Scheme and Syllabus
of
B.Sc. Forensic Science

Vision

To emerge as a premier center for forensic science education and research by developing scientifically skilled, ethically responsible, and technologically competent forensic professionals who contribute to justice delivery and societal safety.

Mission

- To provide strong foundational knowledge in basic sciences, forensic techniques, and legal procedures.
- To impart hands-on laboratory training using modern forensic instruments and technologies.
- To develop analytical thinking, research aptitude, and problem-solving skills for crime investigation.
- To foster professional ethics, legal awareness, and social responsibility.
- To promote collaboration with forensic laboratories, judiciary, and law enforcement agencies for experiential learning.

Program Objectives

- Apply forensic science principles effectively in crime laboratories, investigative agencies, and allied sectors.
- Demonstrate technical competence in evidence examination, analysis, and reporting using modern tools.
- Exhibit professional ethics, legal responsibility, and effective communication in forensic practice.
- Pursue higher education, research, or specialized training in forensic and allied sciences.

Program Outcomes (POs)

After completion of the program, students will be able to:

PO1– Disciplinary Knowledge- Acquire comprehensive knowledge of biology, chemistry, physics, and forensic science principles.

PO2– Critical Thinking- Analyze crime-related problems using scientific reasoning and logical interpretation.

PO3– Problem Solving- Apply forensic methods to identify, examine, and interpret physical

and biological evidence.

PO4– Analytical Reasoning- Use statistical and instrumental techniques for data evaluation and result interpretation.

PO5– Modern Tool Usage- Operate modern forensic instruments and digital technologies safely and efficiently.

PO6– Professional Skills- Perform crime scene management, documentation, evidence handling, and laboratory procedures competently.

PO7– Communication Skills- Prepare forensic reports and present expert testimony clearly in legal and professional settings.

PO8– Ethics and Social Responsibility- Practice professional ethics, maintain chain of custody, and adhere to legal and quality standards.

PO9– Teamwork and Leadership- Work effectively in multidisciplinary teams during investigations and research.

PO10– Environment and Sustainability- Follow safe laboratory practices and environmental considerations in forensic operations.

PO11– Lifelong Learning- Engage in continuous learning, research, and skill enhancement to adapt to technological advancements.

PO12– Employability and Entrepreneurship- Demonstrate competencies suitable for employment, consultancy, or entrepreneurship in forensic and allied sectors.

Semester-1

S. No	Course Code	Subject	Credits	Period			Course Category
				L	T	P	
1.	UFS-101	Introduction to Forensic Science	5	4	0	2	DSC
2.	UFS-102	Chemistry I	5	4	0	2	DSC
3.	UFS-103	Criminology	4	4	0	0	DSC
4.	UFS-104	Environmental Studies	2	2	0	0	DSC
5.	UFS-105	Skill Enhancement	3	3	0	0	DSC
6.	UFS-106	Biology I	4	3	0	2	DSE
	UFS-107	Physics I					
Total			**23**				

Semester-2

S. No	Course Code	Subject	Credits	Period			Course Category
				L	T	P	
1.	UFS-151	Chemistry II	5	4	0	2	DSC
2.	UFS-152	Microbial Forensics	5	3	0	4	DSC
3.	UFS-153	Crime Scene Management	4	3	0	2	DSC
4.	UFS-154	Fundamentals of Criminal Law	5	4	0	2	DSC
5.	UFS-155	Forensic Entomology	2	2	0	0	DSC
6.	UFS-156	Biology II	3	3	0	0	DSE
	UFS-157	Physics II					
Total			**24**				

- DSC- Disciplinary Subject Compulsory
- DSE- Disciplinary Subject Elective
- DSE to be opted based on medical/non-medical background of the student.

Semester-3

S. No	Course Code	Subject	Credits	Period			Course Category
				L	T	P	
1.	UFS-201	Chemistry III	5	4	0	2	DSC
2.	UFS-202	Basics of Computer & Artificial Intelligence	3	3	0	0	DSC
3.	UFS-203	Forensic Food Chemistry & Public Health	4	4	0	0	DSC
4.	UFS-204	Fundamentals of Question Document Examination	5	4	0	2	DSC
5.	UFS-205	Disaster Management	2	2	0	0	DSC
6.	UFS-206	Biology III	4	3	0	2	DSE
	UFS-207	Physics III					
Total			**23**				

Semester-4

S. No	Course Code	Subject	Credits	Period			Course Category
				L	T	P	
1.	UFS-251	Chemistry IV	5	4	0	2	DSC
2.	UFS-252	Fundamentals of Forensic Biology	5	4	0	2	DSC
3.	UFS-253	Technological Methods in Forensic Science	4	3	0	2	DSC
4.	UFS-254	Forensic Dermatoglyphics	5	4	0	2	DSC
5.	UFS-255	Biology IV	4	3	0	2	DSE
	UFS-256	Physics IV					
Total			**23**				

- DSC- Disciplinary Subject Compulsory
- DSE- Disciplinary Subject Elective
- DSE to be opted based on medical/non-medical background of the student.

Semester-5

S. No	Course Code	Subject	Credits	Period			Course Category
				L	T	P	
1.	UFS-301	Chemistry V	5	4	0	2	DSC
2.	UFS-302	Forensic Biology & Serology	3	3	0	0	DSC
3.	UFS-303	Cyber Forensics	4	3	0	2	DSC
4.	UFS-304	Forensic Psycology	4	4	0	0	DSC
5.	UFS-305	Professional Ethics	3	3	0	0	DSC
6.	UFS-306	Biology V	4	3	0	2	DSE
	UFS-307	Physics V					
Total			**23**				

Semester-6

S. No	Course Code	Subject	Credits	Period			Course Category
				L	T	P	
1.	UFS-351	Forensic Ballistics	5	4	0	2	DSC
2.	UFS-352	Applied Biochemistry	4	4	0	0	DSC
3.	UFS-353	Forensic Anthropology	4	3	0	2	DSC
4.	UFS-354	Forensic Toxicology	4	3	0	2	DSC
5.	UFS-355	Statistics and Research Methodology	4	4	0	0	DSC
6.	UFS-356	Project	3	0	0	6	DSC
Total			**24**				

- DSC- Disciplinary Subject Compulsory
- DSE- Disciplinary Subject Elective
- DSE to be opted based on medical/non-medical background of the student.
- After completion of the course, student will earn total 140 credits.

SEMESTER I

Course Code	Course Title	L	T	P	Credit
UFS-101	**Introduction to Forensic Science**	**4**	**0**	**2**	**5**

Prerequisites: Students should possess understanding of fundamental biological concepts, Basic concepts of organic and inorganic chemistry, Familiarity with basic physical principles, ability to understand simple calculations, graphs, ratios, and interpretation of experimental data.

Course Objectives:

- Gain a comprehensive understanding of the history, evolution, and various disciplines within forensic science.
- Develop skills in evaluating and processing crime scenes, emphasizing the importance of preserving and documenting evidence.
- Familiarize students with basic forensic techniques, such as fingerprint analysis, bloodstain pattern analysis, and forensic anthropology.
- Explore the ethical responsibilities and legal considerations associated with forensic science, including the presentation of evidence in court.

Teaching Hours: 47

Unit-I (Teaching Hours-10)

Definition of forensic science; scope and need of forensic science; Functions of Forensic Science; Evidence; classification of evidence: according to Indian Evidence Act, based on nature of evidence, class and individual evidence; Principles of forensic science; Frye Rule; Daubert Standards; Terminologies in forensic science: First responder, chain of custody, mahazaar; Code of conduct for forensic scientists; Qualifications of forensic scientists; Duties of forensic scientists; Data depiction; Report writing. Ethics in Forensic Science

Unit-II (Teaching Hours-12)

Pioneers in Forensic Sciences: History and development of branches of forensic science: forensic biology, forensic chemistry and toxicology, forensic anthropology, fingerprints, questioned document examination, forensic ballistics, digital and cyber forensics, forensic audio analysis, forensic psychology; Contribution of Sir Edgar Hoover through the FBI

Unit-III (Teaching Hours-11)

Forensic Science Laboratories in India: history, development and hierarchical set up; Directorate of Forensic Science Services, Central, State and Regional Forensic Science Laboratories; Mobile Crime Laboratories; Branches of Forensic Science Laboratories (definition and functions): Forensic Biology, DNA, Forensic Chemistry, Forensic Toxicology, Narcotics Unit, Forensic Physics, Forensic Ballistics, Forensic Psychology, Questioned Documents, Computer Forensics, Forensic Audio Analysis

Unit-IV (Teaching Hours-14)

Functions and hierarchical set up of Law enforcement agencies: civil police, reserve police; Government Examiners of Questioned Documents; Fingerprint Bureaus; National Crime Records Bureau; Police & Detective Training Schools; Bureau of Police Research& Development; National and State Police Academies; Police Training Schools/Colleges, Dog Squad, Bomb Detection and Defusal Squad; RAW, CBI, INTERPOL and FBI

Course Outcomes:

By the end of the course, students should be able to:

- Identify and describe the major branches of forensic science and their respective roles.
- Demonstrate proficiency in basic crime scene investigation techniques.
- Apply foundational knowledge to evaluate and analyze common types of forensic evidence.
- Understand the ethical guidelines and legal procedures relevant to the practice of forensic science.

