical considerations involved in administering and interpreting psychological assessments.

**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, Third Edition 2009
3. Laboratory Protocols CIMMYT Applied Molecular Genetics Laboratory Third Edition

**Suggested Readings:**

1. Kathy Mirakovits, Gina Londino, The Basics of Investigating Forensic Science: A Laboratory Manual 2015.
2. Washington state patrol Forensic Laboratory services: Crime Laboratory: Technical & Training Manuals.
3. G.H. Stout & L.H. Jensten, X-ray Structure Determination – A practical Guide; 2<sup>nd</sup> Edn. Wiley, New York, 1989.
4. Personality Psychology by David F. Hassin, Jerry S. DeYoung, and Todd D. Heatherton
5. Psychological Assessment by Ronald C. Thomas and Joel B. Weaver

**Open Educational Resources (OER) Links:**

1. <https://oercommons.org/>
2. Khan Academy: <https://www.khanacademy.org/>
3. MIT OpenCourseWare: <https://ocw.mit.edu/courses/>

**Examination Scheme:**

Evaluation components	Weightage
<b>Internal marks (practical)</b> I. Conduct of experiment II. Lab Record III. Lab Participation IV. Lab Project	<b>10 Marks</b> <b>10 Marks</b> <b>10 Marks</b> <b>20 Marks</b>
<b>II. External Marks (practical)</b> End Term Examination	<b>50 Marks</b>

## SEVENTH SEMESTER

<b>SCFS401</b>	Forensic Pharmacy and Pharmacology of Controlled Drugs	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		3	0	0	3
<b>Category of Course</b>	Major				
<b>Total Contact Hours</b>	60 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** This course delves into the intricate relationship between pharmacy, pharmacology, and the legal aspects of controlled drugs. You'll gain a deep understanding of the properties, effects, and legal implications of controlled substances, equipping you with the knowledge and skills needed to contribute to investigations and legal proceedings.

**Course Outcome:** Students will be:

1. Demonstrating knowledge of toxicokinetics, drug absorption, distribution, metabolism, and elimination, and detect poisons based on metabolic studies.
2. Explaining the concept of clandestine laboratories, the methods used in the synthesis and extraction of drugs, and the associated risks and legal issues.
3. Identifying prohibited substances and performance-enhancing drugs in sports, understand anti-doping regulations, and perform doping tests.
4. Applying principles of environmental forensic toxicology to identify and analyze environmental pollutants and address environmental litigation issues.
5. Understanding the interference caused by ptomaine in poisoning analysis and develop strategies to analyze putrefied samples accurately.

<b>Course contents</b>
<p><b>Section I:</b> Forensic Pharmacology: Introductory Toxicokinetics: Overall Drug Disposition, Absorption, Toxicokinetics and Bioavailability, First-Pass Metabolism, Distribution, Free and Bound Drugs Elimination.</p> <p>Biotransformation: Phase-I and Phase-II reactions. Detection of poison on the basis of their metabolic studies, Some Examples of Applied Biotransformation Knowledge of Codeine, Morphine, Amphetamine Benzodiazepines etc</p>

**Section II:** Clandestine laboratory: Meaning and Definition of Clandestine, Clandestine Laboratory, Related Problems, Factors Contributing to Clandestine Drug Labs, Harms Caused by Clandestine Drug Labs

Equipment Needs: Reflux, Distillation, Hydrogenation, Bucket Chemistry, Extractions, Chemical Needs, Cooking Methods Commonly Used in Clandestine Drug Labs, Extraction Process, Conversion Process, Synthesis Process, Tableting.

Designer drugs: Definition, Analogs of Fentanyl and Meperidine (both synthetic opioids), Phencyclidine (PCP), Amphetamines and methamphetamines (which have hallucinogenic and stimulant properties).

**Section III:** Drug Abuse in Sports: Introduction, International Olympic Committee (IOC), World Anti-Doping Agency (WADA), classification of commonly prohibited substances and Performance enhancing Drugs, Steroids, Stack and Pyramid methods, Dope test and Blood Doping, Sampling techniques, analytical approaches.

**Section IV:** Environmental Forensic Toxicology: Introduction, principles and application, various pollutants, identification of biased environmental data, ground water characterization, soil, vapour survey, analytical methods. Forensic techniques in environmental litigation.

Ptomaine: Introduction, interference caused in analysis of poison, especially in putrefied viscera, poisoning cases due to ptomaine.

**Learning Experience:** Through lectures, laboratory exercises, and case studies, you'll explore the pharmacological properties of controlled drugs, their impact on the human body, and the methods used to detect and analyze them in forensic investigations. You'll also learn about the legal framework governing controlled substances, including classification, regulation, and enforcement.

**Textbooks:**

1. J A Siegel, P.J Saukko (2000) Encyclopedia of Forensic Sciences Vol. I, II and III, Acad. Press.
2. Casarett & Doll Toxicology (2003) The Basic Science of poisons.
3. MaThew E. Johll (2009) Investigating Chemistry: A Forensic Science Perspective
4. JJ Fenton (2002) Toxicology A Case-Oriented Approach

**Suggested Reading:**

1. Forensic Pharmacology by R.E. Ferner
2. Controlled Substances Act (DEA)

3. The Merck Index: An Encyclopedia of Chemicals, Drugs, and Biologicals

### Open Educational Resources (OER)

1. <https://oercommons.org/>
2. Khan Academy: <https://www.khanacademy.org/>
3. Coursera: <https://www.coursera.org/>
4. EdX: <https://www.edx.org/>
5. National Institutes of Health (NIH) Genome Education: <https://www.ncbi.nlm.nih.gov/home/genomes/>

### Examination scheme:

Evaluation components	Weightage
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>



<b>SCFS407</b>	Wildlife Forensics	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		3	0	0	3
<b>Category of Course</b>	Major				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** This course delves into the intricate world of wildlife forensics, providing a deep understanding of the techniques used to investigate wildlife crimes. You'll learn about evidence collection, analysis, and presentation, as well as the legal and ethical implications of wildlife crime.

**Course Outcome:** Students will be:

1. Understanding the field of wildlife forensics, including its scope and importance.
2. Applying knowledge of the wide range of animal evidence used in forensic investigations and its utility in solving cases.
3. Analyzing the benefits of implementing effective risk management practices and understanding the role and responsibilities required to promote a risk management culture.
4. Evaluating the ISO 31000:2009 standard, including the 11 Risk Management Principles, Risk Framework, and the Process for Risk Management.
5. Creating effective risk policies by applying the principles and frameworks of risk management in various contexts.

<b>Course contents</b>
<b>Section I:</b> Introduction to wildlife forensics Introduction to Wildlife Forensics, basic elements of wildlife forensics, application of forensics in wildlife crimes. Introduction to basic analytical techniques in wildlife forensics.
<b>Section II:</b> Evidence examination: Identification of some endangered species of plants and animals, Wildlife life protection Act. Examination of pug marks, horn, antlers, skin, fur and hair, nail , teeth, wood.
<b>Section III:</b> Systematic Forensic examination and their reporting pattern: Important case studies, ethical issues in wildlife forensics, IUCN, CITES, TRAFFIC, Transnational crimes
<b>Section IV :</b> Introduction to Risk Management and its benefits

Introduction Risk Management, Risk Management in organizations and risk ownership, Risk Management standards – Benefits of Risk Management.

ISO 31000 - Elements of Risk Management: ISO 31000 overview, PDCA cycle - Elements and Purpose, Principles of Risk Management, Relationship between Principles, Framework and Process, Understanding the components of the Risk framework, Designing the Framework with Mandate and Commitment.

**Learning Experience:** Through lectures, practical exercises, and case studies, you'll gain hands-on experience in wildlife forensic techniques, including DNA analysis, ballistics, and trace evidence examination. This course equips you with the knowledge and skills needed to contribute to the conservation of wildlife and combat illegal wildlife trade.

**Textbooks:**

1. Simple Tools and Techniques for Enterprise Risk Management Author: Robert J. Chapman. Publisher: John Wiley & Sons (2011) India Risk Report - 2013 - FICCI + Pinkerton.
2. Risk Management: A Driver of Enterprise Value in the Emerging Environment -2011- KPMG ISO 31000 - Risk management— Principles and guidelines

**Suggested Readings:**

1. A corporate governance, risk management and compliance (GRC) handbook -Authors: Richard M Steinberg Publishers: John Wiley & Sons.
2. Richard Saferstein; Forensic Science Hand Book; Ed.; Prentice – Hall, Englewood Cliff, New jersey; (1982) Biology Methods manual.

**Open Educational Resources (OER)**

1. <https://oercommons.org/>
2. Khan Academy: <https://www.khanacademy.org/science/biology>
3. Coursera: <https://www.coursera.org/>
4. EdX: <https://www.edx.org/>

**Examination scheme:**

<b>Evaluation components</b>	<b>Weightage</b>
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>SCFS403</b>	Information Security Audit and Compliance	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		3	0	0	3
<b>Category of Course</b>	Major				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** This course delves into the intricate world of safeguarding sensitive information and ensuring adherence to regulatory standards. You'll gain a deep understanding of information security frameworks, risk assessment methodologies, compliance requirements, and audit techniques.

**Course Outcome:** Students will be:

1. Understanding the definition, purpose, and various types of information security audits, as well as the stages of the audit lifecycle.
2. Explaining the key regulations and standards such as GDPR, HIPAA, SOX, and PCI DSS, and their implications for information security and compliance.
3. Applying major compliance frameworks, including COBIT, ISO/IEC 27001, and the NIST Cybersecurity Framework, to develop and enforce security policies.
4. Utilizing advanced tools and technologies like AI, machine learning, and blockchain to enhance the auditing process and ensure real-time compliance.
5. Conducting comprehensive information security audits using automated continuous auditing techniques and analyze audit results to improve security practices.

<b>Course contents</b>
<b>Section I:</b> Information Security Auditing Definition and purpose, types of audits (internal, external, compliance, operational), Audit Lifecycle, Planning, Execution, Reporting, Follow-up
<b>Section II:</b> Regulations and Standards: General Data Protection Regulation (GDPR), Health Insurance Portability and Accountability Act (HIPAA), Sarbanes-Oxley Act (SOX), Payment Card Industry Data Security Standard (PCI DSS), Compliance frameworks, Industry-specific regulations
<b>Section III:</b> Compliance frameworks: COBIT (Control Objectives for Information and Related Technologies), ISO/IEC 27001, NIST (National Institute of Standards and Technology) Cybersecurity Framework, Policy creation and implementation, Policy enforcement and review

**Section IV:** Tools and technologies: AI and machine learning in auditing, Blockchain and its impact on audit trails, Real-time compliance, Analysis of real-world audit scenarios, Automated continuous auditing,

**Learning Experience:** Through lectures, hands-on exercises, and case studies, you'll develop practical skills in conducting security audits, identifying vulnerabilities, and implementing effective compliance measures. This course is designed to equip you with the knowledge and expertise needed to protect organizations from cyber threats and maintain regulatory compliance.

**Textbooks:**

1. J A Siegel, P.J Saukko (2000) Encyclopedia of Forensic Sciences Vol. I, II and III, Acad. Press.
2. Casarett & Doll Toxicology (2003) The Basic Science of poisons.
3. MaThew E. Johll (2009) Investigating Chemistry: A Forensic Science Perspective
4. JJ Fenton (2002) Toxicology A Case-Oriented Approach

**Suggested Reading:**

1. "Information Security Auditing: A Practical Guide" by Timothy J. Mason
2. "Auditing Information Systems" by James A. Hall
3. "CISA Review Manual" by ISACA

**Open Educational Resources (OER)**

1. Open Security Training (OST): <https://p.ost2.fyi/courses>
2. Cybrary: <https://www.cybrary.it/>
3. MIT OpenCourseWare: <https://ocw.mit.edu/>

**Examination scheme:**

Evaluation components	Weightage
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>

<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>SCFS405</b>	Forensic Audio and speaker identification	L	T	P	C
<b>Version1.0</b>		3	0	0	3
<b>Category of Course</b>	Major				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** This course offers a comprehensive exploration of forensic audio analysis and speaker identification. You'll learn about the principles of acoustics, signal processing techniques, and the application of these methods to various forensic scenarios. Through practical exercises and case studies, you'll develop the skills necessary to analyze audio recordings, identify speakers, and provide expert testimony in legal proceedings.

**Course Outcome:** Students will be:

1. Understanding the basic concepts and principles of forensic audio analysis, including sound recording, enhancement, and authentication.
2. Conducting speaker identification analysis using spectrographic analysis, voice comparison techniques, and other methods to determine the identity of speakers in audio recordings.
3. Analyzing audio recordings using forensic audio analysis techniques to extract relevant information and identify potential evidence.
4. Utilizing specialized software and equipment commonly used in forensic audio analysis, such as spectrographic analysis software and audio enhancement tools.
5. Understanding the legal and ethical issues related to forensic audio analysis, including the admissibility of audio evidence in court and the importance of maintaining the chain of custody.