Assessment Model:

- Average of best four out of six Quizzes (20 Marks)-20 Marks
- Average of Two Mid-Terms (50 Marks) –15 Marks
- Attendance Marks(05 Marks)-05 Marks
- End-Term (100 Marks) – 60 marks

Total Assessment (Out of 100 Marks)

Preferred Reading:

- "Criminal Profiling: An Introduction to Behavioral Evidence Analysis"(2011): Brent E. Turvey, Academic Press.
- Techniques of Crime Scene Investigation (2013): Barry A.J. Fisher and David R. Fisher, CRC Press.
- Criminalistics: An Introduction to Forensic Science (2014): Saferstein R, Pearson.
- Forensic Science: An Introduction to Scientific and Investigative Techniques (2014): Max M. Houck, Jones & Bartlett Learning.
- "Forensic Science: An Introduction to Criminalistics" (2019): Peter DeForest, Robert Gaensslen, and Henry C. Lee, McGraw-Hill Education.

Practicals:

1. Identifying and classifying evidence from a given case study.
2. Using the principle of probability on a case study with respect to one evidence
3. Tracing the use of forensic science from any one of the following: a. Aarushi Talwar case b. Nirbhaya case
4. Tracing the use of forensic science from any one of the following: a. Ted Bundy b. The Lindberg Kidnapping
5. Analysis of Daubert vs Merrell Dow Pharmaceuticals case study
6. Identifying evidence and relating the branch of forensic science that it should be sent to from a case study.
7. Writing a forensic report on a crime case from a case study.
8. Using a case study identify the agencies that need to be involved in the process of investigation with proper justification.
9. Examine the latest report of NCRB and study the data pertaining to murder cases in

India using digital pie charts and graphs for depiction.

10. Understanding the hierarchical set up of different forensic science establishments and suggest improvements

Assessment and Evaluation:

- Lab work:10 marks
- Record:10 marks
- Viva-voce:10 marks

Total Assessment: Average of best seven practical's out of all the weekly practical's(30 Marks)

Course Code	Course Title	L	T	P	Credit
UFS-102	Chemistry I	4	0	2	5

Prerequisites: Students should possess foundational knowledge and skills in introductory chemistry**;** basic concepts of organic and inorganic chemistry, biomolecules, acids and bases, and laboratory reagents relevant to biochemistry and analytical techniques.

Course Objective:

- Introduce fundamental concepts of chemistry essential for understanding forensic science principles.
- Develop a clear understanding of atomic structure, molecular calculations, and chemical bonding.
- Explain basic thermodynamic and kinetic principles relevant to chemical reactions in forensic analysis.
- Familiarize students with acid-base theories and their applications in chemical and forensic contexts.
- Impart foundational knowledge of organic chemistry, particularly hydrocarbons, required for forensic investigations.

Teaching Hours: 48

Unit-I (Teaching Hours-12)

Concept of Chemistry: Matter; States of matter; Concept of atom (theories), electronic configuration of elements. Deducing molecular formula and empirical/chemical formula from molecular weight, Molecular mass, mole concept, normality, molarity, molality, mole fraction, deduction of empirical and molecular formula from molecular weight, Quantum numbers, Afbau's principle, Hund's rule, Pauli's exclusion principle, effective nuclear charge. Atomic orbitals-shapes of s, p and d orbitals; isotopes-their types, characteristics and properties; definitions of isotones and isobars.

Chemical bonding: covalent bonding-general characteristics and coordinate covalent bond; valence bond approach; σ and π bonds, bond length, bond order and formal charge; VSEPR theory and molecular geometry; hybridization and its types (sp, sp^2, sp^3, sp^3d and sp^3d^2); hydrogen bonding-intermolecular and intramolecular hydrogen bonding and valence bond treatment.

Unit-II (Teaching Hours-12)

Chemical kinetics-concept of reaction rates; simple chemical reactions; zero-, first-, second- and pseudo-order reactions; integrated rate equations, half-life and mean life; order and molecularity of reactions; factors affecting reaction rates including temperature, pressure and catalysts; Arrhenius equation and activation energy. Kinetic theory of gases-postulates and derivation of kinetic gas equation; ideal and real gases; deviation from ideal behaviour, compressibility factor and causes of deviation; van der Waals equation of state. Properties of liquids-surface tension and its determination using stalagmometer; viscosity and determination of coefficient of viscosity using Ostwald viscometer; qualitative effect of temperature on surface tension and viscosity.

Unit-III (Teaching Hours-10)

Arrhenius concept of acids and bases, Brønsted-Lowry acid base theory and conjugate acid-base pairs, Lux-Flood concept with applications in oxide systems, Solvent system concept of acids and bases, Lewis acid-base concept and coordination compounds, Comparison and limitations of different acid-base theories, Classification of acids and bases as hard, soft, and borderline, HSAB principle, Potentiometric titrations, Conductometric titrations, Acid–base reactions in qualitative and quantitative forensic analysis, acidity/basicity in biological samples (blood, urine, gastric contents), acid-base strength and hardness and softness, Symbiosis.

Unit-IV (Teaching Hours-14)

Physical effects and electronic displacements in organic molecules-inductive, electromeric and resonance effects, and hyperconjugation; bond cleavage processes-homolytic and heterolytic fission. Structure, shape and reactivity of organic molecules; nature and role of nucleophiles and electrophiles. Reactive intermediates-carbocations, carbanions and free radicals. Conformational analysis of ethane, butane and cyclohexane; interconversion of wedge, Newman, sawhorse and Fischer representations. Stereochemistry-concept of chirality (up to two chiral carbon atoms); geometrical and optical isomerism including enantiomers, diastereomers and meso compounds; threo and erythro forms; D-L and cis-trans nomenclature; CIP rules for R/S (up to two chiral centres) and E/Z nomenclature (up to two C=C systems).

Course Outcomes:

By the end of the course, students should be able to:

- Explain the basic concepts of matter, atomic structure, electronic configuration, and periodic trends.
- Perform quantitative chemical calculations involving mole concept, concentration terms, and molecular formula determination.
- Understand and apply principles of thermodynamics and chemical kinetics to simple chemical reactions.
- Differentiate between various acid–base theories and apply HSAB principles to chemical systems.
- Describe the chemistry, nomenclature, reactions, and conformational behaviour of alkanes and cycloalkanes relevant to forensic chemistry.

Assessment Model:

- Average of best four out of six Quizzes (20 Marks)-20 Marks
- Average of Two Mid-Terms (50 Marks) –15 Marks
- Attendance Marks(05 Marks)-05 Marks
- End-Term (100 Marks) – 60 marks

Total Assessment (Out of 100 Marks)

Preferred Reading:

- Forensic Science, Handbook, Volume I (2001): Saferstein Richard, Prentice Hall.
- Textbook of Organic Chemistry (2017): Morrison R.T. and Boyd R.N., Pearson Education.
- Physical Chemistry (2018): Atkins P. and de Paula J., Oxford University Press.
- Inorganic Chemistry (2014): Huheey J.E., Keiter E.A. and Keiter R.L., Pearson Education.

- Essentials of Forensic Science (2015): Siegel J.A., Saukko P.J. and Knupfer G.C., Academic Press (Elsevier).

Practicals:

1. To determine the boiling point of given liquid.
2. To determine the melting point of given organic compound
3. To prepare the Normal, Molar and Standard solutions
4. Preparation of buffer solutions and measure their pH using pH meter.
5. To separate the components of two immiscible liquids by liquid-liquid extraction.
6. To analyse the various acid and basic radical in given salt using qualitative analysis.
7. To examine the corrosive chemicals in crime exhibits of acid/alkali in vitriol age cases.
8. To separate the green leaf pigments (spinach leaves may be used) and determination of Rf values using thin layer chromatography.
9. To separate the mixture of dyes using cyclohexane and ethyl acetate (8.5: 1.5) and determination of Rf values using thin layer chromatography.
10. To determine the amount of chlorine in the given sample of water by titrating it against N/20 sodium thiosulphate solution.
11. Determination of pH of a solution using pH meter.
12. To study the distribution of iodine between water and CCl_4.

Assessment and Evaluation:

- Lab work:10 marks
- Record:10 marks
- Viva-voce:10 marks

Total Assessment: Average of best seven practical's out of all the weekly practical's(30 Marks)

Course Code	Course Title	L	T	P	Credit
UFS-103	**Criminology**	**4**	**0**	**0**	**4**

Prerequisites: This course explores the theoretical foundations and empirical aspects of criminology. Students will examine the causes of criminal behavior, the societal response to crime, and the role of law enforcement and criminal justice systems.

Course Objectives:

- Analyze various criminological theories to understand the causes and motivations behind criminal behavior.
- Explore the components and functions of criminal justice systems at local, national, and international levels.
- Examine the social and psychological impact of crime on individuals and communities.
- Investigate and evaluate crime prevention strategies and intervention programs.

Teaching Hours: 48

Unit-I (Teaching Hours-10)

Crime: definition, characteristics of crime, elements of crime, and crime triangle; Criminology – definitions, historical perspectives, nature, origin, and scope. Theories of Criminology: Pre-Classical, Classical, Neo-Classical, Positivist, Biological, Social Learning Theory, Differential Association theory, Labelling Theory, Containment theory and Routine Activity Theory.

Unit-II (Teaching Hours-10)

Causes of crime: Social, Economic, Political and Psychological; Social Problems and crime: Juvenile Delinquency, Prostitution, Dowry, drug abuse, and child labor. Types of Crime: Crimes against persons, violent crimes, sexual offences, crimes against property, cyber-crime, hate crimes and public disorder, emerging crimes. Types of Criminals: Habitual, Professional and White-Collar criminals.

Unit-III (Teaching Hours-15)

Historical Development of Penology and definitions of punishment, Concepts of correctional administration and types of punishments, Theories of punishment: Retributive, Prevention, Deterrence and Reformative Prisons: Historical development of Indian Prisons, Correctional Administration: Classification of Prisons and Prisoners, Non-Institutional Programmes-Probation, Parole, and After-Care. Unusual Problems in Correctional Institutions

Unit-IV (Teaching Hours-13)

Introduction to victimology: Meaning of victimology, Historical Development of Victimology; Victim and Victimization: Concept, Nature and Related Issues. Key Concepts in Victimology: Victim - Crime victim - Victim genesis -Victim Precipitation- General Victim- Victimization Proneness, Victim Responsiveness. Victim Psychology, Psychodynamics of Victimization- Primary Victimization, Secondary Victimization, Tertiary Victimization, Victim Vulnerability and Victimless Crimes

Course Outcomes:

By the end of the course, students should be able to:

- Discuss and critique major criminological theories.
- Analyze the structure and function of criminal justice systems.
- Assess the impact of crime on individuals and society.
- Propose and evaluate crime prevention strategies based on criminological principles.

Assessment Model:

- Average of best four out of six Quizzes (20 Marks)-20 Marks
- Average of Two Mid-Terms (50 Marks) –15 Marks
- Attendance Marks(05 Marks)-05 Marks
- End-Term (100 Marks) – 60 marks

Total Assessment (Out of 100 Marks)

Preferred Reading:

- Criminology and penology (2014): EI-Dakkak, P. D., Abu Dhabi: The Judicial Department
- Criminology: explaining crime and its context (2015): Brown, S. E., Esbensen, F. A., Geis, G, Elsevier Science; Routledge.
- Understanding Victimology: an Active-Learning Approach (2020): Clevenger, S., Higgins, G. E., Marcum, C. D., Navarro, J. N, Taylor and Francis.

Course Code	Course Title	L	T	P	Credit
UFS-104	**Environmental Studies**	**2**	**0**	**0**	**2**

Prerequisites: Students should possess foundational knowledge and skills in Basic Biology and environmental studies; Understanding of fundamental biological concepts including cell structure, basic plant and animal biology, and human physiology.

Course Objectives:

- Understand the components of the environment and recognize the interrelationship between human activities and natural systems.
- Analyze environmental issues and promote the concept of sustainable development.
- Understand major environmental laws and develop legal and ethical responsibility toward environmental protection.

Teaching Hours:32

Unit-I (Teaching Hours-6)

Multidisciplinary nature of environmental studies: Definition, scope and importance; components of environment –atmosphere, hydrosphere, lithosphere and biosphere, Concept of sustainability and sustainable development. Natural resources: Land resources and land use change, land degradation, soil erosion and desertification

Unit-II (Teaching Hours-9)

Deforestation: causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal population. Water Resources- Use and over-exploitation of surface and groundwater, floods, drought, conflicts over water (international and inter-state). Heating of earth and circulation of air; air mass formation and precipitation. Energy resources-renewable and non-renewable energy sources, use of alternate energy sources, Growing energy needs, Case Studies

Environmental Pollution: types, causes, effects and control, Nuclear hazards and human health risks.

Unit-III (Teaching Hours-8)

Ecosystem: Definition; Structure and function of an ecosystem; Energy flow in the ecosystem; Food chains, food webs and ecological succession.

Introduction, types, features, structures and functions of following ecosystems-Forest ecosystem; Grassland ecosystem; Desert ecosystem; Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

Climate change, global warming, ozone layer depletion, acid rain and its impacts, Solid waste management- control measures

Unit-IV (Teaching Hours-9)

Biodiversity: Levels of biological diversity: genetic, species and ecosystem diversity; Value of biodiversity, Biogeographic zones of India; biodiversity patterns and global biodiversity hotspots. India as a mega–biodiversity nation; Endangered and Endemic Species of India.

Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

Ecosystem and biodiversity services: ecological, economic, social, ethical, aesthetic and information value.

Environmental Laws: Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and Control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Chemical Weapons Convention (CWC), Issues involved in Enforcement of Environment Legislation, Public awareness.

Course Outcomes:

By the end of the course, students should be able to:

- Understand natural resources and evaluate limitations surrounding renewable and non-renewable resources.
- Understand the nuances of ecosystem and learn about behavior of various ecosystem
- Learn about the types, services and threats to our biodiversity and importance of conserving it.

Assessment Model:

- Average of best four out of six Quizzes (20 Marks)-20 Marks
- Average of Two Mid-Terms (50 Marks) –15 Marks
- Attendance Marks(05 Marks)-05 Marks
- End-Term (100 Marks) – 60 marks

Total Assessment (Out of 100 Marks)

Preferred Reading:

- Biodiversity –An Introduction 2nd edition (2004): Gaston K. J. and Spicer J. I., Blackwell Publishing.
- Fundamentals of ecology (2009): Dash and Dash, Tata McGraw-Hill Education
- Principles of Environmental Science (2019): William P. Cunningham, Mary Ann Cunningham, McGraw-Hill.
- Environmental Science: A global concern (2021): William P. Cunningham, Mary Ann Cunningham, McGraw- Hill Education.

Course Code	Course Title	L	T	P	Credit
UFS-106	**Biology I**	**3**	**0**	**2**	**4**

Prerequisites: Students should possess foundational knowledge and skills in the basic biology; understanding of fundamental biological concepts including cell structure, basic plant and animal biology, and human physiology.

Course Objectives:

- Gain a comprehensive understanding of the history, evolution, and various disciplines within forensic biology.
- Develop skills to study plant and animal anatomy.
- Introduction to Forensic techniques and instruments.

Teaching Hours: 38

Unit-I(Teaching Hours-10)

Cell biology: Origin of life and theories of evolution, discovery of cell, Cell theory, Ultra structure of prokaryotic & eukaryotic cell, Structural organization and functions of plasma membrane and cell wall of prokaryotes & eukaryotes. Cellular Organelles and Cytoskeleton structures (Microtubules, Microfilaments and Intermediate filaments). Biochemistry: Amino acids, proteins, enzymes, nucleic acids, carbohydrates, lipids, vitamins.

Unit-II(Teaching Hours-11)

Plant physiology: Plant anatomy, morphology of leaves, stem, flowers, roots, classification and taxonomy and system of classification of angiosperms (Bentham and Hooker) and Gymnosperms (chamberlain) scale. Mechanical and conducting tissue systems in plants Introduction to Insect biology: types of insects and their forensic significance.

Unit-III(Teaching Hours-10)

Human physiology: Introduction to Nervous system, respiratory system, digestive system, circulatory system, endocrine system, blood and its function, composition of blood, formation and types of blood cells, blood groups Introduction to osteology and odontology: Human skeletal system, Formation of bones, different types of bones, ossification, Dental structure of humans, types of teeth and arrangement.

Unit-IV(Teaching Hours-7)

Basic instrumentation: Beer and Lambert's law, colorimetry and spectrophotometry (UV & IR), principle, methods and application of chromatography, Basics of PCR, electrophoresis, centrifugation, Gel documentation, and its forensic applications

Course Outcomes:

By the end of the course, students should be able to:

- Identify and describe the major branches of forensic biology and their respective roles.
- Demonstrate proficiency in basic crime scene investigation techniques.
- Apply foundational knowledge to evaluate and analyze common types of forensic evidence.

Assessment Model:

- Average of best four out of six Quizzes (20Marks)-20 Marks

- Average of Two Mid-Terms (50 Marks) –15 Marks
- Attendance Marks(05 Marks)-05 Marks
- End-Term (100 Marks) – 60 marks

Total Assessment (Out of 100 Marks)

Preferred Reading:

- Lehninger Principles of Biochemistry 5th ed. (2005): Nelson and Cox, W.H Freeman.
- Harper's Illustrated Biochemistry (2009): Murray et.al McGraw Hill professional.
- Cell and molecular biology 3rd ed.: P.K Gupta, Rastogi publications.
- Cell Biology (1984): C.B Powar, Himalaya Publications**.**

Practicals:

1. Study of Instruments: Microscope, Autoclave, Hot air oven, Incubator, pH meter, Colorimeter, Centrifuge, Laminar air flow
2. Qualitative analysis of sugar (amylase), proteins, lipids and nucleic acids.
3. Study the effect of substrate concentration on enzyme activity.
4. Estimation of protein by Folin lowry method.
5. Estimation of DNA by DPA method & RNA by Orcinol method.
6. Staining of bacteria: Simple staining, Negative staining, Gram's Staining.
7. Study of aseptic techniques-preparation of cotton plugs for test tubes and pipettes, wrapping of petri plates, transfer of media and inoculum.
8. Study of conducting tissue, -xylem and phloem elements in angiosperms and Gymnosperms as seen in L.S. and R.C.S.
9. Study of beer-lamberts law using colorimeter.