<b>Course contents</b>
<b>Section I:</b> Introduction to Forensic Audio: Introduction to Forensic Audio, Definition and scope of forensic audio analysis, Historical development and milestones in forensic audio, Legal and ethical considerations, Basic Concepts of Sound, Properties of sound: frequency, amplitude, waveform, Sound propagation and acoustic principles, Digital audio fundamentals: sampling rate, bit depth, codecs

**Section II:** Collection and Preservation of Audio Evidence: Protocols for collecting audio evidence, Chain of custody for audio recordings, Techniques for preserving audio integrity, Audio Enhancement Techniques, Noise reduction methods, Filtering and equalization, Time-frequency analysis (spectrograms), Authentication and Analysis of Audio Recordings, detecting tampering and alterations, Identifying background noise and environmental sounds, Audio transcription and speech analysis.

**Section III:** Speaker identification: Principles of Speaker Identification, Biological and behavioral characteristics of speech, Factors affecting speaker variability, Introduction to phonetics and phonology, Methods of Speaker Identification, Auditory and acoustic analysis, Audio Recording and Equipment, Types of audio recording devices, Microphones, recorders, and playback equipment, Best practices for audio recording in forensic contexts.

**Section IV:** Automatic speaker recognition systems: Automatic speaker recognition systems, Comparative analysis techniques, Practical Applications and Case Studies, Real-world cases of forensic audio and speaker identification, Challenges and limitations in forensic audio analysis, Reporting and presenting audio evidence in court.

**Learning Experience:** Through lectures, practical exercises, and case studies, you'll gain hands-on experience with audio analysis tools and techniques. You'll learn to identify speakers, analyze audio quality, and detect alterations or manipulations. This course will foster your critical thinking and problem-solving skills, enabling you to contribute to the field of forensic audio analysis with confidence and expertise.

**Textbooks:**

1. Univaso, P. (2017). Forensic speaker identification: A tutorial. IEEE Latin America Transactions, 15(9), 1754-1770.
2. Umar, R., Riadi, I., Hanif, A., & Helmiyah, S. (2019). Identification of speaker recognition for audio forensic using k-nearest neighbor. Int. J. Sci. Technol. Res, 8(11), 3846-3850.

**Suggested Readings:**



1. Gonzalez-Rodriguez, J., Fierrez-Aguilar, J., & Ortega-Garcia, J. (2003, April). Forensic identification reporting using automatic speaker recognition systems. In 2003 IEEE International Conference on Acoustics, Speech, and Signal Processing, 2003. Proceedings. (ICASSP'03). (Vol. 2, pp. II-93). IEEE.
2. Singh, S. (2018). Forensic and Automatic Speaker Recognition System. International Journal of Electrical & Computer Engineering (2088-8708), 8(5).

### Open Educational Resources (OER)

1. Coursera: <https://www.coursera.org/courses?query=forensic>
2. MIT OpenCourseWare: <https://ocw.mit.edu/courses/audio-video-courses/>
3. Khan Academy: <https://www.khanacademy.org/test-prep>

### Examination scheme:

Evaluation components	Weightage
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>UCH107</b>	Inorganic and Physical chemistry	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		3	0	0	3
<b>Category of Course</b>	Minor				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** This paper offers a comprehensive exploration of the underlying concepts that govern chemical reactions and the properties of matter. You'll delve into the intricacies of physical chemistry, including thermodynamics, kinetics, and quantum mechanics, and gain a solid understanding of organic chemistry, focusing on the structure, properties, and reactions of carbon-containing compounds.

**Course Outcome:** Students will be:

1. Understanding crystal field effects in octahedral and tetrahedral symmetries.
2. Explaining the wave-particle duality and its connection to spectroscopy.
3. Analyzing IR spectra of diatomic molecules and interpreting vibrational spectra for polyatomic molecules.
4. Describing the quantization of rotational energy levels.
5. Applying the laws of photochemistry.

<b>Course contents</b>
<b>Section I:</b> Crystal Field Theory: Crystal field effect, octahedral symmetry. Crystal field stabilization energy (CFSE), Crystal field effects for weak and strong fields. Tetrahedral symmetry. Factors affecting the magnitude of D. Spectrochemical series. Comparison of CFSE for Oh and Td complexes, Tetragonal distortion of octahedral geometry. Jahn-Teller distortion, Square planar coordination
<b>Section II:</b> Quantum Chemistry: Waveparticle duality. Link between spectroscopy and quantum chemistry. Electromagnetic radiation and its interaction with matter. Born- Oppenheimer approximation: Separation of molecular energies into translational, rotational, Vibrational And Electronic Components.

**Section III:** Rotational Motion: Schrödinger equation of a rigid rotator and brief discussion of its results (solution not required). Quantization of rotational energy levels. Microwave (pure rotational) spectra of diatomic molecules. Selection rules. Structural information derived from rotational spectroscopy. Vibrational Motion: Schrödinger equation of a linear harmonic oscillator and brief discussion of its results (solution not required). Quantization of vibrational energy levels. Selection rules, IR spectra of diatomic molecules. Structural information derived from vibrational spectra. Vibrations of polyatomic molecules.

**Section IV:** Photochemistry: Laws of photochemistry, Lambert-Beer's law. Fluorescence and phosphorescence. Quantum efficiency and reasons for high and low quantum yields. Primary and secondary processes in photochemical reactions. Photochemical and thermal reactions. Photoelectric cells.

### **Learning Experience:**

Through a combination of lectures, laboratory experiments, and problem-solving exercises, you'll develop a strong foundation in chemical principles and learn to apply them to real-world scenarios. You'll also have the opportunity to work on projects and collaborate with peers, fostering critical thinking and problem-solving skills.

### **Textbooks:**

1. Allied Chemistry – Prof. Mathur and others.
2. Elements of Properties of Matter – D.S. Mathur, S. Chand & Co. (1999).
3. Modern Chemistry – S. Chand & Co. (2006).
4. Electronic Principles and Applications – A.B. Bhattacharya, New Central Book Agency, Calcutta.
5. Introduction to Fiber optics by K. Thyagarajan and Ajay Ghatak, Cambridge, University Press(1999).

### **Suggested Readings:**

1. Physical Chemistry: Atkins & de Paula, "Physical Chemistry"
2. Organic Chemistry: Wade, "Organic Chemistry"

### **Open Educational Resources (OER):**

1. OpenStax: <https://openstax.org/details/books/chemistry-2e/>
2. LibreTexts: <https://chem.libretexts.org/>
3. Khan Academy: <https://www.khanacademy.org/science/chemistry>

**Examination scheme:**

<b>Evaluation components</b>	<b>Weightage</b>
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>SCFS409</b>	Technology in Research	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version 1.0</b>		2	0	0	2
<b>Category of Course</b>	Skill Enhancement Course				
<b>Total Contact Hours</b>	30				
<b>Pre-Requisites/Co Requisites</b>	-				

**Course Perspective :** This course equips students with essential tools and techniques for conducting scientific research. It covers the systematic process of identifying a problem, formulating a hypothesis, collecting data, and analyzing results. By understanding various research designs, methods of data collection, and statistical analysis, students develop the ability to critically evaluate existing research and contribute original findings. The course emphasizes ethical considerations, ensuring that research is conducted with integrity and responsibility.

**Course Outcomes** Upon completion of this course, the learner will be able to:

1. Explain how various technologies enhance data collection, analysis, and collaboration in research, demonstrating an understanding of their impact on the research process.
2. Applying the effectiveness of different technological tools in optimizing various stages of the research process, evaluating their impact on data quality and research outcomes.
3. Analyzing various technological tools and methods to design and conduct research projects, effectively integrating technology into their research workflows.
4. Critically evaluating the strengths and limitations of different technological approaches in research, assessing their suitability for specific research objectives and contexts.
5. Designing and developing innovative research methodologies by integrating advanced technological tools, creating novel approaches to address complex research questions.

<b>Course contents</b>
Unit I Introduction to Technology in Research: Overview of Technology's Role in Research: Historical perspective, current trends, and future directions; Types of Research Technologies: Data collection tools (e.g., surveys, sensors), data management systems, and analysis software; Ethical and Practical Considerations: Data privacy, security, and responsible use of technology.
Unit II: Data Collection and Management: Advanced Data Collection Methods: Digital surveys, remote sensing, IoT devices; Data Storage Solutions: Cloud computing, databases, and data

warehousing; Data Quality and Integrity: Techniques for ensuring accurate and reliable data collection.

Unit III: Data Analysis and Visualization: Analytical Tools and Techniques: Statistical software, machine learning algorithms, and AI applications; Data Visualization: Tools and methods for creating effective charts, graphs, and interactive visualizations; Interpreting and Presenting Data: Techniques for making data-driven decisions and communicating findings.

Unit IV: Innovation and Application in Research: Emerging Technologies: Blockchain, augmented reality (AR), virtual reality (VR) in research; Developing and Implementing Technological Solutions: Designing research methodologies and tools using advanced technology; Case Studies and Practical Applications: Real-world examples of technology applied in various research fields and hands-on project development.

**Learning Experience:** This course will be conducted through a mix of interactive lectures, hands-on workshops, and real-world case studies to ensure experiential learning. Students will explore the role of technology in research, learning to use advanced tools for data collection, management, and analysis. Practical sessions will involve using statistical software, AI applications, and data visualization techniques, allowing students to apply these tools to real research scenarios. The course will also include group discussions, collaborative projects, and case studies, fostering participatory learning and innovation in applying emerging technologies like blockchain and AR/VR in research.

### **Textbooks**

1. "Research Design: Qualitative, Quantitative, and Mixed Methods Approaches" by John W. Creswell – This book provides a comprehensive overview of research methodologies, including historical perspectives and trends in research technology.
2. "The Handbook of Research on Educational Communications and Technology" edited by J. Michael Spector, M. David Merrill, Jan Elen, and M.J. Bishop – Covers technology's role in research, current trends, and future directions across disciplines.
3. "Technology in Research: Methods, Tools, and Strategies" by Brian M. Slator – Offers insights into various research technologies and the ethical issues surrounding them.

### **Suggested Readings**

1. "Historical Perspectives and Future Directions in Research Technologies" by Klaus Schwab – Provides a discussion on how technology has evolved in research and its future potential.

2. "Ethical Considerations in Research Technology" by Annette Markham and Elizabeth Buchanan –  
Focuses on ethical challenges such as data privacy and the responsible use of emerging technologies

**Examination scheme:**

<b>Evaluation components</b>	<b>Weightage</b>
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>SCFS411</b>	Research Ethics and Report Writing	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version 1.0</b>		2	0	0	2
<b>Category of Course</b>	Skill Enhancement Course				
<b>Total Contact Hours</b>	30				
<b>Pre-Requisites/ Requisites</b>	<b>Co-</b>				

### Course Perspective

Research Methodology equips students with essential tools and techniques for conducting scientific research. It covers the systematic process of identifying a problem, formulating a hypothesis, collecting data, and analyzing results. By understanding various research designs, methods of data collection, and statistical analysis, students develop the ability to critically evaluate existing research and contribute original findings. The course emphasizes ethical considerations, ensuring that research is conducted with integrity and responsibility. Ultimately, Research Methodology fosters a deeper understanding of the scientific process, enabling students to approach problems methodically and contribute to academic and professional knowledge.

### Course Outcomes

Upon completion of the Research Methodology course, the learner will be able to:

1. Defining key concepts in research ethics and recalling significant ethical guidelines.
2. Explaining core ethical principles and describing the role of Institutional Review Boards (IRBs).
3. Analyzing ethical principles in research design and utilizing proper citation techniques.
4. Analyzing ethical dilemmas in research case studies and breaking down the structure of research reports.
5. Critiquing research proposals for ethical integrity and assessing data management practices.
6. Developing ethically sound research proposals and composing well-structured research reports.

<b>Course contents</b>
Unit 1: Introduction to Research Ethics: Definition and importance of research ethics, Historical perspectives on research ethics, Core ethical principles: autonomy, beneficence, non-maleficence, and justice, Ethical issues in various research contexts
Unit 2: Ethical Issues in Research Design and Data Management: Informed consent, confidentiality,



and privacy, Ethical considerations in qualitative vs. quantitative research, Role and function of Institutional Review Boards (IRBs) , Ethical data management: collection, storage, and sharing, Avoiding research misconduct: fabrication, falsification, and plagiarism, Authorship and intellectual property rights
Unit 3: Research Proposal Writing and Report Structuring: Components of a research proposal: Ethical considerations in proposal writing, Structuring a research report: Introduction, Literature Review, Methodology, Results, Discussion, Conclusion, Language, tone, and style in academic writing.
Unit 4: Citation, Peer Review, and Presentation of Research: Importance of proper citation and common citation styles (APA, MLA, Chicago), Avoiding plagiarism through correct attribution, Understanding the peer review process, Techniques for self-editing and revising research reports, Preparing and presenting research findings, Ethical issues in presenting research: avoiding bias and misrepresentation, Case studies in research ethics: group discussions and analysis

### **Learning Experience**

This course will be conducted through interactive lectures, discussions, and case studies, making the learning process experiential and participatory. Students will engage in real-world scenarios to understand ethical issues, participate in group discussions to explore research dilemmas, and work on writing exercises to develop research proposals and reports. Hands-on activities like peer reviews and presentations will allow students to apply ethical principles in research design, data management, and academic writing. The course emphasizes active learning through debates, case study analysis, and collaborative projects.

### **Textbooks and Readings:**

1. "Research Ethics: A Reader" by David B. Resnik
2. "The Craft of Research" by Wayne C. Booth, Gregory G. Colomb, and Joseph M. Williams
3. Selected journal articles and case studies provided by the instructor

### **Examination scheme:**

<b>Evaluation components</b>	<b>Weightage</b>

<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>UCH157</b>	Practical Chemistry-VII	L	T	P	C
<b>Version1.0</b>		0	0	4	2
<b>Category of Course</b>	Practical (Minor)				
<b>Total Contact Hours</b>	30 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** Chemistry Practical VII provides a comprehensive exploration of molecular and spectroscopic techniques, crucial for understanding the electronic structure, transitions, and bonding in both simple and complex molecules. By investigating phenomena such as d-orbital splitting, rotational and vibrational spectra, and electronic transitions, students will delve into the core principles of coordination chemistry, quantum mechanics, and molecular spectroscopy. The course emphasizes the practical application of these techniques, bridging theoretical concepts with experimental observations, and is vital for fields like chemical analysis, materials science, and molecular physics.

**Course Outcome:** Students will be:

1. Understanding UV-Vis, microwave, and IR spectroscopy to study molecular structures, transitions, and bonding in complexes and diatomic molecules.
2. Analysing ligand field effects, calculate CFSE, and examine spectra to deduce molecular geometry and bonding.
3. Analyzing quantum mechanics, including the Born-Oppenheimer approximation, to explain electronic transitions and molecular motion.
4. Performing quantitative analysis using Lambert-Beer's law and distinguish fluorescence from phosphorescence through emission spectra.
5. Interpreting rotational and vibrational spectra to determine bond lengths, rotational constants, and electronic configurations.

### Course contents

1. To calculate CFSE for metal complexes in octahedral and tetrahedral geometries using UV-Vis spectroscopy.
2. To explore the effect of weak and strong field ligands on metal d-orbital splitting.
3. To observe molecular electronic transitions and understand how the Born-Oppenheimer approximation separates electronic and nuclear motion.
4. To study the rotational spectra of diatomic molecules using microwave spectroscopy.

5. To measure the pure rotational spectra of diatomic molecules and interpret the results.
6. To record and interpret the IR spectra of diatomic and polyatomic molecules.
7. To study the absorption of light by solutions at different concentrations and verify Lambert-Beer's law.
8. To differentiate between fluorescence and phosphorescence by studying emission spectra of organic molecules.

### Learning Experience:

Through hands-on experiments using UV-Vis, microwave, and infrared spectroscopy, students will gain practical skills in calculating crystal field stabilization energy (CFSE), analyzing ligand field effects, and interpreting molecular spectra. They will engage with real-world applications of the Born-Oppenheimer approximation and Lambert-Beer's law, while also distinguishing between fluorescence and phosphorescence. By measuring and interpreting rotational and vibrational spectra, students will develop a robust understanding of molecular structure, transitions, and the interaction of light with matter, preparing them for advanced research and analytical roles in chemistry and physics.

### Text and References:

1. Cotton, F.A., Wilkinson, G., Advanced Inorganic Chemistry, Wiley.
2. Atkins, P., de Paula, J., Physical Chemistry, Oxford University Press.
3. Banwell, C. N., McCash, E. M., Fundamentals of Molecular Spectroscopy, McGraw-Hill.
4. Graybeal, J.D., Molecular Spectroscopy, McGraw-Hill.
5. Wayne, R. P., Principles and Applications of Photochemistry, Oxford University Press.

### Open Educational Resources:

1. Khan Academy
2. MIT OpenCourseWare - Chemical Equilibrium
3. ChemCollective - Virtual Lab

### Examination Scheme:

Evaluation components	Weightage
<b>Internal marks (practical)</b> I. Conduct of experiment II. Lab Record III. Lab Participation IV. Lab Project	<b>10 Marks</b> <b>10 Marks</b> <b>10 Marks</b> <b>20 Marks</b>

<b>II. External Marks (practical)</b> End Term Examination	<b>50 Marks</b>
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<b>SEC084</b>	Forensic Practical VII	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		0	0	2	1
<b>Category of Course</b>	Practical (Major)				
<b>Total Contact Hours</b>	30 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** This course provides a comprehensive understanding of the chemical analysis techniques used in forensic science, focusing on the identification and examination of dyes, pigments, polymers, oils, fats, and various consumer products. It emphasizes practical skills in detecting poisons and toxic substances, particularly through the analysis of metallic poisons and the extraction of toxins from viscera. By integrating theoretical knowledge with hands-on laboratory work, the course equips students with essential forensic skills for real-world applications.

**Course Outcome:** Students will be:

1. Understanding the principles and techniques used in the analysis of dyes, pigments, and polymers, with a focus on their forensic applications.
2. Applying oils and fats through forensic methods to determine their composition and identify adulteration or contamination.
3. Analyzing forensic techniques to the analysis of chemical fertilizers and various consumer items such as gold, silver, tobacco, tea, sugar, and salts, ensuring the detection of fraud or quality deviations.
4. Performing the Reinsch Test to detect the presence of metallic poisons, and assess the forensic significance of such findings in toxicological investigations.
5. Interpreting the processes involved in the extraction and analysis of different categories of poisons from viscera, using appropriate forensic techniques for identifying toxic substances.

### **Course contents**

1. Analysis of Dyes, Pigments & Polymers
2. Forensic analysis of oils and fats
3. Analysis of chemical fertilizers, consumer items such as gold, silver, tobacco, tea, sugar, salts
4. Detection of metallic poisons using Reinsch Test.
5. Extraction and analysis of different categories of poisons from viscera.

**Learning Experience:** In this course, students will analyze dyes, pigments, polymers, oils, and fats, and test consumer items like gold, silver, and fertilizers. They will also perform the Reinsch Test for metallic poisons and learn to extract and analyze poisons from viscera, gaining hands-on forensic experience.

**Textbook:**

1. "Forensic Chemistry" by Suzanne Bell.
2. "Introduction to Forensic Chemistry" by Kelly M. Elkins
3. "Forensic Science: An Introduction to Scientific and Investigative Techniques" by Stuart H. James and Jon J. Nordby
4. "Principles of Instrumental Analysis" by Douglas A. Skoog, F. James Holler, and Stanley R. Crouch
5. "Clark's Analysis of Drugs and Poisons" by Anthony C. Moffat, M. David Osselson, and Brian Widdop

**Suggested Readings:**

1. "Forensic Toxicology: Principles and Concepts" by Nicholas T. Lappas and Courtney M. Lappas
2. "Essentials of Forensic Medicine and Toxicology" by K. S. Narayan Reddy
3. "Chemistry and Crime: From Sherlock Holmes to Today's Courtroom" by Samuel M. Gerber

**Open Educational Resources:**

1. <https://www.aafs.org/>
2. <https://www.asclld.org/>
3. <https://nij.ojp.gov/>
4. <https://nij.ojp.gov/>

**Examination Scheme:**

Evaluation components	Weightage
<b>Internal marks (practical)</b> I. Conduct of experiment II. Lab Record III. Lab Participation IV. Lab Project	<b>10 Marks</b> <b>10 Marks</b> <b>10 Marks</b> <b>20 Marks</b>
<b>II. External Marks (practical)</b> End Term Examination	<b>50 Marks</b>

### **EIGHTH SEMESTER [For BSc (H.) Forensic Science]**

<b>SCFS402</b>	Forensics Genomics and DNA Profiling	L	T	P	C
<b>Version1.0</b>		4	0	0	4
<b>Category of Course</b>	Major				
<b>Total Contact Hours</b>	60 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** This course delves into the intricate world of human genetics and forensic DNA analysis. You'll gain a deep understanding of the fundamental concepts of genetics, DNA profiling techniques, statistical analysis, and the legal and ethical implications of DNA databasing.

**Course Outcome:** Students will be:

1. Demonstrating a thorough understanding of human genetics and related concepts such as heredity, alleles, mutations, and population genetics.
2. Explaining the molecular biology principles and historical development underlying DNA profiling techniques.
3. Comparing and contrast various DNA extraction methods and conduct DNA typing using techniques like RFLP, PCR, and SNP analysis.
4. Applying DNA statistical methods to estimate allele frequencies and interpret forensic results, including paternity/maternity and sibling indices.
5. Critically evaluating the Human Genome Project, its goals, benefits, and the ethical, legal, and social issues it raises, and understand the forensic applications and legal standards of DNA profiling.

<b>Course contents</b>
<b>Section I:</b> Human genetics Human Genetics, Heredity, Alleles, Mutations and Population Genetics, The concept of Genetics polymorphism, Hardy-Weinberg Law
<b>Section II:</b> DNA profiling- Introduction, History of DNA Typing, molecular biology of DNA, variations, polymorphism, DNA Extraction-Organic and Inorganic extraction, Comparison of Extraction methods, Commercial kits, DNA typing systems- RFLP analysis, PCR amplifications, sequence polymorphism.



Analysis of SNP, YSTR, Mitochondrial DNA, Ancient DNA typing, Evaluation of results, New and future technologies: DNA chips, SNPs and limitations of DNA profiling.

**Section III:** DNA Statistics: frequency estimate calculations, interpretations, allele frequency determination, Paternity/Maternity index, Sibling index, Probability of match. Human Genome Project: Introduction, History, Goals, Benefits, Social, Ethical and Legal Issues, DNA Forensic Databases, Ethical, Legal, and Social Issues Associated with DNA Databanking, Potential Benefits of DNA Data banking. Quality control, certification and accreditation.

**Section IV:** Forensic Significance of DNA profiling: Applications in disputed paternity cases, child swapping, missing person's identity- civil immigration, veterinary, wildlife and agriculture cases, legal

Perspectives- legal standards for admissibility of DNA profiling, procedural and ethical concerns, status of development of DNA profiling in India and abroad.

**Learning Experience:** Through lectures, practical exercises, and case studies, you'll gain a comprehensive understanding of how DNA is used in various fields, from criminal investigations to paternity testing. This course is designed to equip you with the knowledge and skills needed to contribute to the advancement of forensic science and the ethical use of DNA technology.

**Textbooks:**

1. Saferstein, R. (1982) Science Handbook, Vol. I, II, & III, Prentice Hall New Jersey.
2. Kirby : DNA Fingerprinting Technology.
3. DNA structure and functions by Richard R. Sinden; Academic Press, Inc. 1994.
4. DNA Profiling and DNA fingerprinting (1999) Edited by Jorg T. Epplen and Thomas Lubjuhn; Birkhauser Verlag, Switzerland.

**Suggested Readings:**

1. Forensic DNA Profiling Protocols (1998) Patrick J. Lincoln and Jim Thomson; Humana Press, Inc.
2. DNA and other Polymorphism in Forensic Science (1990) Henry C. Lee and R.E. Gaensslen; Year book Medical Publishers, Inc.
3. Keith In man and Norah Rudin (1997) An Introduction to Forensic DNA Analysis, CRC Press; Ny.

4. John M. Butler (2005) Forensic DNA Typing: Biology, Technology, and Genetics of STR Markers Academic Press.

### Open Educational Resources (OER)

1. <https://dnalc.cshl.edu/>
2. <https://oercommons.org/>
3. <https://ocw.mit.edu/>
4. <https://www.coursera.org/>
5. <https://www.edx.org/>

### Examination scheme:

Evaluation components	Weightage
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>UCH108</b>	Analytical chemistry II	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		3	0	0	3
<b>Category of Course</b>	Minor				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** This course delves into the intricacies of physical and organic chemistry, focusing on advanced spectroscopic techniques and the assessment of chemical hazards. You'll gain a deep understanding of photoelectron spectroscopy, Mossbauer spectroscopy, X-ray diffraction, and the various hazards encountered in chemical environments. Through theoretical concepts and practical applications, you'll develop a strong foundation in these essential areas of chemistry.

**Course Outcome:** Students will be:

1. Understanding the principles of photoelectron spectroscopy.
2. Explaining the Mössbauer effect and its related phenomena.
3. Analyzing the Bragg condition, Miller indices, and various X-ray diffraction techniques to evaluate crystal structures.
4. Recognizing and assessing physical hazards, including noise and ionizing/non-ionizing radiation.
5. Evaluating the properties, exposure limits, and control measures associated with chemical hazards.