Assessment and Evaluation:

- Lab work:10 marks
- Record:10 marks
- Viva-voce:10 marks

Total Assessment: Average of best seven practical's out of all the weekly practical's(30 Marks)

Course Code	Course Title	L	T	P	Credit
UFS-107	Physics I	3	0	2	4

Prerequisites: Students should possess foundational knowledge and skills in elementary physics**;** familiarity with basic physical principles such as light, wavelength, absorption, and simple instrumentation concepts applicable to spectrophotometry and electrophoresis.

Course Objectives:

- Provide fundamental understanding of classical mechanics, elasticity, and fluid dynamics relevant to physical evidence analysis.
- Develop knowledge of acoustics and sound phenomena with applications in architectural acoustics and forensic investigations.
- Introduce principles of geometrical and wave optics, including interference, diffraction, polarization, and optical instruments used in forensic examinations.
- Familiarize students with nuclear physics concepts, radiation, radioisotopes, and their applications and safety aspects in forensic science.
- Explain the working principles of lasers, holography, and optical fibers and their modern forensic applications.

Teaching Hours:39

Unit-I (Teaching Hours-8)

Interpretation and applications of Newton's laws of motion, Collisions, types of collisions and conservation laws in collisions. Pseudo forces, Elastic properties of matter, elastic constants and their interrelations. Bending of beams and it's bending moment. Fluid dynamics, Equation of continuity, Bernoulli's equation, Stream line and turbulent flow, Lines of flow in air foil, Posseuille's equation

Unit-II (Teaching Hours-9)

Velocity of sound, noise and sound Intensity measurement, echo, reverberation, Sabine's Formula, absorption coefficient and it's measurement, sound absorbing materials, transmission of sound and transmission loss, Musical sounds and their characteristics, Consonance and Dissonance, Acoustics of buildings and factors affecting Architectural Acoustics, Sound distribution in an auditorium, Introduction to ultrasonic waves

Unit-III (Teaching Hours-12)

Refraction through thin layers, thick lens, thick lens and lens combinations, Aberrations, Interference in thin films, fringes in wedge shaped films, Newton's rings, Simple table spectrometer, total internal reflection. Resolving power of optical instruments, Diffraction due to straight edge. Polarization, Birefringence, Huygen's & Ramsden's Eye-pieces & their comparison. nuclear properties and half-life**.**

Unit-IV (Teaching Hours-10)

Induced absorption, Spontaneous and stimulated emission, Population inversion, pumping process, Condition for lasing action, LASER-Production, types and working, properties and applications, Holography and it's applications. Optical fibers, Propagation of light through optical fiber, Angle of acceptance and numerical aperture.

Course Outcomes:

By the end of the course, students should be able to:

- Understand and evaluate Newtons's laws, fluid mechanics, sound and acoustic properties, including noise measurement, reverberation, and sound transmission relevant to forensic acoustics.
- Explain refraction, interference, diffraction, and polarization phenomena and use optical principles in spectrometry and optical analysis.
- Analyze optical instruments such as spectrometers and understand resolving power and total internal reflection.
- Describe nuclear properties, radioactive decay, and nuclear reactions, along with radiation hazards, protection methods, and waste disposal.
- Understand laser principles, population inversion, and holography, and identify their applications in forensic investigations.

Assessment Model:

- Average of best four out of six Quizzes (20 Marks)-20 Marks
- Average of Two Mid-Terms (50 Marks) –15 Marks
- Attendance Marks(05 Marks)-05 Marks
- End-Term (100 Marks) – 60 marks

Total Assessment (Out of 100 Marks)

Preferred Reading:

- Engineering mechanics (2009):R. K. Bansal, Laxmi Publications (P) Ltd.
- Engineering Mechanics (2010): D.P Sharma et al., Pearson.
- Engineering Physics: R. K. Gaur & S. L. Gupta, Dhanpat Rai Publications
- Engineering Physics: A. S. Vasudeva, S- Chand.
- University Physics (2007): J. C. Upadhyaya, Himalaya Publications.

Practicals:

1. Find the moment of inertia of a flywheel.
2. Study one-dimensional elastic collision using two hanging spheres.
3. Determine the wavelength of sodium light using Newton's Rings method.
4. Study attenuation loss in a single-mode optical fibre.
5. Determine laser parameters: (i) Power distribution within the laser, (ii) Beam spot size.
6. Study the V–I characteristics of a Zenner diode.
7. Examine the current–voltage characteristics of a PN junction.
8. Determine the focal length of a concave lens using a telescope using the relation $1/v - 1/u = 1/f$.

Assessment and Evaluation:

- Lab work:10 marks
- Record:10 marks
- Viva-voce:10 marks

Total Assessment: Average of best seven practical's out of all the weekly practical's(30 Marks)

Course Code	Course Title	L	T	P	Credit
UFS-106	Skill Enhancement	3	0	0	3

Prerequisites: Students should possess ability to comprehend basic scientific terms and communicate observations effectively in written and verbal form.

Course Objectives:

Teaching Hours:36

Unit 1 (Teaching Hours-8)

Foundations & Dynamics of Communication: The Communication Process: The cycle of encoding, transmission, decoding, and feedback. Definition & Nature: The essence and role of communication in human interaction. Networks & Flow:Vertical: Upward and downward communication within a hierarchy. Horizontal: Communication between peers. Diagonal: Cross-functional communication between different levels and departments. Barriers to Communication: Identifying and overcoming Physical, Language/Semantic, Socio-psychological, and Organisational hurdles. Gateways to Effectiveness: Strategies for communicative competence and choosing the appropriate channel/medium.

Unit 2 (Teaching Hours-10)

Communication Modes (Verbal & Non-Verbal): Verbal Communication: Oral: Forms, advantages, and disadvantages. Written: Forms, advantages, and disadvantages. Non-Verbal Communication (KOPPACT): Kinesics (Body Language), Oculesics (Eye Contact), Proxemics (Space), Para-language (Tone/Pitch), Artefacts (Appearance), Chronemics (Time), and Haptics (Touch). The Digital Dimension: Effective use of social media and the importance of digital literacy.

Unit 3 (Teaching Hours-10)

Receptive & Oral Productive Skills: Reading Competence: Significance, comprehension, gathering/evaluating ideas, and identifying context. Listening Skills: Understanding its role within the LSRW (Listening, Speaking, Reading, Writing) framework. Speaking & Presentation Skills: Core Elements: Fluency, vocabulary, grammar, and pronunciation. Functions: Interactional, transactional, and performance-based speaking. Public Speaking: Audience analysis, structuring messages, and using audio-visual aids. Methods of Delivery: Impromptu, Extemporaneous, Memorisation, Manuscript, and Outlining.

Unit 4: (Teaching Hours-8)

Professional Composition & Writing: Writing Foundations: Paragraph development techniques and essay writing structure.

Correspondence: Letter Writing: Personal, Official, and Business letters. Job Application: Cover letters and Resume writing.

Technical & Academic Writing: Report Writing: Structuring data and observations. Paper Writing: Academic research and formal documentation. Precise Writing: Summarising complex information concisely. Creative Expression: Story writing and narrative flow.

Course Outcomes:

By the end of the course, students should be able to:

- Understand the basic processes of communication, both verbal as well as non-verbal, nature, scope, and power of communication processes.
- Demonstrate cultural sensitivity in communication and appreciation of cultural variations of diverse socio-cultural contexts.
- Develop an awareness of the role of mass media in shaping public psyche, beliefs, and perceptions about social realities and build an informed and critical perspective.
- Analyse situations and audiences to make the right choices about the most effective and efficient ways to communicate and deliver messages.
- Assess various barriers in communication and develop communicative competence, thereby for effective communication.

Assessment Model:

- Average of best four out of six Quizzes (20 Marks)-20 Marks
- Average of Two Mid-Terms (50 Marks) –15 Marks
- Attendance Marks(05 Marks)-05 Marks
- End-Term (100 Marks) – 60 marks

Total Assessment (Out of 100 Marks)

Preferred Reading:

- Communication Skills (2024): P. D. Sanjay Kumar and Pushp Lata, Oxford University Press
- Business Communication: Concepts, Cases and Applications (2006): P. D. Chaturvedi and Mukesh Chaturvedi, Pearson Education
- Business Communication (2012): Meenakshi Raman and Prakash Singh, Oxford University Press
- Soft Skills for Everyone (2017): Jeff Butterfield, Cengage Learning.

SEMESTER II

Course Code	Course Title	L	T	P	Credit
UFS-151	Chemistry II	4	0	2	5

Prerequisites: This course delves into the principles and applications of organic and analytical chemistry relevant to forensic science. Students will explore the chemical structure of organic compounds, analytical techniques, and their application in forensic investigations.