<b>Course contents</b>
<b>Section I:</b> Photoelectron Spectroscopy: Basic principles; photo-electric effect, ionization process, Koopman's theorem. Photoelectron spectra of simple molecules, ESCA, chemical information from ESCA. Auger electron spectroscopy –basic idea. Photoacoustic Spectroscopy. Basic principles of photoacoustic spectroscopy (PAS), chemical and surface applications
<b>Section II:</b> Mossbauer spectroscopy - Mossbauer effect, recoilless emission and absorption, hyperfine interaction, chemical isomer shift, magnetic hyperfine and quadruple interaction, Application of the technique to the studies of (1) bonding and structures of Fe+2 and Fe+3 compounds including those of intermediate spin, (2) Sn+2 and Sn+4 compounds and (3) detection of oxidation state

**Section III:** X-ray Diffraction. Bragg condition, Miller indices, Laue method, Bragg method, Debye-Scherrer method of X-ray structural analysis of crystals, index reflections, identification of Unit cells from systematic absences in diffraction pattern. Structure of simple lattices and X-ray intensities, structure factor and its relation to intensity and electron density. Description of the procedure for an X-ray structure analysis.

**Section IV:** Physical and Chemical Hazards: Noise, noise exposure regulation, properties of sound, occupational damage, risk factors, v sound measuring instruments, permissible exposure limit. Ionizing radiation, types, effects, monitoring instruments, control programs, OSHA standard- non-ionizing radiations, effects, types, radar hazards, microwaves and radio-waves, lasers, TLV- cold environments, hypothermia, wind chill index, control measureshot environments, thermal comfort, heat stress indices, acclimatization, estimation and control. Recognition of chemical hazards-dust, fumes, mist,Air Sampling instruments, Types, Measurement Procedures.

**Learning Experience:** Through a combination of lectures, laboratory experiments, and case studies, you'll gain hands-on experience with spectroscopic techniques and learn how to identify, evaluate, and mitigate chemical hazards. You'll also develop critical thinking and problem-solving skills as you analyze data and interpret results. This course will equip you with the knowledge and skills needed for a successful career in chemistry or related fields.

**Textbooks:**

1. Allied Chemistry – Prof. Mathur and others.
2. Elements of Properties of Matter – D.S. Mathur, S. Chand & Co. (1999).
3. Modern Chemistry – S. Chand & Co. (2006).
4. Electronic Principles and Applications – A.B. Bhattacharya, New Central Book Agency, Calcutta.
5. Introduction to Fiber optics by K. Thyagarajan and Ajay Ghatak, Cambridge, University Press(1999).

**Suggested Readings:**

1. Physical Chemistry: Atkins, P. W. (2010). Physical Chemistry. Oxford University Press.
2. Spectroscopy: Skoog, D. A., West, D. M., Holler, J. F., & Crouch, S. R. (2014). Fundamentals of Analytical Chemistry. Cengage Learning.
3. Organic Chemistry: Wade, L. G. (2015). Organic Chemistry. Pearson Education.

**Open Educational Resources (OER):**

1. Khan Academy: <https://www.khanacademy.org/science/chemistry>
2. MIT OpenCourseWare: <https://ocw.mit.edu/courses/chemistry/>
3. Coursera: <https://www.coursera.org/>
4. EdX: <https://www.edx.org/>

**Examination scheme:**

Evaluation components	Weightage
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>SCFS404</b>	Forensic Nursing	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		4	0	0	4
<b>Category of Course</b>	Major				
<b>Total Contact Hours</b>	60 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** A forensic nursing course provides a unique blend of nursing and legal knowledge. It equips students to understand the intersection of healthcare and the justice system, enabling them to provide specialized care to victims of crime and violence. The course delves into the application of nursing principles in forensic investigations, including evidence collection, patient assessment, and legal testimony.

**Course Outcome:** Students will be:

1. Understanding the history, scope, and ethical responsibilities of forensic nursing, including the roles and regulations set by the Indian Nursing Council (INC) and State Nursing Councils (SNC).
2. Applying the physical, psychosocial, cultural, and legal aspects of forensic nursing care for victims of violence, ensuring patient rights and confidentiality are upheld.
3. Analyzing trauma-informed care principles in various forensic nursing situations, such as domestic violence cases, sexual assault examinations, and death investigations.
4. Performing tasks related to the recognition, collection, preservation, and documentation of forensic evidence, ensuring proper handling and forwarding of biological samples for forensic examination.
5. Interpreting real-world forensic nursing cases to assess the effectiveness of evidence preservation, care strategies, and the legal role of nurses in complex forensic scenarios.

<b>Course contents</b>
<b>Section I:</b> Introduction to Forensic nursing Definition, History and development, Scope - setting of practice, areas of practice and subspecialties, Ethical issues, Roles and responsibilities of nurse, INC & SNC Acts

<p><b>Section II:</b> Comprehensive forensic nursing care of victim and family</p> <p>Physical aspects, Psychosocial aspects, Cultural and spiritual aspects, Legal aspects, Assist forensic team in care beyond scope of her practice, Admission and discharge/referral/death of victim of violence, Responsibilities of nurse as a witness, Patient rights and confidentiality</p>
<p><b>Section III:</b> Role of nurses in different cases:</p> <p>Trauma-Informed Care, Principles and practices, Strategies for supporting victims, Sexual Assault Nurse Examiner (SANE), Identification and assessment of domestic violence, role of forensic nurse in death investigations (natural, accidental, suicide, homicide), autopsy assistance, role in disaster response, mass fatality management</p>
<p><b>Section IV:</b> Evidence preservation- role of nurses, Observation , Recognition, Collection, Preservation, Documentation of Biological and other evidence related to criminal/traumatic event, Forwarding biological samples for forensic examination, Analysis of real-world forensic nursing cases</p>

**Learning Experience:** Students can expect a dynamic and engaging **Learning Experience** that combines theoretical knowledge with practical skills. Through classroom lectures, case studies, simulations, and potential clinical placements, students will develop a deep understanding of forensic nursing concepts and their real-world applications. They will also learn about the ethical considerations and legal implications of their role as forensic nurses.

#### **Textbooks:**

1. Panchali Pal; Introduction to Forensic Nursing And Indian Laws; Vision Health Publishers.
2. Raman Kalia, Monaliza, Introduction to Forensic Nursing And Indian Laws; Lotus Publication
3. J Magendran, Manisha Praharaj; Essentials of Forensic Nursing and Indian Laws; CBS Publishers

#### **Suggested Readings:**

1. Dr. Hitesh Chawla; Textbook Of Forensic Nursing & Indian Laws For B.Sc Nursing Students; Saurabh Medical Publishers
2. Gautam Biswas; Fundamentals of Forensic Nursing & Introduction to Laws; Jaypee Publishers

#### **Open Educational Resources (OER)**

1. <https://oercommons.org/>

2. National Institutes of Justice: <https://www.ojp.gov/>
3. American Nurses Association: <https://www.nursingworld.org/>

**Examination scheme:**

<b>Evaluation components</b>	<b>Weightage</b>
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>



<b>SCFS406</b>	Forensic Odontology	L	T	P	C
<b>Version1.0</b>		4	0	0	4
<b>Category of Course</b>	Major				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** This course offers a deep dive into the applications of dental science in forensic investigations. Students will gain practical knowledge about identifying individuals based on dental records, analysing bite marks in violent crimes, estimating age in living and deceased individuals, and handling dental evidence in mass disasters. The course equips students with the scientific, ethical, and analytical skills necessary for working as forensic odontologists or in related forensic roles. It also provides insight into the medico-legal challenges and evidentiary importance of dental science in the legal field.

**Course Outcome:** Students will be:

1. Understanding the role of forensic odontology in human identification, including teeth development and dental records.
2. Analysing bite marks and determine their significance in criminal investigations.
3. Analyzing techniques for age estimation and identification in forensic cases.
4. Assessing and comparing dental evidence in mass disaster situations and individual cases.
5. Critically evaluating the role of forensic odontologists in criminal justice and ethical issues surrounding forensic dental practices.

<b>Course contents</b>
<p><b>Section I:</b> Introduction to Forensic Odontology- Definition and Scope of Forensic Odontology, Role of Forensic Odontologists in Legal Investigations, History and Development of Forensic Odontology, Human Dentition and Dental Anatomy, Types of teeth (primary vs permanent), Structure of teeth (enamel, dentin, pulp, etc.), Developmental and Morphological Differences in Teeth</p>
<p><b>Section II:</b> Dental Identification and Record Keeping- Dental Identification in Forensic Investigations, Importance of dental records in human identification, Comparing ante-mortem and post-mortem dental records, Methods of Dental Record Collection, Radiographs, charts, and dental</p>

casts, Dental Evidence in Disaster Victim Identification (DVI), Mass disasters, fire cases, plane crashes, etc., Palatal Rugoscopy and Cheiloscopy (Lip Prints) in Identification.

**Section III:** Bite Mark Analysis and Age Estimation- Bite Mark Analysis, Anatomy of bite marks, Collection, preservation, and analysis of bite mark evidence, Controversies and limitations of bite mark evidence in court, Comparison of Bite Marks to Suspect's Dental Profile, Digital methods for bite mark analysis, Age Estimation from Teeth, Eruption patterns and teeth development in different age groups, Gustafson's Method for age estimation in adults, Using cementum and dentin for age estimation

**Section IV:** Legal and Ethical Issues in Forensic Odontology- Legal Responsibilities of Forensic Odontologists, Role in court as an expert witness, Admissibility of dental evidence in courts(Daubert standards), Ethical Issues in Forensic Odontology, Ethical standards and guidelines for forensic odontologists, Privacy concerns in using dental records, Challenges in Forensic Dental Evidence, Limitations and reliability of dental identification, Future of forensic odontology (advancements in technology)

**Learning Experience:** Students will engage in practical experiences that encompass dental identification techniques, including the analysis of ante-mortem and post-mortem records, and the collection and preservation of bite mark evidence. They will gain insights into the challenges and controversies surrounding bite mark analysis, while also applying digital methods for evidence comparison. Through case studies, students will explore the ethical and legal responsibilities of forensic odontologists, understanding their role as expert witnesses and the standards for admissibility of dental evidence in court.

**Textbooks and References:**

1. Forensic Odontology by Derek H. Clark
2. Manual of Forensic Odontology by Senn and Weems
3. Dental Evidence: A Guide for Forensic Investigators by David R. Senn
4. Textbook of Forensic Odontology by Ashith B. Acharya

**Examination scheme:**

Evaluation components	Weightage

<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>SCFS408</b>	Food Adulteration	L	T	P	C
<b>Version1.0</b>		4	0	0	4
<b>Category of Course</b>	Major				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** This course provides a comprehensive overview of food adulteration, additives, and safety regulations, highlighting the importance of understanding adulteration and its effects on human health. The course is designed to explore the types, methods, and forensic significance of adulterants in various food items. By studying additives and food safety regulations, students will gain insights into the legal framework and scientific techniques for ensuring food quality and safety, which is critical for public health and forensic investigations.

**Course Outcome:** Students will be:

1. Understanding the types, methods, and forensic significance of adulteration in food items and their harmful effects on human health.
2. Applying knowledge of food additives, including preservatives, colorants, and flavor enhancers, to assess their role and impact on food quality and safety.
3. Analyzing food safety laws and regulations, such as the Food Safety and Standards Act (FSSA), to evaluate compliance in food businesses and packaging standards.
4. Evaluating the qualitative and quantitative detection of adulterants in edibles using color tests, chromatographic, and spectrophotometric techniques.
5. Creating interpretations of food analysis results to ensure food safety and quality, while adhering to legal standards and public health guidelines.

<b>Course contents</b>
<b>Section I:</b> Food and Adulteration- Introduction to adulteration in edibles, Definition and types of adulteration, common adulterants in different edible items, Cheap substitutes, spoiled parts. Means of adulteration, Adulterants in the following food articles: Milk, Oil, Grain, Sugar, Spices and condiments, Processed food, Fruits and vegetables, Effects and side-effects of adulteration, and its forensic significance.

**Section II:** Additives- Introduction to additives, types of additives: nature and characteristics and use of additives in food such as antioxidants, chelating agents, colouring agents, curing agents, emulsions, flavours and flavour enhancers, flour improvers, humectants and anti-caking agents, nutrient supplements, non-nutritive sweeteners, pH control agents, stabilizers and thickeners. Raising agents – types and their role in food processing., artificial colours, Artificial flavours, FDA guidelines, preservatives-permitted and non-permitted, colours and other chemicals used in edible items and their harmful effects. General Impact of additives on Human Health

**Section III:** Examination of Adulteration in edibles Evaluation of quality and assessment of edibles like milk and milk products, fruits and vegetables, beverages, freshly prepared food, cereals and pulses, Detection and instrumental analysis both qualitative and quantitative methods for detection and examination of various adulterants in edible items i.e. colour tests, chromatographic and spectrophotometric techniques.

**Section IV:** Food Safety acts- Prevention of Food Adulteration Act 1954. Food Safety and Standards Act 2006 (FSSA): Provisions under FSSA, Food Safety and Standards (Licensing and Registration of Food Businesses) Regulation, 2011, Food Safety and Standards (Packaging and Labelling) Regulation, 2011, Food Safety and Standards (Laboratory and Sampling Analysis) Regulation, 2011, Food Safety and Standards (Food Product Standards and Food Additives) Regulation, 2011. Section 272 and 273 IPC. Role of voluntary agencies: Agmark, I.S.I.

**Learning Experience:** Students will engage with practical examples of food adulteration, learning to identify common adulterants and their harmful effects through both theoretical knowledge and hands-on detection techniques. They will explore the role of food additives and their impact on health, applying analytical methods like chromatography and spectrophotometry to evaluate food quality. Additionally, students will become familiar with food safety laws and regulations, equipping them to assess food safety standards and contribute to food quality assurance in various industries.

#### **Textbooks and References:**

1. H.D. Belitz: Food chemistry, Springer, 1999.
2. R.J. Taylor: Food Additives, Wiley–Blackwell, 1980
3. Patricia and Curtis A, An operational Text Book, Guide to Food Laws and Regulations, Wiley-Blackwell, 2005)
4. The Food Safety and Standards act, 2006 along with Rules & Regulations 2011

**Examination scheme:**

<b>Evaluation components</b>	<b>Weightage</b>
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>UCH158</b>	Practical Chemistry-VIII	L	T	P	C
<b>Version1.0</b>		0	0	2	1
<b>Category of Course</b>	Practical (Minor)				
<b>Total Contact Hours</b>	30 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** Chemistry practical VIII introduces students to ionization mechanisms and the concept of core electron binding energy in molecules. The experiment aids in understanding how electrons interact with the nucleus and the ionization potential of atoms.

**Course Outcome:** Students will be:

1. Understanding the proficiency in the operation of instruments used in photoelectron, Mössbauer, and X-ray diffraction spectroscopy.
2. Recognizing physical and chemical hazards, including noise and radiation exposure, and employing appropriate monitoring and control measures.
3. Analysing safety standards and guidelines to reduce occupational risks associated with noise, ionizing and non-ionizing radiation, and chemical agents in laboratory and industrial settings.
4. Analysing and interpreting spectral data to identify molecular structures and bonding characteristics.
5. Evaluating chemical and surface properties using photoacoustic and Auger electron spectroscopy.

#### **Course contents**

1. Study ionization processes and measure the binding energy of core electrons in simple molecules.
2. Study the principles of PAS and analyze surface properties of solids.
3. Determine chemical states of elements and surface composition.
4. Analyze surface composition using AES.
5. Study hyperfine interactions and bonding in iron compounds.
6. Detect oxidation states and bonding characteristics in tin compounds.
7. Use XRD to determine the structure of simple crystals.
8. Conduct X-ray structural analysis using the Debye-Scherrer method.
9. Calculate structure factors and their relation to intensity and electron density
10. Monitor ionizing and non-ionizing radiation levels using dosimeters and other instruments.

**Learning Experience:**

Students gain hands-on experience in analyzing electron binding energy using spectrometric methods, enhancing their knowledge of molecular structure and electron dynamics.

**Text and References:**

1. Cotton, F.A., Wilkinson, G., Advanced Inorganic Chemistry, Wiley.
2. Atkins, P., de Paula, J., Physical Chemistry, Oxford University Press.
3. Banwell, C. N., McCash, E. M., Fundamentals of Molecular Spectroscopy, McGraw-Hill.
4. Graybeal, J.D., Molecular Spectroscopy, McGraw-Hill.
5. Wayne, R. P., Principles and Applications of Photochemistry, Oxford University Press.

**Examination Scheme:**

Evaluation components	Weightage
<b>Internal marks (practical)</b> I. Conduct of experiment II. Lab Record III. Lab Participation IV. Lab Project	<b>10 Marks</b> <b>10 Marks</b> <b>10 Marks</b> <b>20 Marks</b>
<b>II. External Marks (practical)</b> End Term Examination	<b>50 Marks</b>



**SEVENTH SEMESTER [For BSc (H.) Forensic Science with Research]**

<b>SCFS401</b>	Forensic Pharmacy and Pharmacology of Controlled Drugs	L	T	P	C
<b>Version1.0</b>		3	0	0	3
<b>Category of Course</b>	Major				
<b>Total Contact Hours</b>	60 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** This course delves into the intricate relationship between pharmacy, pharmacology, and the legal aspects of controlled drugs. You'll gain a deep understanding of the properties, effects, and legal implications of controlled substances, equipping you with the knowledge and skills needed to contribute to investigations and legal proceedings.

**Course Outcome:** Students will be:

1. Understanding fundamental concepts of forensic pharmacology, including drug disposition and metabolic processes.
2. Applying biotransformation knowledge to detect poisons based on metabolic studies.
3. Analyzing factors and harms associated with clandestine drug laboratories.
4. Evaluating the impact of designer drugs on human physiology and behavior.
5. Creating strategies to address drug abuse in sports and implement dope testing.

<b>Course contents</b>
<b>Section I:</b> Forensic Pharmacology: Introductory Toxicokinetics: Overall Drug Disposition, Absorption, Toxicokinetics and Bioavailability, First-Pass Metabolism, Distribution, Free and Bound Drugs Elimination.  Biotransformation: Phase-I and Phase-II reactions. Detection of poison on the basis of their metabolic studies, Some Examples of Applied Biotransformation Knowledge of Codeine, Morphine, Amphetamine Benzodiazepines etc
<b>Section II:</b> Clandestine laboratory: Meaning and Definition of Clandestine, Clandestine Laboratory, Related Problems, Factors Contributing to Clandestine Drug Labs, Harms Caused by Clandestine

## Drug Labs

Equipment Needs: Reflux, Distillation, Hydrogenation, Bucket Chemistry, Extractions, Chemical Needs, Cooking Methods Commonly Used in Clandestine Drug Labs, Extraction Process, Conversion Process, Synthesis Process, Tableting.

Designer drugs: Definition, Analogs of Fentanyl and Meperidine (both synthetic opioids), Phencyclidine (PCP), Amphetamines and methamphetamines (which have hallucinogenic and stimulant properties).

**Section III:** Drug Abuse in Sports: Introduction, International Olympic Committee (IOC), World Anti-Doping Agency (WADA), classification of commonly prohibited substances and Performance enhancing Drugs, Steroids, Stack and Pyramid methods, Dope test and Blood Doping, Sampling techniques, analytical approaches.

**Section IV:** Environmental Forensic Toxicology: Introduction, principles and application, various pollutants, identification of biased environmental data, ground water characterization, soil, vapour survey, analytical methods. Forensic techniques in environmental litigation.

Ptomaine: Introduction, interference caused in analysis of poison, especially in putrefied viscera, poisoning cases due to ptomaine.

**Learning Experience:** Through lectures, laboratory exercises, and case studies, you'll explore the pharmacological properties of controlled drugs, their impact on the human body, and the methods used to detect and analyze them in forensic investigations. You'll also learn about the legal framework governing controlled substances, including classification, regulation, and enforcement.

### Textbooks:

1. J A Siegel, P.J Saukko (2000) Encyclopedia of Forensic Sciences Vol. I, II and III, Acad. Press.
2. Casarett & Doll Toxicology (2003) The Basic Science of poisons.
3. MaThew E. Johll (2009) Investigating Chemistry: A Forensic Science Perspective
4. JJ Fenton (2002) Toxicology A Case-Oriented Approach

### Suggested Reading:

1. Forensic Pharmacology by R.E. Ferner
2. Controlled Substances Act (DEA)
3. The Merck Index: An Encyclopedia of Chemicals, Drugs, and Biologicals

### Open Educational Resources (OER)

1. <https://oercommons.org/>
2. Khan Academy: <https://www.khanacademy.org/>
3. Coursera: <https://www.coursera.org/>
4. EdX: <https://www.edx.org/>
5. National Institutes of Health (NIH) Genome Education: <https://www.ncbi.nlm.nih.gov/home/genomes/>

**Examination scheme:**

<b>Evaluation components</b>	<b>Weightage</b>
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>SCFS407</b>	Wildlife Forensics	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		3	0	0	3
<b>Category of Course</b>	Major				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** This course delves into the intricate world of wildlife forensics, providing a deep understanding of the techniques used to investigate wildlife crimes. You'll learn about evidence collection, analysis, and presentation, as well as the legal and ethical implications of wildlife crime.

**Course Outcome:** Students will be:

1. Understanding the fundamental principles and applications of wildlife forensics, including analytical techniques used in wildlife crime investigations.
2. Applying knowledge of endangered species identification and the Wildlife Protection Act in evidence examination, including physical evidence such as pug marks, horns, and fur.
3. Analyzing systematic forensic examination processes and ethical issues in wildlife forensics, with reference to important case studies and organizations like IUCN and CITES.
4. Evaluating the benefits of risk management in organizations and understanding the elements of ISO 31000 standards.
5. Creating a comprehensive risk management framework, incorporating the PDCA cycle and principles of risk management.

<b>Course contents</b>
<b>Section I:</b> Introduction to wildlife forensics Introduction to Wildlife Forensics, basic elements of wildlife forensics, application of forensics in wildlife crimes. Introduction to basic analytical techniques in wildlife forensics.
<b>Section II:</b> Evidence examination: Identification of some endangered species of plants and animals, Wildlife life protection Act. Examination of pug marks, horn, antlers, skin, fur and hair, nail , teeth, wood.
<b>Section III:</b> Systematic Forensic examination and their reporting pattern: Important case studies, ethical issues in wildlife forensics, IUCN, CITES, TRAFFIC, Transnational crimes

**Section IV : Introduction to Risk Management and its benefits**

Introduction Risk Management, Risk Management in organizations and risk ownership, Risk Management standards – Benefits of Risk Management.

ISO 31000 - Elements of Risk Management: ISO 31000 overview, PDCA cycle - Elements and Purpose, Principles of Risk Management, Relationship between Principles, Framework and Process, Understanding the components of the Risk framework, Designing the Framework with Mandate and Commitment.

**Learning Experience:** Through lectures, practical exercises, and case studies, you'll gain hands-on experience in wildlife forensic techniques, including DNA analysis, ballistics, and trace evidence examination. This course equips you with the knowledge and skills needed to contribute to the conservation of wildlife and combat illegal wildlife trade.

**Textbooks:**

1. Simple Tools and Techniques for Enterprise Risk Management Author: Robert J. Chapman. Publisher: John Wiley & Sons (2011) India Risk Report - 2013 - FICCI + Pinkerton.
2. Risk Management: A Driver of Enterprise Value in the Emerging Environment -2011- KPMG ISO 31000 - Risk management— Principles and guidelines

**Suggested Readings:**

1. A corporate governance, risk management and compliance (GRC) handbook -Authors: Richard M Steinberg Publishers: John Wiley & Sons.
2. Richard Saferstein; Forensic Science Hand Book; Ed.; Prentice – Hall, Englewood Cliff, New jersey; (1982) Biology Methods manual.

**Open Educational Resources (OER)**

1. <https://oercommons.org/>
2. Khan Academy: <https://www.khanacademy.org/science/biology>
3. Coursera: <https://www.coursera.org/>
4. EdX: <https://www.edx.org/>

**Examination scheme:**

<b>Evaluation components</b>	<b>Weightage</b>
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>SCFS403</b>	Information Security Audit and Compliance	L	T	P	C
<b>Version 1.0</b>		3	0	0	3
<b>Category of Course</b>	Major				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** This course delves into the intricate world of safeguarding sensitive information and ensuring adherence to regulatory standards. You'll gain a deep understanding of information security frameworks, risk assessment methodologies, compliance requirements, and audit techniques.

**Course Outcome:** Students will be:

1. Understanding the definition, purpose, and types of information security audits, along with the audit lifecycle stages.
2. Applying knowledge of regulations and standards such as GDPR, HIPAA, and PCI DSS in the context of information security compliance.
3. Analyzing various compliance frameworks, including COBIT and ISO/IEC 27001, and their roles in policy creation and enforcement.
4. Evaluating the effectiveness of tools and technologies, such as AI and blockchain, in enhancing auditing processes and compliance.
5. Creating comprehensive audit strategies by integrating real-world scenarios and automated continuous auditing techniques.