Course Objectives:

- Provide fundamental understanding of organic chemistry principles relevant to forensic applications.
- Explain electronic effects, reaction intermediates, and mechanisms governing organic reactions.
- Familiarize students with commonly used organic reagents and their chemical behavior.
- Introduce basic concepts of analytical chemistry, including qualitative and quantitative analysis techniques.
- Impart knowledge of UV-Visible spectroscopy and its application in structure elucidation and forensic analysis.

Teaching Hours: 46

Unit-I (Teaching Hours-12)

Organic chemistry: tetravalency of carbon; classification and nomenclature of hydrocarbons; structural and stereoisomerism; types of organic reactions-addition, substitution and elimination. Important organic reagents and their chemistry-$LiAlH_4$, $NaBH_4$, DIBAL-H, Lindlar's catalyst, LDA, $K_2Cr_2O_7$, $KMnO_4$, KOH, Grignard's reagent and $AlCl_3$.

Alcohols-preparation, properties and relative reactivity of 1°, 2° and 3° alcohols; glycols-preparation, properties and oxidative cleavage by periodic acid and lead tetraacetate; Pinacol–Pinacolone rearrangement. Phenols-preparation, properties and acidity; electrophilic aromatic substitution reactions; Reimer-Tiemann, Kolbe-Schmidt, Fries and Claisen rearrangements (with mechanism). Ethers and epoxides-preparation and reactions with acids; reactions of epoxides with alcohols and ammonia.

Unit-II (Teaching Hours-14)

Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; field, steric and solvent effects; bond polarity and bond energy. Homolytic and heterolytic fission with suitable examples; reaction intermediates and transition state; energy profile diagrams and Hammond postulate. Electrophiles and nucleophiles: definition, classification and examples; ambident nucleophiles; nucleophilicity and basicity and factors affecting them; solvent and steric effects. Types, structure, shape and relative stability of carbocations, carbanions and free radicals; classical and non-classical carbocations and rearrangements; spin density in free radicals. Carbenes and nitrenes: generation, singlet and triplet states, structure, stability and reactivity. Aromaticity, antiaromaticity and non-aromaticity; Hückel's rule and effect of conjugation on stability.

Unit-III (Teaching Hours-10)

Basic analytical chemistry: quantitative and qualitative analysis; accuracy and precision; errors and their classification. Separation techniques: distillation and fractional distillation; solvent extraction and solid-phase extraction; ion-exchange chromatography and its principles and applications. Titrimetric analysis: classification of titrations; acid-base titrations, redox titrations and complexometric titrations; indicators and end-point detection. Gravimetric analysis: principles, types of precipitates, co-precipitation and post-precipitation, drying and ignition, and applications.

Unit-IV (Teaching Hours-10)

Ultraviolet (UV) absorption spectroscopy: absorption laws (Beer-Lambert law); molar absorptivity; presentation and analysis of UV spectra; types of electronic transitions; effect of conjugation; concept of chromophore and auxochrome; bathochromic, hypsochromic, hyperchromic and hypochromic shifts; Woodward-Fieser rules and their application in calculating λmax of conjugated alkenes. Other spectroscopic techniques used in forensic science (brief): Infrared (IR) spectroscopy for functional group identification; Nuclear Magnetic Resonance (^{1}H and ^{13}C NMR) spectroscopy for structural elucidation; Mass spectrometry for molecular weight determination and fragmentation patterns; Atomic absorption/emission spectroscopy for elemental analysis; Raman spectroscopy for non-destructive material identification; fluorescence spectroscopy for trace and biological evidence analysis.

Course Outcomes:

By the end of the course, students should be able to:

- Classify, name, and explain the structure and reactions of hydrocarbons and organic compounds.
- Interpret electronic effects, reactive intermediates, and their role in determining reaction pathways and stability.
- Identify and apply common organic reagents in synthetic and analytical chemistry contexts.
- Perform basic qualitative and quantitative analytical techniques, including separation and titrimetric methods.
- Explain the principles of UV absorption spectroscopy and apply spectral rules for structural analysis of organic compounds.

Assessment Model:

- Average of best four out of six Quizzes (20 Marks)-20 Marks
- Average of Two Mid-Terms (50 Marks) –15 Marks
- Attendance Marks(05 Marks)-05 Marks
- End-Term (100 Marks) – 60 marks

Total Assessment (Out of 100 Marks)

Preferred Reading:

- Organic Chemistry: Morrison R. T. and Boyd R. N., Pearson Education, India.
- Organic Chemistry: McMurry John, Cengage Learning, India.
- A Guidebook to Mechanism in Organic Chemistry: Peter Sykes, Pearson Education,

India.

- Textbook of Analytical Chemistry: Vogel A. I., Pearson Education, India.
- Analytical Chemistry: Gary D. Christian, John Wiley & Sons, USA.
- Spectrometric Identification of Organic Compounds: Silverstein R. M., Webster F. X. and Kiemle D. J., John Wiley & Sons, USA.
- Principles of Instrumental Analysis: Skoog D. A., Holler F. J. and Crouch S. R., Cengage Learning, USA.
- Forensic Science Handbook, Volume I: Saferstein Richard, Prentice Hall.

Practicals:

1. Checking the calibration of the thermometer.
2. Determination of the melting points of above compounds and unknown organic compounds.
3. Determination of boiling point of liquid compounds (boiling point lower than and more than 100 °C by distillation and capillary method)
4. To separate the mixture of two amino acids by paper chromatography.
5. Volumetric analysis-To estimate the amount of oxalic acid present in 250ml of given solution using 0.02 M $KMnO_4$ solution.
6. To determine the strength of given $KMnO_4$ solution using standard ferrous ammonium sulphate solution.
7. To determine the Zn^{2+} ions by complexometric titration using EBT indicator.
8. Gravimetric analysis- To determine the concentration of chloride ions in water sample using Gravimetric analysis.
9. To verify the Lambert beer law using $KMnO_4$ / $K_2Cr_2O_7$ solution.

Assessment and Evaluation:

- Lab work:10 marks
- Record:10 marks
- Viva-voce:10 marks

Total Assessment: Average of best seven practical's out of all the weekly practical's(30 Marks)

Course Code	Course Title	L	T	P	Credit
UFS-152	Microbial Forensics	3	0	4	5

Prerequisites: This course explores the foundational concepts, structure, evolution and application of forensic science and microbiology, within the criminal justice system, with emphasis on both scientific principles and legal practice.

Course Objectives:

- Introduce the fundamental of forensic microbiology including scope, history and relevance in forensic investigations.
- Provide comprehensive knowledge of microorganisms.
- Develop understanding of microbial culture techniques used in forensic laboratories.
- Familiarize students with microorganisms involved in forensic and biocrime investigations.

Teaching Hours: 40

Unit-I (Teaching Hours-10)

Introduction to Microbiology and forensic microbiology, Basics of Microbiology; History of microbiology; Broad classification of microorganisms: bacteria, fungi, virus, algae, protozoa; Concepts of Pure culture techniques; Media: composition, preparation and inoculation, An overview of Scope of Microbiology.

Unit-II (Teaching Hours-10)

Diversity of Microbial World, Systems of classification, Difference between prokaryotic and eukaryotic microorganisms. General characteristics of different groups: Acellular microorganisms and Cellular microorganisms with emphasis on distribution and occurrence, morphology, mode of reproduction and economic importance.

Major incidents of microbial forensics, Classification of microorganisms involved in bio crimes: Anthrax, Influenza, Fungal and viral pathogens; Collection, Preservation and identification of specific microorganisms used in biocrimes.

Unit-III (Teaching Hours-10)

Algae: History of phycology, General characteristics, algae cell ultra-structure, asexual and sexual reproduction, life cycles in algae: Haplobiontic, Diplobiontic and Diplohaplontic. Applications of algae in agriculture, industry, environment and food.

Fungi: History of Mycology, General characteristics, ultra- structure, thallus organization and aggregation, fungal wall structure and synthesis, reproduction, heterokaryosis, heterothallism and parasexual mechanism. Economic importance of fungi with examples in agriculture, environment, Industry, medicine, food, biodeterioration and mycotoxins.

Unit-IV (Teaching Hours-10)

Methods of analysis sampling of microbial forensic investigations, toxin analysis using Microbial Culturing; Staining methods for identification; Design of genomic signatures for pathogen identification and characterization; inferential validation and evidence interpretation.

Bioterrorism: Historical cases; Different modes of terrorism using pathogenic microorganisms; Safety precautions for collection & preservation of samples; Forensic

aspects of biological toxins.

Course Outcomes:

Assessment Model:

- Average of best four out of six Quizzes (20 Marks)-20 Marks
- Average of Two Mid-Terms (50 Marks) –15 Marks
- Attendance Marks(05 Marks)-05 Marks
- End-Term (100 Marks) – 60 marks

Total Assessment (Out of 100 Marks)

Preferred Reading:

- Tortora GJ, Funke BR and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education
- Hester, R. E., & Harrison, R. M. (2008). Environmental Forensics. RSC Publishing
- Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition
- Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited
- Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9th Edition. McGraw Hill International.
- Atlas RM. (1997). Principles of Microbiology. 2nd edition. WM. T. Brown Publishers.
- Breeze, R. G., Budowle, B., & Schutzer, S. E. (2011). Microbial forensics. Burlington, MA: Elsevier Academic Press.
- Cano, R. J., Toranzos, G.A. (2017). Environmental Microbial Forensics. ASM Press.