<b>Course contents</b>
<b>Section I: Information Security Auditing</b> Definition and purpose, types of audits (internal, external, compliance, operational), Audit Lifecycle, Planning, Execution, Reporting, Follow-up
<b>Section II: Regulations and Standards:</b> General Data Protection Regulation (GDPR), Health Insurance Portability and Accountability Act (HIPAA), Sarbanes-Oxley Act (SOX), Payment Card Industry Data Security Standard (PCI DSS), Compliance frameworks, Industry-specific regulations
<b>Section III: Compliance frameworks:</b> COBIT (Control Objectives for Information and Related Technologies), ISO/IEC 27001, NIST (National Institute of Standards and Technology) Cybersecurity Framework, Policy creation and implementation, Policy enforcement and review

**Section IV:** Tools and technologies: AI and machine learning in auditing, Blockchain and its impact on audit trails, Real-time compliance, Analysis of real-world audit scenarios, Automated continuous auditing,

**Learning Experience:** Through lectures, hands-on exercises, and case studies, you'll develop practical skills in conducting security audits, identifying vulnerabilities, and implementing effective compliance measures. This course is designed to equip you with the knowledge and expertise needed to protect organizations from cyber threats and maintain regulatory compliance.

**Textbooks:**

1. J A Siegel, P.J Saukko (2000) Encyclopedia of Forensic Sciences Vol. I, II and III, Acad. Press.
2. Casarett & Doll Toxicology (2003) The Basic Science of poisons.
3. MaThew E. Johll (2009) Investigating Chemistry: A Forensic Science Perspective
4. JJ Fenton (2002) Toxicology A Case-Oriented Approach

**Suggested Reading:**

1. "Information Security Auditing: A Practical Guide" by Timothy J. Mason
2. "Auditing Information Systems" by James A. Hall
3. "CISA Review Manual" by ISACA

**Open Educational Resources (OER)**

1. Open Security Training (OST): <https://p.ost2.fyi/courses>
2. Cybrary: <https://www.cybrary.it/>
3. MIT OpenCourseWare: <https://ocw.mit.edu/>

**Examination scheme:**

Evaluation components	Weightage
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>



<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>SCFS405</b>	Forensic Audio and speaker identification	L	T	P	C
<b>Version1.0</b>		3	0	0	3
<b>Category of Course</b>	Major				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** This course offers a comprehensive exploration of forensic audio analysis and speaker identification. You'll learn about the principles of acoustics, signal processing techniques, and the application of these methods to various forensic scenarios. Through practical exercises and case studies, you'll develop the skills necessary to analyze audio recordings, identify speakers, and provide expert testimony in legal proceedings.

**Course Outcome:** Students will be:

1. Understanding the definition, scope, and historical development of forensic audio analysis, along with the basic concepts of sound and digital audio fundamentals.
2. Applying protocols for collecting and preserving audio evidence, including techniques for maintaining audio integrity and understanding chain of custody.
3. Analyzing audio recordings through enhancement techniques, noise reduction methods, and identifying alterations or tampering in recordings.
4. Evaluating the principles of speaker identification, including biological and behavioral characteristics of speech and methods of auditory and acoustic analysis.
5. Creating reports and presenting findings from automatic speaker recognition systems and real-world case studies in forensic audio analysis.

<b>Course contents</b>
<b>Section I:</b> Introduction to Forensic Audio: Introduction to Forensic Audio, Definition and scope of forensic audio analysis, Historical development and milestones in forensic audio, Legal and ethical considerations, Basic Concepts of Sound, Properties of sound: frequency, amplitude, waveform, Sound propagation and acoustic principles, Digital audio fundamentals: sampling rate, bit depth, codecs
<b>Section II:</b> Collection and Preservation of Audio Evidence: Protocols for collecting audio evidence, Chain of custody for audio recordings, Techniques for preserving audio integrity, Audio Enhancement Techniques, Noise reduction methods, Filtering and equalization, Time-frequency

analysis (spectrograms), Authentication and Analysis of Audio Recordings, detecting tampering and alterations, Identifying background noise and environmental sounds, Audio transcription and speech analysis.

**Section III:** Speaker identification: Principles of Speaker Identification, Biological and behavioral characteristics of speech, Factors affecting speaker variability, Introduction to phonetics and phonology, Methods of Speaker Identification, Auditory and acoustic analysis, Audio Recording and Equipment, Types of audio recording devices, Microphones, recorders, and playback equipment, Best practices for audio recording in forensic contexts.

**Section IV:** Automatic speaker recognition systems: Automatic speaker recognition systems, Comparative analysis techniques, Practical Applications and Case Studies, Real-world cases of forensic audio and speaker identification, Challenges and limitations in forensic audio analysis, Reporting and presenting audio evidence in court.

**Learning Experience:** Through lectures, practical exercises, and case studies, you'll gain hands-on experience with audio analysis tools and techniques. You'll learn to identify speakers, analyze audio quality, and detect alterations or manipulations. This course will foster your critical thinking and problem-solving skills, enabling you to contribute to the field of forensic audio analysis with confidence and expertise.

#### **Textbooks:**

1. Univaso, P. (2017). Forensic speaker identification: A tutorial. *IEEE Latin America Transactions*, 15(9), 1754-1770.
2. Umar, R., Riadi, I., Hanif, A., & Helmiyah, S. (2019). Identification of speaker recognition for audio forensic using k-nearest neighbor. *Int. J. Sci. Technol. Res*, 8(11), 3846-3850.

#### **Suggested Readings:**

1. Gonzalez-Rodriguez, J., Fierrez-Aguilar, J., & Ortega-Garcia, J. (2003, April). Forensic identification reporting using automatic speaker recognition systems. In *2003 IEEE International Conference on Acoustics, Speech, and Signal Processing, 2003. Proceedings.(ICASSP'03)*. (Vol. 2, pp. II-93). IEEE.
2. Singh, S. (2018). Forensic and Automatic Speaker Recognition System. *International Journal of Electrical & Computer Engineering* (2088-8708), 8(5).

### Open Educational Resources (OER)

1. Coursera: <https://www.coursera.org/courses?query=forensic>
2. MIT OpenCourseWare: <https://ocw.mit.edu/courses/audio-video-courses/>
3. Khan Academy: <https://www.khanacademy.org/test-prep>

### Examination scheme:

Evaluation components	Weightage
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>UCH107</b>	Inorganic and Physical chemistry	L	T	P	C
<b>Version1.0</b>		3	0	0	3
<b>Category of Course</b>	Minor				
<b>Total Contact Hours</b>	30 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** Chemistry VII offers a comprehensive exploration of the underlying concepts that govern chemical reactions and the properties of matter. You'll delve into the intricacies of physical chemistry, including thermodynamics, kinetics, and quantum mechanics, and gain a solid understanding of organic chemistry, focusing on the structure, properties, and reactions of carbon-containing compounds.

**Course Outcome:** Students will be:

1. Understanding crystal field theory concepts, including octahedral and tetrahedral symmetries and crystal field stabilization energy (CFSE).
2. Applying quantum chemistry principles to analyze electromagnetic radiation interactions with matter.
3. Analyzing rotational and vibrational motion using Schrödinger equations and interpreting associated spectra.
4. Evaluating photochemistry laws and processes, including Lambert-Beer's law and quantum efficiency.
5. Creating reports on structural information derived from spectroscopy and photochemical reactions.

<b>Course contents</b>
<b>Section I:</b> Crystal Field Theory: Crystal field effect, octahedral symmetry. Crystal field stabilization energy (CFSE), Crystal field effects for weak and strong fields. Tetrahedral symmetry. Factors affecting the magnitude of D. Spectrochemical series. Comparison of CFSE for Oh and Td complexes, Tetragonal distortion of octahedral geometry. Jahn-Teller distortion, Square planar coordination
<b>Section II:</b> Quantum Chemistry: Waveparticle duality. Link between spectroscopy and quantum chemistry. Electromagnetic radiation and its interaction with matter. Born- Oppenheimer

approximation: Separation of molecular energies into translational, rotational, Vibrational And Electronic Components.

**Section III:** Rotational Motion: Schrödinger equation of a rigid rotator and brief discussion of its results (solution not required). Quantization of rotational energy levels. Microwave (pure rotational) spectra of diatomic molecules. Selection rules. Structural information derived from rotational spectroscopy. Vibrational Motion: Schrödinger equation of a linear harmonic oscillator and brief discussion of its results (solution not required). Quantization of vibrational energy levels. Selection rules, IR spectra of diatomic molecules. Structural information derived from vibrational spectra. Vibrations of polyatomic molecules.

**Section IV:** Photochemistry: Laws of photochemistry, Lambert-Beer's law. Fluorescence and phosphorescence. Quantum efficiency and reasons for high and low quantum yields. Primary and secondary processes in photochemical reactions. Photochemical and thermal reactions. Photoelectric cells.

**Learning Experience:** Through a combination of lectures, laboratory experiments, and problem-solving exercises, you'll develop a strong foundation in chemical principles and learn to apply them to real-world scenarios. You'll also have the opportunity to work on projects and collaborate with peers, fostering critical thinking and problem-solving skills.

**Textbooks:**

1. Allied Chemistry – Prof. Mathur and others.
2. Elements of Properties of Matter – D.S. Mathur, S. Chand & Co. (1999).
3. Modern Chemistry – S. Chand & Co. (2006).
4. Electronic Principles and Applications – A.B. Bhattacharya, New Central Book Agency, Calcutta.
5. Introduction to Fiber optics by K. Thyagarajan and Ajay Ghatak, Cambridge, University Press(1999).]

**Suggested Readings:**

1. Physical Chemistry: Atkins & de Paula, "Physical Chemistry"
2. Organic Chemistry: Wade, "Organic Chemistry"

**Open Educational Resources (OER):**

4. OpenStax: <https://openstax.org/details/books/chemistry-2e/>
5. LibreTexts: <https://chem.libretexts.org/>
6. Khan Academy: <https://www.khanacademy.org/science/chemistry>

**Examination scheme:**

<b>Evaluation components</b>	<b>Weightage</b>
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>SCFS409</b>	Technology in Research	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version 1.0</b>		2	0	0	2
<b>Category of Course</b>	Skill Enhancement Course				
<b>Total Contact Hours</b>	30				
<b>Pre-Requisites/ Co Requisites</b>	-				

### Course Perspective

Research Methodology equips students with essential tools and techniques for conducting scientific research. It covers the systematic process of identifying a problem, formulating a hypothesis, collecting data, and analyzing results. By understanding various research designs, methods of data collection, and statistical analysis, students develop the ability to critically evaluate existing research and contribute original findings.

### Course Outcomes

Upon completion of the Research Methodology course, the learner will be able to:

1. Explain how various technologies enhance data collection, analysis, and collaboration in research, demonstrating an understanding of their impact on the research process.
2. Applying the effectiveness of different technological tools in optimizing various stages of the research process, evaluating their impact on data quality and research outcomes.
3. Analyzing various technological tools and methods to design and conduct research projects, effectively integrating technology into their research workflows.
4. Critically evaluate the strengths and limitations of different technological approaches in research, assessing their suitability for specific research objectives and contexts.
5. Design and develop innovative research methodologies by integrating advanced technological tools, creating novel approaches to address complex research questions.

<b>Course contents</b>
Unit I Introduction to Technology in Research: Overview of Technology's Role in Research: Historical perspective, current trends, and future directions; Types of Research Technologies: Data collection tools (e.g., surveys, sensors), data management systems, and analysis software; Ethical and Practical Considerations: Data privacy, security, and responsible use of technology.
Unit II: Data Collection and Management: Advanced Data Collection Methods: Digital surveys,



remote sensing, IoT devices; Data Storage Solutions: Cloud computing, databases, and data warehousing; Data Quality and Integrity: Techniques for ensuring accurate and reliable data collection.

Unit III: Data Analysis and Visualization: Analytical Tools and Techniques: Statistical software, machine learning algorithms, and AI applications; Data Visualization: Tools and methods for creating effective charts, graphs, and interactive visualizations; Interpreting and Presenting Data: Techniques for making data-driven decisions and communicating findings.

Unit IV: Innovation and Application in Research: Emerging Technologies: Blockchain, augmented reality (AR), virtual reality (VR) in research; Developing and Implementing Technological Solutions: Designing research methodologies and tools using advanced technology; Case Studies and Practical Applications: Real-world examples of technology applied in various research fields and hands-on project development.

**Learning Experience:** This course will be conducted through a mix of interactive lectures, hands-on workshops, and real-world case studies to ensure experiential learning. Students will explore the role of technology in research, learning to use advanced tools for data collection, management, and analysis. Practical sessions will involve using statistical software, AI applications, and data visualization techniques, allowing students to apply these tools to real research scenarios.

### **Textbooks**

1. "Research Design: Qualitative, Quantitative, and Mixed Methods Approaches" by John W. Creswell – This book provides a comprehensive overview of research methodologies, including historical perspectives and trends in research technology.
2. "The Handbook of Research on Educational Communications and Technology" edited by J. Michael Spector, M. David Merrill, Jan Elen, and M.J. Bishop – Covers technology's role in research, current trends, and future directions across disciplines.
3. "Technology in Research: Methods, Tools, and Strategies" by Brian M. Slator – Offers insights into various research technologies and the ethical issues surrounding them.

### **Suggested Readings**

1. "Historical Perspectives and Future Directions in Research Technologies" by Klaus Schwab – Provides a discussion on how technology has evolved in research and its future potential.