Practicals:

1. To analyse the principles of sterilization techniques.
2. To study the principle and applications of instruments (microscope, biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter) used in the microbiology laboratory.
3. Preparation of culture media for microbial cultivation.
4. To analyse various culturing techniques of microbes.
5. To evaluate different microbial staining techniques.
6. To study the morphological classification of bacteria.
7. To study the biochemical characterization of bacteria.
8. To evaluate the growth patterns of microbes.

Assessment and Evaluation:

- Lab work:10 marks
- Record:10 marks
- Viva-voce:10 marks

Total Assessment: Average of best seven practical's out of all the weekly practical's(30 Marks)

Course Code	Course Title	L	T	P	Credit
UFS-153	Crime Scene Management	3	0	2	4

Prerequisites: Nil

Course Objectives:

- Understand the techniques behind the management of different crime scenes, including photography.
- Evaluate the importance of evidence and its correct collection, handling, and preservation techniques.
- Develop proficiency in the analysis and reconstruction of crime scenes and the presentation of evidence in court.

Teaching Hours: 41

Unit-I (Teaching Hours-10)

Introduction to Crime Scene Management Introduction to the crime scene; Types of crime scenes; Evaluation and processing of crime scenes; Securing the scene of the crime; Documenting the crime scene: Note making, sketching; Searching techniques of crime scene; Reconstruction of the scene of crime; Report writing of crime scene visits; Role of the first arriving officer and investigating officer at the crime scene; Manpower and logistics management of crime scene; Case studies

Unit-II (Teaching Hours-8)

Crime Scene Photography Types of crime scene photography; Cameras: SLR & DSLR, lenses, filters, films; Exposing, development, and printing; Different kinds of developers and fixers; Specialized photography: UV, IR, X-Ray; Photography using scientific equipment; Videography of crime scene.

Unit-III(Teaching Hours-11)

Introduction to Physical Evidence Introduction to physical evidence; Types of physical evidence; Classification and role of physical evidence in criminal investigations & trials; Processing of physical evidence: Discovering, recognizing, and examination of physical evidence; Collection, safety measures for evidence collection; Preservation, packaging, sealing, labeling, and forwarding of physical evidence; Maintaining the chain of custody; Probative value of physical evidence

Unit-IV (Teaching Hours-12)

Tools and Techniques for Crime Scene Investigation Tools: Basic kits, Investigator's kit, Tools used in the mobile laboratory; Techniques: Detective dyes, Speed detection devices, 3-D scanning technique, Neutron radiography, Tele forensic technology for crime scene investigation; Technology innovation in crime scene management; National and international scenario of crime scene management

Overview of the legal system; Role of forensic experts in court; Presentation of physical evidence in court; Preparation of expert witness testimony; Cross-examination techniques; Legal and ethical responsibilities of forensic experts

Course Outcomes:

On successful completion of this course, students will be able to:

- Apply skills in investigation, documentation, and reconstruction for crime scenes and makelogical deductions.
- Develop proficiency in crime scene photography.
- Process the standards for handling different types of evidence.
- Understand various tools and techniques for the analysis of different types of crime scene evidence. 5. Maintain the chain of custody for physical evidence and present findings effectively in a court of law.

Assessment Model:

- Average of best four out of six Quizzes (20 Marks)-20 Marks
- Average of Two Mid-Terms (50 Marks) –15 Marks
- Attendance Marks(05 Marks)-05 Marks
- End-Term (100 Marks) – 60 marks

Total Assessment (Out of 100 Marks)

Preferred Reading:

- Crime Scene Management (A Scientific Approach) (2009): M S Dahiya, Shanti Prakashan.
- Criminalistics: An Introduction to Forensic Science (2011): Richard Saferstein, Pearson.
- Fisher's Techniques of Crime Scene Investigation (2013): W.J. Tilstone, M.L. Hastrup, and C. Hald CRCPress, Boca Raton.
- Forensic Science: An Introduction to Scientific and Investigative Techniques (2013): CRC Press, S.H. James and J.J. Nordby, Boca Raton, CRC Press.
- Jay A. Siegel, Pekka J. Saukko, and Geoffrey C. Kooupfer, Encyclopedia of Forensic Science, Academic Press (2000).

Practicals:

1. Collecting and processing evidence.
2. Crime scene documentation.
3. To study the principle and applications of microscope.
4. Finger rolling technique and minutiae identification.
5. Lifting fingerprints from metal and glass surfaces.
6. Analyze and identify bloodstain patterns by performing bloodstain analysis.
7. Fiber and hair analysis.
8. Tire track analysis.

Assessment and Evaluation:

- Lab work:10 marks
- Record:10 marks
- Viva-voce:10 marks

Total Assessment: Average of best seven practical's out of all the weekly practical's(30 Marks)

Course Code	Course Title	L	T	P	Credit
UFS-154	**Fundamentals of Criminal Law**	**4**	**0**	**2**	**5**

Prerequisites: Nil

Course Objectives:

- Understand Key Legal Frameworks: Develop a foundational understanding of criminal law, including key legal terminology, court structures, and procedures under the IPC, CrPC, and IEA.
- Explore Law Enforcement Structures: Learn about national and international police organizations, their functions, and their role in criminal justice.
- Analyze Special Laws: Examine laws related to narcotics, explosives, environmental protection, and other socio-economic issues and their relevance to forensic science

Teaching Hours: 46

Unit-I (Teaching Hours-12)

Law Fundamentals : Definition of Law, Court, and Judge; Basic Terminology in Law; Introduction to Criminal Procedure Code (CrPC); FIR and Differences between Civil and Criminal Justice; Object of Punishment and Types of Punishment; Classification of Cases: Civil, Criminal; Essential Elements of Criminal Law; Constitution and Hierarchy of Criminal Courts, Cognizable and Non-Cognizable Offences; Bailable and Non-Bailable Offences; Sentences by Chief Judicial Magistrate;

Unit-II (Teaching Hours-12)

Section related to Forensic Science : IPC Sections related to Forensic Science (e.g., Sections 121A, 299, 302, 304A, 307, 309, 319, 320, 324, 3, 351, 354, 359, 362, 375 and 377andtheir amendments); Indian Evidence Act: Evidence and Rules of Relevancy, Expert Witness, cross-examination and re-examination of witness; CrPC Sections: 291, 291A, 292, 293

Unit-III (Teaching Hours-10)

Police Science: Definition and Scope of Police Science; Central Government Police Organizations: BPR&D, CBI, IB, RAW, NCRB, NICFS, NPA, UT Police Force; International Police Organization: INTERPOL; State Police Organization: Structure and Functions at State, Range, and District Levels

Unit-IV (Teaching Hours-12)

Acts Relating to Socio-Economic and Environmental Crimes: Narcotic Drugs and Psychotropic Substances Act; Essential Commodity Act; Drugs and Cosmetics Act; Explosive Substances Act; Arms Act; Dowry Prohibition Act; Prevention of Food Adulteration Act; Prevention of Corruption Act; Wildlife Protection Act; Information Technology (IT) Act; Environment Protection Act; Untouchability Offences Act

Merging Special Laws Relevant to Forensics: Integration of Special Laws into Forensic Practices; Comparative Analysis of Indian and International Laws; Case Studies involving Multiple Legal Frameworks; Practical Implications of Legal Mergers in Forensic Investigations; Current Trends and Updates in Forensic Law.

Course Outcomes:

By the end of the course, students should be able to:

- Apply Legal Knowledge: Demonstrate understanding of criminal law, legal procedures, and evidence rules in forensic contexts.
- Understand Police and Legal Institutions: Describe the structure and functions of police organizations and their impact on criminal investigations.
- Interpret Special Laws: Analyze and apply various laws related to drugs, explosives, environmental protection, and socio-economic issues.
- Engage with Forensic Evidence: Utilize knowledge of the IPC, CrPC, and IEA to handle forensic evidence and expert witness procedures.
- Navigate Legal Frameworks: Show proficiency in navigating the legal system and understanding the implications of different legal statutes for forensic science.

Assessment Model:

- Average of best four out of six Quizzes (20 Marks)-20 Marks
- Average of Two Mid-Terms (50 Marks) –15 Marks
- Attendance Marks(05 Marks)-05 Marks
- End-Term (100 Marks) – 60 marks

Total Assessment (Out of 100 Marks)

Preferred Reading:

- Law for the Expert Witness (1999):D.A. Bronstein, CRC Press, Boca Raton.
- Law of Evidence, 6th Edition (2006): Vipa P. Sarthi, Eastern Book Co., Lucknow.
- Criminal Law, 6th Edition (1983): A.S. Pillia, N.M. Tripathi Pvt Ltd., Mumbai
- Law of Crimes in India, Volume I (1965): R.C. Nigam, Asia Publishing House, New Delhi.
- (Chief Justice) M. Monir, Law of Evidence, 6th Edition, Universal Law Publishing Co. Pvt. Ltd., New Delhi (2002)

Practicals:

1. To study a crime case in which an accused was punished under different sections.
2. To study a case in which the Drugs and Cosmetic Act was invoked.
3. To study a case in which the Explosive Substances Act was invoked.
4. To study a case in which the Arms Act was invoked.
5. In light of Section 304B of the Indian Penal Code, cite a case involving dowry death.