2. "Ethical Considerations in Research Technology" by Annette Markham and Elizabeth Buchanan –  
Focuses on ethical challenges such as data privacy and the responsible use of emerging technologies.

**Examination scheme:**

<b>Evaluation components</b>	<b>Weightage</b>
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>SCFS411</b>	Research Ethics and Report Writing	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version 1.0</b>		2	0	0	2
<b>Category of Course</b>	Skill Enhancement Course				
<b>Total Contact Hours</b>	30				
<b>Pre-Requisites/Co Requisites</b>	-				

### Course Perspective

Research Methodology equips students with essential tools and techniques for conducting scientific research. It covers the systematic process of identifying a problem, formulating a hypothesis, collecting data, and analyzing results. By understanding various research designs, methods of data collection, and statistical analysis, students develop the ability to critically evaluate existing research and contribute original findings. The course emphasizes ethical considerations, ensuring that research is conducted with integrity and responsibility.

### Course Outcomes

Upon completion of the Research Methodology course, the learner will be able to:

1. Defining key concepts in research ethics and recall significant ethical guidelines.
2. Explaining core ethical principles and describe the role of Institutional Review Boards (IRBs).
3. Analyzing ethical principles to research design and utilize proper citation techniques.
4. Analyzing ethical dilemmas in research case studies and break down the structure of research reports.
5. Criticizing research proposals for ethical integrity and assess data management practices.

<b>Course contents</b>
<b>Section I:</b> Introduction to Research Ethics: Definition and importance of research ethics, Historical perspectives on research ethics, Core ethical principles: autonomy, beneficence, non-maleficence, and justice, Ethical issues in various research contexts.
<b>Section II:</b> Ethical Issues in Research Design and Data Management: Informed consent, confidentiality, and privacy, Ethical considerations in qualitative vs. quantitative research, Role and function of Institutional Review Boards (IRBs) , Ethical data management: collection, storage, and sharing, Avoiding research misconduct: fabrication, falsification, and plagiarism, Authorship and intellectual

property rights.
<b>Section III:</b> Research Proposal Writing and Report Structuring: Components of a research proposal: Ethical considerations in proposal writing, Structuring a research report: Introduction, Literature Review, Methodology, Results, Discussion, Conclusion, Language, tone, and style in academic writing.
<b>Section IV:</b> Citation, Peer Review, and Presentation of Research: Importance of proper citation and common citation styles (APA, MLA, Chicago), Avoiding plagiarism through correct attribution, Understanding the peer review process, Techniques for self-editing and revising research reports, Preparing and presenting research findings, Ethical issues in presenting research: avoiding bias and misrepresentation, Case studies in research ethics: group discussions and analysis

### Learning Experience

This course will be conducted through interactive lectures, discussions, and case studies, making the learning process experiential and participatory. Students will engage in real-world scenarios to understand ethical issues, participate in group discussions to explore research dilemmas, and work on writing exercises to develop research proposals and reports. Hands-on activities like peer reviews and presentations will allow students to apply ethical principles in research design, data management, and academic writing. The course emphasizes active learning through debates, case study analysis, and collaborative projects.

### Textbooks and Readings:

1. "Research Ethics: A Reader" by David B. Resnik
2. "The Craft of Research" by Wayne C. Booth, Gregory G. Colomb, and Joseph M. Williams
3. Selected journal articles and case studies provided by the instructor

### Examination scheme:

Evaluation components	Weightage

<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>UCH157</b>	Practical Chemistry-VII	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		0	0	2	1
<b>Category of Course</b>	Practical (Minor)				
<b>Total Contact Hours</b>	30 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** Chemistry Practical VII provides a comprehensive exploration of molecular and spectroscopic techniques, crucial for understanding the electronic structure, transitions, and bonding in both simple and complex molecules. By investigating phenomena such as d-orbital splitting, rotational and vibrational spectra, and electronic transitions, students will delve into the core principles of coordination chemistry, quantum mechanics, and molecular spectroscopy. The course emphasizes the practical application of these techniques, bridging theoretical concepts with experimental observations, and is vital for fields like chemical analysis, materials science, and molecular physics.

**Course Outcome:** Students will be:

1. Understanding UV-Vis, microwave, and IR spectroscopy to study molecular structures, transitions, and bonding in complexes and diatomic molecules.
2. Analyse ligand field effects, calculate CFSE, and examine spectra to deduce molecular geometry and bonding.
3. Analyzing quantum mechanics, including the Born-Oppenheimer approximation, to explain electronic transitions and molecular motion.
4. Performing quantitative analysis using Lambert-Beer's law and distinguish fluorescence from phosphorescence through emission spectra.
5. Interpreting rotational and vibrational spectra to determine bond lengths, rotational constants, and electronic configurations.

#### **Course contents**

1. To calculate CFSE for metal complexes in octahedral and tetrahedral geometries using UV-Vis spectroscopy.
2. To explore the effect of weak and strong field ligands on metal d-orbital splitting.
3. To observe molecular electronic transitions and understand how the Born-Oppenheimer approximation separates electronic and nuclear motion.

4. To study the rotational spectra of diatomic molecules using microwave spectroscopy.
5. To measure the pure rotational spectra of diatomic molecules and interpret the results.
6. To record and interpret the IR spectra of diatomic and polyatomic molecules.
7. To study the absorption of light by solutions at different concentrations and verify Lambert-Beer's law.
8. To differentiate between fluorescence and phosphorescence by studying emission spectra of organic molecules.

**Learning Experience:** Through hands-on experiments using UV-Vis, microwave, and infrared spectroscopy, students will gain practical skills in calculating crystal field stabilization energy (CFSE), analyzing ligand field effects, and interpreting molecular spectra. They will engage with real-world applications of the Born-Oppenheimer approximation and Lambert-Beer's law, while also distinguishing between fluorescence and phosphorescence. By measuring and interpreting rotational and vibrational spectra, students will develop a robust understanding of molecular structure, transitions, and the interaction of light with matter, preparing them for advanced research and analytical roles in chemistry and physics.

#### **Text and References:**

1. Cotton, F.A., Wilkinson, G., Advanced Inorganic Chemistry, Wiley.
2. Atkins, P., de Paula, J., Physical Chemistry, Oxford University Press.
3. Banwell, C. N., McCash, E. M., Fundamentals of Molecular Spectroscopy, McGraw-Hill.
4. Graybeal, J.D., Molecular Spectroscopy, McGraw-Hill.
5. Wayne, R. P., Principles and Applications of Photochemistry, Oxford University Press.

#### **Examination Scheme:**

<b>Evaluation components</b>	<b>Weightage</b>
<b>Internal marks (practical)</b> I. Conduct of experiment II. Lab Record III. Lab Participation IV. Lab Project	<b>10 Marks</b> <b>10 Marks</b> <b>10 Marks</b> <b>20 Marks</b>
<b>II. External Marks (practical)</b> End Term Examination	<b>50 Marks</b>





<b>SEC084</b>	Forensic Practical VII	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		0	0	4	2
<b>Category of Course</b>	Practical (Major)				
<b>Total Contact Hours</b>	60 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

#### **Course Perspective:**

The course offers a comprehensive overview of key forensic science practices, blending theory with practical application in areas like wildlife forensics, toxicology, and environmental analysis. Students will gain proficiency in emerging technologies, such as FTIR and automatic speaker recognition, preparing them to address legal and scientific challenges in forensic investigations, while emphasizing ethical and accurate evidence handling.

#### **Course Outcome:** Students will be:

1. Understanding the methods for collection, preservation, and enhancement of audio evidence in forensic investigations, and apply noise reduction and filtering techniques to improve audio quality.
2. Applying biological and behavioral characteristics of speech to conduct speaker identification, and perform automatic speaker recognition using acoustic and auditory techniques.
3. Analyzing forensic examination techniques to wildlife evidences, such as pug marks, fur, and antlers, and interpret findings in accordance with wildlife protection laws and ethical standards.
4. Performing toxicology screening for NDPS (Narcotic Drugs and Psychotropic Substances) drugs, and understand the analytical techniques used in identifying controlled substances in forensic toxicology.
5. Interpreting the results of FTIR (Fourier-Transform Infrared) analysis for the detection of contaminants in drinking water and different drugs, applying forensic methodologies for accurate interpretation.

#### **Course contents**

1. Collection, Preservation, and Enhancement of Audio Evidence
2. Speaker Identification and Automatic Speaker Recognition Systems.
3. Forensic Examination and Reporting Wildlife Evidences.
4. Toxicology Screening for NDPS Drugs.

5. Detection of contaminants in drinking water.
6. FTIR based analysis and interpretation of different drugs.
7. Morphological and microscopic examination of plants of forensic importance.

**Learning Experience:** This course provides a hands-on learning experience through practical exercises in forensic techniques such as audio evidence collection, speaker identification, wildlife forensics, and toxicology screening. Students will explore advanced tools like FTIR for drug analysis and methods for detecting contaminants in water. By engaging in labs, case studies, and collaborative work, students will develop essential analytical and technical skills for handling forensic evidence in real-world scenarios.

### **Text and References:**

1. Koenig, B. E. (1991). Spectrographic voice identification: A forensic survey. Journal of the Acoustical Society of America.
2. Hollien, H. (2002). Forensic Voice Identification. Academic Press.
3. Ogden, R. (2010). Forensic science, genetics and wildlife biology: getting the right mix for a wildlife DNA forensics laboratory. Forensic Science Medicine and Pathology.
4. Cooper, J. E., & Cooper, M. E. (2007). Introduction to Veterinary and Comparative Forensic Medicine. Blackwell Publishing.
5. Baselt, R. C. (2011). Disposition of Toxic Drugs and Chemicals in Man. Biomedical Publications.
6. Karch, S. B. (2006). Drug Abuse Handbook. CRC Press.
7. Stuart, B. (2004). Infrared Spectroscopy: Fundamentals and Applications. John Wiley & Sons.
8. Bell, S. (2006). Forensic Chemistry. Pearson Prentice Hall.
9. Murphy, B. L., & Morrison, R. D. (2007). Introduction to Environmental Forensics. Academic Press.
10. Meyers, R. A. (2010). Encyclopedia of Analytical Chemistry: Applications, Theory, and Instrumentation. Wiley.

### **Examination Scheme:**

Evaluation components	Weightage
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<b>Internal marks (practical)</b> I. Conduct of experiment II. Lab Record III. Lab Participation IV. Lab Project	<b>10 Marks</b> <b>10 Marks</b> <b>10 Marks</b> <b>20 Marks</b>
<b>II. External Marks (practical)</b> End Term Examination	<b>50 Marks</b>

**EIGHTH SEMESTER [For BSc (H.) Forensic Science with Research]**

<b>SCFS402</b>	Forensics Genomics and DNA Profiling	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		4	0	0	4
<b>Category of Course</b>	Major				
<b>Total Contact Hours</b>	60 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** This course delves into the intricate world of human genetics and forensic DNA analysis. You'll gain a deep understanding of the fundamental concepts of genetics, DNA profiling techniques, statistical analysis, and the legal and ethical implications of DNA databasing.

**Course Outcome:** Students will be:

1. Understanding fundamental concepts of human genetics, including heredity, alleles, mutations, and population genetics.
2. Applying DNA profiling techniques, including extraction methods and various DNA typing systems like RFLP, PCR, and SNP analysis.
3. Analyzing statistical concepts related to DNA, including frequency estimates, allele frequencies, and calculating paternity/maternity indices.
4. Evaluating the ethical, legal, and social issues surrounding DNA databanking and the Human Genome Project.
5. Creating strategies for applying DNA profiling in forensic contexts, including paternity disputes, missing persons, and legal standards for admissibility.

<b>Course contents</b>
<b>Section I:</b> Human genetics Human Genetics, Heredity, Alleles, Mutations and Population Genetics, The concept of Genetics polymorphism, Hardy-Weinberg Law
<b>Section II:</b> DNA profiling- Introduction, History of DNA Typing, molecular biology of DNA, variations, polymorphism, DNA Extraction-Organic and Inorganic extraction, Comparison of Extraction methods, Commercial

<p>kits</p> <p>DNA typing systems- RFLP analysis, PCR amplifications, sequence polymorphism.</p> <p>Analysis of SNP, YSTR, Mitochondrial DNA, Ancient DNA typing, Evaluation of results</p> <p>New and future technologies: DNA chips, SNPs and limitations of DNA profiling.</p>
<p><b>Section III:</b> DNA Statistics: frequency estimate calculations, interpretations, allele frequency determination, Paternity/Maternity index, Sibling index, Probability of match.</p> <p>Human Genome Project: Introduction, History, Goals, Benefits, Social, Ethical and Legal Issues</p> <p>DNA Forensic Databases, Ethical, Legal, and Social Issues Associated with DNA Databanking, Potential Benefits of DNA Databanking. Quality control, certification and accreditation.</p>
<p><b>Section IV:</b> Forensic Significance of DNA profiling: Applications in disputed paternity cases, child swapping, missing person's identity- civil immigration, veterinary, wildlife and agriculture cases, legal</p> <p>Perspectives- legal standards for admissibility of DNA profiling, procedural and ethical concerns, status of development of DNA profiling in India and abroad.</p>

**Learning Experience:** Through lectures, practical exercises, and case studies, you'll gain a comprehensive understanding of how DNA is used in various fields, from criminal investigations to paternity testing. This course is designed to equip you with the knowledge and skills needed to contribute to the advancement of forensic science and the ethical use of DNA technology.