Assessment and Evaluation:

- Lab work:10 marks
- Record:10 marks
- Viva-voce:10 marks

Total Assessment: Average of best seven practical's out of all the weekly practical's(30 Marks)

Course Code	Course Title	L	T	P	Credit
UFS-155	Forensic Entomology	2	0	0	2

Prerequisites: This course delves into the specialized field of forensic entomology, examining the role of insects in postmortem investigations. Students will explore the life cycles of forensic insects, their behavior, and the application of entomological evidence in estimating the time of death and other aspects of death scene investigations.

Course Objectives:

- Understand the basic principles and historical development of forensic entomology.
- Identify and classify common forensic insects.
- Explore the life cycles, behavior, and ecological roles of insects relevant to forensic investigations.
- Learn techniques for estimating the postmortem interval (PMI) based on insect evidence.
- Apply forensic entomology principles to assess and interpret insect evidence at crime scenes.
- Analyze case studies demonstrating the application of entomological evidence in real investigations.

Teaching Hours: 30

Unit-I (Teaching Hours-6)

History and Introduction to Forensic Entomology : History of Forensic Entomology, Insect Anatomy & Taxonomy, Insect Diversity: Forensically Relevant Insects, Insect Diversity: Forensically Relevant Diptera

Unit-II (Teaching Hours-9)

Insect Anatomy & Taxonomy : Chemical Attraction & Communication, Reproductive Strategies of Necrophagous Insects, Biology of Maggots & Temperature Tolerances of Necrophagous Flies, Insect Succession & Postmortem Decomposition

Unit-III (Teaching Hours-8)

Factors that Affect Insect Succession & Entomo-toxicology, Estimating Postmortem Interval, Forensically Important Aquatic insects; Postmortem Submergence Interval, Molecular Methods for Forensic Entomology, Legal Case Report Meetings

Unit-IV (Teaching Hours-7)

Urban & Stored Product Entomology, Necrophagous and Parasitic Indicators of Neglect and Abuse, Livestock & Veterinary Entomology, Insects as Weapons and Threats to National Security, Forensic Entomology and the Law

Course Outcomes:

By the end of the course, students should be able to:

- Identify and classify common forensic insects, understanding their significance in death investigations.
- Describe the life cycles, behavior, and ecological roles of forensic insects, considering the impact of environmental factors.
- Apply techniques to estimate the postmortem interval using entomological evidence,

recognizing the complexities involved.

- Evaluate crime scenes using forensic entomology principles, demonstrating the ability to contribute valuable insights to death investigations.

Assessment Model:

- Average of best four out of six Quizzes (20 Marks)-20 Marks
- Average of Two Mid-Terms (50 Marks) –15 Marks
- Attendance Marks(05 Marks)-05 Marks
- End-Term (100 Marks) – 60 marks

Total Assessment (Out of 100 Marks)

Preferred Reading:

- Textbook of Applied Entomology Vol. 1 (2010): K.P. Shrivastav, Kalyani Publications
- General and Applied Entomology, 2nd Edition (2004): B. V. David and Ananth Krishnan, Tata McGraw-Hill Education Pvt. Ltd.

Course Code	Course Title	L	T	P	Credit
UFS-156	Biology II	3	0	0	3

Prerequisites: Nil

Course Objectives:

- Introduce students to the classification, structure, and reproduction of primitive plant groups, including algae, fungi, lichens, bryophytes, gymnosperms and pteridophytes.
- Enable students to understand the ecological and economic importance of lower plants in environmental and industrial contexts.
- Familiarize students with the life cycles, adaptations, and distinguishing characteristics of representative genera from each group.

Teaching Hours:35

Unit-I (Teaching Hours-7)

Algae: General characteristics of algae, their classification based on Fritsch's system, structure and reproduction of selected genera forensically significant. Economic importance of algae in areas like food, biofertilizers, agar production, and medicine.

Unit-II (Teaching Hours-9)

Fungi and Lichens: general features of fungi, their modes of reproduction: asexual and sexual, detailed study of Rhizopus, Aspergillus, and Puccinia with simplified life cycles. Economic roles of fungi in antibiotics, food fermentation, and plant diseases. Lichens: structure, types and their ecological importance, especially as pollution indicators. Forensic significance of algae, fungi and lichen.

Unit-III (Teaching Hours -9)

Bryophytes: Introduction, general characteristics, habitat and distribution, alteration of generation, classification, morphology and anatomy, reproduction, evolutionary significance, major groups, life cycle, ecological and economic importance, forensic relevance of Bryophytes.

Gymnosperms: general characteristics, classification, morphology, anatomy, reproduction of Cycas and pinus, economic importance.

Unit-IV (Teaching Hours-10)

Pteridophytes: General features and the structure of representative genera, along with their ecological significance, evolutionary significance, Comparison with bryophytes and gymnosperms, classification, major groups, morphology and anatomy, external morphology, types of steles, reproduction, life cycle, ecological and economic importance, forensic relevance of pteridophytes.

Course Outcomes:

By the end of the course, students should be able to:

- Explain the characteristics, classification, and economic importance of algae.
- Describe the structure, reproduction, and significance of fungi and lichens.
- Understand the life cycles and ecological roles of bryophytes and pteridophytes.
- Identify the types of crime scenes and the roles of personnel in crime scene management.

- Apply biological and investigative techniques in crime scene documentation and reconstruction.

Assessment Model:

- Average of best four out of six Quizzes (20 Marks)-20 Marks
- Average of Two Mid-Terms (50 Marks) –15 Marks
- Attendance Marks(05 Marks)-05 Marks
- End-Term (100 Marks) – 60 marks

Total Assessment (Out of 100 Marks)

Preferred Reading:

- Biodiversity –An Introduction 2nd edition (2004): Gaston K. J. and Spicer J. I., Blackwell Publishing.
- A textbook of botany- Volume I: B.P Pandey
- Introductory Phycology: H.D. Kumar
- The Fungi: Sarah C. Watkinson, Lynne Boddy, and Nicholas P. Money
- Bryophyte Biology: B.Goffinet, A.J. Shaw

Course Code	Course Title	L	T	P	Credit
UFS-157	Physics II	3	0	0	3

Prerequisites: Nil

Course Objectives:

- Calculate forces, velocities, and accelerations
- Analyze collisions and conservation of momentum
- Understand rotational motion and torque
- Apply work-energy principles to solve problems
- Analyze vibrations and oscillations

Teaching Hours- 35

Unit-I (Teaching Hours-7)

Fundamentals of Mechanics: Coordinate systems and motion of a particle: Volume, velocity and acceleration in Cartesian and Spherical co-ordinate systems, Solid angle. Space Time Symmetry and Conservation Laws: Relationship of conservation laws of energy and momentum. Symmetries of space and time. Frames of Reference: Inertial frames of reference, Galilean transformation and Galilean invariance. Non-inertial frames, Coriolis force and its applications; Foucault‟s pendulum.

Unit-II (Teaching Hours-9)

Gravitational Force: Newton's Law of Gravitation, Various forces in nature. Properties of Gravitational Force: Central and non-central forces, Inverse square force, Centre of mass and gravity: Equivalent one body problem. Reduced mass, angular momentum in central force field. Equation of motion under a force law. Kepler's laws of Planetory Motion: Equation of orbit and turning points. Relationship between eccentricity and energy, Basic idea of global positioning system (GPS).

Unit-III (Teaching Hours -9)

Special Theory of Relativity: Concept of stationary universal frame of reference and search for ether. Michelson- Morley experiment, postulates of special theory of relativity. Lorentz transformations. Observer in relativity. Relativity of simultaneity. Effects of Relativity: Length contraction. Time dilation. Relativistic addition of velocities. Relativistic Doppler effect. Variation of mass with velocity and mass energy equivalence. Minkowsky space.