#### **Textbooks:**

1. Saferstein, R. (1982) Science Handbook, Vol. I, II, & III, Prentice Hall New Jersey.
2. Kirby : DNA Fingerprinting Technology.
3. DNA structure and functions by Richard R. Sinden; Academic Press, Inc. 1994.
4. DNA Profiling and DNA fingerprinting (1999) Edited by Jorg T. Epplen and Thomas Lubjuhn; Birkhauser Verlag, Switzerland.

#### **Suggested Readings:**

1. Forensic DNA Profiling Protocols (1998) Patrick J. Lincoln and Jim Thomson; Humana Press, Inc.
2. DNA and other Polymorphism in Forensic Science (1990) Henry C. Lee and R.E. Gaensslen; Year book

Medical Publishers, Inc.

3. Keith In man and Norah Rudin (1997) An Introduction to Forensic DNA Analysis, CRC Press; Ny.
4. John M. Butler (2005) Forensic DNA Typing: Biology, Technology, and Genetics of STR Markers Academic Press.

### Open Educational Resources (OER)

1. <https://dnalc.cshl.edu/>
2. <https://oercommons.org/>
3. <https://ocw.mit.edu/>
4. <https://www.coursera.org/>
5. <https://www.edx.org/>

### Examination scheme:

Evaluation components	Weightage
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>UCH108</b>	Analytical chemistry II	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		3	0	0	3
<b>Category of Course</b>	Minor				
<b>Total Contact Hours</b>	45 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** This course delves into the intricacies of physical and organic chemistry, focusing on advanced spectroscopic techniques and the assessment of chemical hazards. You'll gain a deep understanding of photoelectron spectroscopy, Mossbauer spectroscopy, X-ray diffraction, and the various hazards encountered in chemical environments. Through theoretical concepts and practical applications, you'll develop a strong foundation in these essential areas of chemistry.

**Course Outcome:** Students will be:

1. Understanding the basic principles of photoelectron spectroscopy, including the photoelectric effect and ionization processes.
2. Applying Mossbauer spectroscopy techniques to study the bonding and structures of metal compounds and detect oxidation states.
3. Analysing X-ray diffraction methods and their application in structural analysis of crystals, including Bragg's law and unit cell identification.
4. Evaluating physical and chemical hazards in the workplace, including noise exposure, ionizing radiation, and chemical hazards.
5. Creating safety protocols and control measures to mitigate risks associated with physical and chemical hazards in various environments.

<b>Course contents</b>
<b>Section I:</b> Photoelectron Spectroscopy: Basic principles; photo-electric effect, ionization process, Koopman's theorem. Photoelectron spectra of simple molecules, ESCA, chemical information from ESCA. Auger electron spectroscopy –basic idea. Photoacoustic Spectroscopy. Basic principles of photoacoustic spectroscopy (PAS), chemical and surface applications
<b>Section II:</b> Mossbauer spectroscopy - Mossbauer effect, recoilless emission and absorption, hyperfine interaction, chemical isomer shift, magnetic hyperfine and quadruple interaction, Application of the

technique to the studies of (1) bonding and structures of Fe<sup>+2</sup> and Fe<sup>+3</sup> compounds including those of intermediate spin, (2) Sn<sup>+2</sup> and Sn<sup>+4</sup> compounds and (3) detection of oxidation state

**Section III:** X-ray Diffraction. Bragg condition, Miller indices, Laue method, Bragg method, Debye-Scherrer method of X-ray structural analysis of crystals, index reflections, identification of Unit cells from systematic absences in diffraction pattern. Structure of simple lattices and X-ray intensities, structure factor and its relation to intensity and electron density. Description of the procedure for an X-ray structure analysis.

**Section IV:** Physical and Chemical Hazards: Noise, noise exposure regulation, properties of sound, occupational damage, risk factors, v sound measuring instruments, permissible exposure limit. Ionizing radiation, types, effects, monitoring instruments, control programs, OSHA standard- non-ionizing radiations, effects, types, radar hazards, microwaves and radio-waves, lasers, TLV- cold environments, hypothermia, wind chill index, control measureshot environments, thermal comfort, heat stress indices, acclimatization, estimation and control. Recognition of chemical hazards-dust, fumes, mist,Air Sampling instruments, Types, Measurement Procedures.

**Learning Experience:** Through a combination of lectures, laboratory experiments, and case studies, you'll gain hands-on experience with spectroscopic techniques and learn how to identify, evaluate, and mitigate chemical hazards. You'll also develop critical thinking and problem-solving skills as you analyze data and interpret results. This course will equip you with the knowledge and skills needed for a successful career in chemistry or related fields.

**Textbooks:**

1. Allied Chemistry – Prof. Mathur and others.
2. Elements of Properties of Matter – D.S. Mathur, S. Chand & Co. (1999).
3. Modern Chemistry – S. Chand & Co. (2006).
4. Electronic Principles and Applications – A.B. Bhattacharya, New Central Book Agency, Calcutta.
5. Introduction to Fiber optics by K. Thyagarajan and Ajay Ghatak, Cambridge, University Press (1999).

**Suggested Readings:**

1. Physical Chemistry: Atkins, P. W. (2010). Physical Chemistry. Oxford University Press.



2. Spectroscopy: Skoog, D. A., West, D. M., Holler, J. F., & Crouch, S. R. (2014). Fundamentals of Analytical Chemistry. Cengage Learning.
3. Organic Chemistry: Wade, L. G. (2015). Organic Chemistry. Pearson Education.

**Open Educational Resources (OER):**

1. Khan Academy: <https://www.khanacademy.org/science/chemistry>
2. MIT OpenCourseWare: <https://ocw.mit.edu/courses/chemistry/>
3. Coursera: <https://www.coursera.org/>
4. EdX: <https://www.edx.org/>

**Examination scheme:**

Evaluation components	Weightage
<b>Internal marks (Theory)</b> <b>I. Continuous assessment(30 marks)</b> All the components to be evenly spaced Test/Project/quizzes/assignment and essays/presentation/ participation/attendance/case studies/reflective journals(minimum of five components to be evaluated)	<b>30 Marks</b>
<b>II. Internal marks(Theory):</b> Mid Term Examination	<b>20 Marks</b>
<b>III. External Marks (Theory):</b> End Term Examination	<b>50 Marks</b>

<b>UCH158</b>	Practical Chemistry-VIII	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		0	0	2	1
<b>Category of Course</b>	Practical (Minor)				
<b>Total Contact Hours</b>	30 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** Chemistry practical VIII introduces students to ionization mechanisms and the concept of core electron binding energy in molecules. The experiment aids in understanding how electrons interact with the nucleus and the ionization potential of atoms.

**Course Outcome:** Students will be:

1. Understanding the proficiency in the operation of instruments used in photoelectron, Mossbauer, and X-ray diffraction spectroscopy.
2. Recognize physical and chemical hazards, including noise and radiation exposure, and employ appropriate monitoring and control measures.
3. Analyzing safety standards and guidelines to reduce occupational risks associated with noise, ionizing and non-ionizing radiation, and chemical agents in laboratory and industrial settings.
4. Analyze and interpret spectral data to identify molecular structures and bonding characteristics.
5. Evaluate chemical and surface properties using photoacoustic and Auger electron spectroscopy.

#### **Course contents**

1. Study ionization processes and measure the binding energy of core electrons in simple molecules.
2. Study the principles of PAS and analyze surface properties of solids.
3. Determine chemical states of elements and surface composition.
4. Analyze surface composition using AES.
5. Study hyperfine interactions and bonding in iron compounds.
6. Detect oxidation states and bonding characteristics in tin compounds.
7. Use XRD to determine the structure of simple crystals.
8. Conduct X-ray structural analysis using the Debye-Scherrer method.
9. Calculate structure factors and their relation to intensity and electron density
10. Monitor ionizing and non-ionizing radiation levels using dosimeters and other instruments.

**Learning Experience:**

Students gain hands-on experience in analyzing electron binding energy using spectrometric methods, enhancing their knowledge of molecular structure and electron dynamics.

**Text and References:**

1. Cotton, F.A., Wilkinson, G., Advanced Inorganic Chemistry, Wiley.
2. Atkins, P., de Paula, J., Physical Chemistry, Oxford University Press.
3. Banwell, C. N., McCash, E. M., Fundamentals of Molecular Spectroscopy, McGraw-Hill.
4. Graybeal, J.D., Molecular Spectroscopy, McGraw-Hill.
5. Wayne, R. P., Principles and Applications of Photochemistry, Oxford University Press.

**Examination Scheme:**

Evaluation components	Weightage
<b>Internal marks (practical)</b> I. Conduct of experiment II. Lab Record III. Lab Participation IV. Lab Project	<b>10 Marks</b> <b>10 Marks</b> <b>10 Marks</b> <b>20 Marks</b>
<b>II. External Marks (practical)</b> End Term Examination	<b>50 Marks</b>

<b>SEC085</b>	Forensic Practical VIII	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		0	0	4	2
<b>Category of Course</b>	Practical (Major)				
<b>Total Contact Hours</b>	30 Hours				
<b>Pre-requisites/ Co-requisites</b>	--				

**Course Perspective:** This course provides a comprehensive understanding of the chemical analysis techniques used in forensic science, focusing on the identification and examination of dyes, pigments, polymers, oils, fats, and various consumer products. It emphasizes practical skills in detecting poisons and toxic substances, particularly through the analysis of metallic poisons and the extraction of toxins from viscera. By integrating theoretical knowledge with hands-on laboratory work, the course equips students with essential forensic skills for real-world applications.

**Course Outcome:** Students will be:

1. Understanding the principles and techniques used in the analysis of dyes, pigments, and polymers, with a focus on their forensic applications.
2. Applying oils and fats through forensic methods to determine their composition and identify adulteration or contamination.
3. Analyzing forensic techniques to the analysis of chemical fertilizers and various consumer items such as gold, silver, tobacco, tea, sugar, and salts, ensuring the detection of fraud or quality deviations.
4. Performing the Reinsch Test to detect the presence of metallic poisons, and assess the forensic significance of such findings in toxicological investigations.
5. Interpreting the processes involved in the extraction and analysis of different categories of poisons from viscera, using appropriate forensic techniques for identifying toxic substances.

### **Course contents**

1. Analysis of Dyes, Pigments & Polymers
2. Forensic analysis of oils and fats
3. Analysis of chemical fertilizers, consumer items such as gold, silver, tobacco, tea, sugar, salts
4. Detection of metallic poisons using Reinsch Test.
5. Extraction and analysis of different categories of poisons from viscera.

**Learning Experience:**

In this course, students will analyze dyes, pigments, polymers, oils, and fats, and test consumer items like gold, silver, and fertilizers. They will also perform the Reinsch Test for metallic poisons and learn to extract and analyze poisons from viscera, gaining hands-on forensic experience.

**Textbook:**

1. "Forensic Chemistry" by Suzanne Bell
2. "Introduction to Forensic Chemistry" by Kelly M. Elkins
3. "Forensic Science: An Introduction to Scientific and Investigative Techniques" by Stuart H. James and Jon J. Nordby
4. "Principles of Instrumental Analysis" by Douglas A. Skoog, F. James Holler, and Stanley R. Crouch
5. "Clark's Analysis of Drugs and Poisons" by Anthony C. Moffat, M. David Osselson, and Brian Widdop

**References:**

1. "Forensic Toxicology: Principles and Concepts" by Nicholas T. Lappas and Courtney M. Lappas
2. "Essentials of Forensic Medicine and Toxicology" by K. S. Narayan Reddy
3. "Chemistry and Crime: From Sherlock Holmes to Today's Courtroom" by Samuel M. Gerber

**Examination Scheme:**

Evaluation components	Weightage
<b>Internal marks (practical)</b> I. Conduct of experiment II. Lab Record III. Lab Participation IV. Lab Project	<b>10 Marks</b> <b>10 Marks</b> <b>10 Marks</b> <b>20 Marks</b>
<b>II. External Marks (practical)</b> End Term Examination	<b>50 Marks</b>

<b>SCFS410</b>	Project Work	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Version1.0</b>		0	0	0	12
<b>Category of Course</b>	Major-DSC				

<b>Total Contact Hours</b>	
<b>Pre-requisites/ Co-requisites</b>	--

**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 VIII, each faculty member will assign a suitable research topic to the students from the selected topics in the areas of forensic sciences. The student will write a dissertation based on the research work carried out during the semester 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 the 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**

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