Unit-IV (Teaching Hours-10)

Radiation and nuclear physics, types of radiation, interaction of radiation, radiation detection and safety, applications in radiography, Applications of Radio Isotopes, Radiation hazards and levels of safety, Biological effects of nuclear radiation and protection methods, Nuclear disaster and waste disposal**.**

Course Outcomes:

By the end of the course, students should be able to:

- Calculate velocity, acceleration, and displacement
- Apply Newton's laws to solve problems
- Analyze energy and momentum conservation

- Understand rotational motion and torque.
- Apply mechanics principles to real-world problems

Assessment Model:

- Average of best four out of six Quizzes (20 Marks)-20 Marks
- Average of Two Mid-Terms (50 Marks) –15 Marks
- Attendance Marks(05 Marks)-05 Marks
- End-Term (100 Marks) – 60 marks

Total Assessment (Out of 100 Marks)

Preferred Reading:

- An introduction to mechanics (1973): D. Kleppner, R.J. Kolenkow, McGraw-Hill.
- Mechanics, Berkeley Physics, vol.1 (2007): C. Kittel, W. Knight, et.al. Tata McGraw-Hill. 2007
- Physics Resnick (2008): Halliday and Walker 8/e. Wiley.
- *Fundamentals of Physics* : D. Halliday, R. Resnick & J. Walker .Wiley
- R. Murugeshan – *Mechanics and Mathematical Physics*, S. Chand Publishing

SEMESTER III

Course Code	Course Title	L	T	P	Credit
UFS-201	Chemistry III	4	0	2	5

Prerequisites: Nil

Course Objectives:

- Provide a comprehensive understanding of periodic classification and periodic trends of elements.
- Explain fundamental concepts of chemical bonding and molecular structure.
- Introduce coordination chemistry and bonding theories relevant to forensic and analytical applications.
- Impart knowledge of properties and reactivity of s-, p-, and d-block elements.
- Develop the ability to correlate inorganic chemical principles with forensic science applications.

Teaching Hours: 46

Unit-I (Teaching Hours-12)

Periodic table and chemical periodicity: relationship between chemical periodicity and electronic structure of atoms; modern periodic law and long form of the periodic table; classification into s-, p-, d- and f-block elements. Periodic trends across periods and down groups: atomic and ionic radii, ionization enthalpy (ionization potential), electron affinity, electronegativity, valency, metallic and non-metallic character, magnetic properties and atomic radiation. Comparative study of s- and p-block elements; general group trends with special reference to electronic configuration, variable valency, color, magnetic and catalytic properties. Lanthanoids and actinoids: electronic configurations, oxidation states, color and magnetic properties; lanthanide contraction and its consequences; separation of lanthanides by ion-exchange method.

Unit-II (Teaching Hours-11)

Chemical bonding: ionic bonding-formation, properties and structures of ionic compounds; covalent bonding-formation, properties and structures of covalent compounds; concept of hybridization and types of hybridization with suitable examples. Molecular orbital theory: bonding and antibonding molecular orbitals; molecular orbital diagrams and bond order. Hydrogen bonding: intermolecular and intramolecular hydrogen bonding and their effects on physical and chemical properties.

Unit-III (Teaching Hours-12)

Coordination chemistry: coordination compounds-introduction, Werner's theory, nomenclature and isomerism. Ligands and complex ions: types of ligands, coordination number and chelation; coordination isomerism. Bonding theories in coordination compounds: valence bond theory, crystal field theory and molecular orbital theory. Valence bond theory (VBT): inner- and outer-orbital complexes of Cr, Fe, Co, Ni and Cu with coordination numbers 4 and 6; limitations of VBT. Crystal field theory (CFT): crystal field effect,

octahedral symmetry, crystal field stabilization energy (CFSE); crystal field effects in weak and strong ligand fields; spectrochemical series.

Unit-IV (Teaching Hours-11)

Chemistry of s-, p- and d-block elements-introduction, occurrence, electronic configuration and general properties. Main group elements: Group 1 and Group 2 elements-properties, reactivity and comparative trends of alkali and alkaline earth metals; important compounds and anomalous behavior of first member. Group 13 to Group 18 elements-occurrence, properties and chemistry of boron, carbon, nitrogen, oxygen, fluorine and noble gases; general group trends, oxidation states and allotropy; acid-base behavior of oxides and hydrides; comparative study within groups. d-block elements: general characteristics, variable oxidation states, complex formation, catalytic and magnetic properties. Applications of s-, p- and d-block elements in industry and environment.

Course Outcomes:

By the end of the course, students should be able to:

- Explain the relationship between electronic structure and periodic properties of elements.
- Describe ionic, covalent, and coordinate bonding along with molecular orbital and hybridization concepts.
- Apply bonding theories to explain structure, stability, and properties of coordination compounds.
- Identify and classify ligands, coordination numbers, and types of isomerism in coordination chemistry.
- Describe the chemistry, properties, and applications of s- and p-block elements relevant to forensic investigations.

Assessment Model:

- Average of best four out of six Quizzes (20 Marks)-20 Marks
- Average of Two Mid-Terms (50 Marks) –15 Marks
- Attendance Marks(05 Marks)-05 Marks
- End-Term (100 Marks) – 60 marks

Total Assessment (Out of 100 Marks)

Preferred Reading:

- Inorganic Chemistry (2016): James E. Huheey, Ellen A. Keiter, and Richard L. Keiter, Pearson Education India
- Concise Inorganic Chemistry (2007). J.D. Lee, Wiley India
- Inorganic Chemistry (2023): Gary L. Miessler, Paul J. Fischer, and Donald A. Tarr,Pearson India Education
- Textbook of Inorganic Chemistry for B.Sc. (2023). Dr. R. K. Gupta, R. Chand & Company Ltd.

Practicals:

Semi micro qualitative analysis of mixture containing not more than four radicals (including interfering and excluding insoluble)

1. Pb^{2+}, Hg^{2+}, Hg_2^{2+}, Ag^{+}, Bi^{3+}, Cu^{2+}, Cd^{2+}, As^{3+}, Sb^{3+}, Sn^{2+},

2. Fe^{3+}, Cr^{3+} ,Al^{3+} , Co^{2+} , Ni^{2+} , Mn^{2+} , Zn^{2+} , Ba^{2+} , Sr^{2+} , Ca^{2+} , Mg^{2+} , NH^{4+} , CO_3^{2-}, S^{2-}, SO_3^{2-}, $S_2O_3^{2-}$,
3. NO_2-, CH_3COO-, Cl-, Br-, I-, NO_3-, SO_4^{2-}, $C_2O_4^{2-}$, PO_4^{3-} , BO_3^{3-}
4. To estimate calcium content in chalk as calcium oxalate by permanganometry.
5. To prepare and submit Zinc sulphate ($ZnSO_4$)
6. To prepare and submit Boric acid(H_3BO_3)
7. To Determine alkali content in antacid tablet using HCl
8. To Estimate of hardness of water by EDTA method
9. To determine chloride ion by Mohr's Method & Volhard's method.
10. To Estimate ferrous and ferric by dichromate method.
11. To Prepare copper tetra ammine complex $[Cu(NH_3)_4]SO_4$
12. To Prepare cis and trans- bisoxalato diaqua chromate (III) ion.

Assessment and Evaluation:

- Lab work:10 marks
- Record:10 marks
- Viva-voce:10 marks

Total Assessment: Average of best seven practical's out of all the weekly practical's(30 Marks)

Course Code	Course Title	L	T	P	Credit
UFS-202	Basics of Computer & Artificial Intelligence	3	0	0	3

Prerequisites: Student should have basic knowledge of computer fundamentals and operating systems.

Course Objectives:

- Understand number systems and their applications in computing.
- Gain foundational knowledge of computer fundamentals, including hardware, software, and operating systems.
- Learn the basics of computer networking, internet technologies, and biometric systems.

Teaching Hours-38

Unit-I (Teaching Hours-8)

Computer Fundamentals, Definition and History of Computers; Key Terms and Concepts; Hardware vs. Software; Primary and Secondary Storage Devices; Basics of Operating Systems; Introduction to Filesystems; Windows and Linux OS Architectures; Introduction to Computer-Related Crimes.

Unit-II (Teaching Hours-9)

Basics of Computer Networking and Internet: Definition and Components of Computer Networks; Network Topology and Types; Introduction to OSI Layers and TCP/IP Protocol Suite; Communication Devices; IP and MAC Addresses; Understanding the Internet; Introduction to Websites and Webpages; Understanding Firewalls, IDS, and IPS; Introduction to Network and Internet-Related Crimes.

Unit-III (Teaching Hours-11)

Introduction to Artificial Intelligence: Definitions, Scope, and Relevance to Forensics, Basics of Forensic Science: Evidence Types, Chain of Custody, and Scientific Examination, Machine Learning Fundamentals: Supervised, Unsupervised, and Reinforcement Learning, Data Preprocessing in Forensic Science: Noise, Missing Values, and Normalization, Neural Networks and Deep Learning Basics, Natural Language Processing (NLP) in Legal and Forensic Documents, Computer Vision for Forensic Image and Video Analysis, AI-based Pattern Recognition in Fingerprints and Biometrics, Overview of AI Tools and Software Used in Forensics, Ethical, Legal, and Privacy Issues in AI-driven Forensics.

Unit-IV (Teaching Hours-10)

AI in Fingerprint Recognition and Comparison, Facial Recognition and Deepfake Detection, Voice and Speech Analysis for Speaker Identification, AI in Handwriting and Questioned Document Examination, Cyber Forensics: AI for Malware and Intrusion Detection, AI in DNA Profiling and Genetic Data Interpretation, AI-driven Toxicological and Chemical Analysis, Crime Scene Reconstruction using Virtual Reality and AI, Predictive Policing and Crime Pattern Analysis, Case Studies of AI Applications in Global Forensic Investigations.

Course Outcomes:

On successful completion of this course, students will be able to:

- Convert between different number systems and perform arithmetic and logical

operations on binary numbers.

- Understand the core concepts of computer hardware, software, and operating systems, and recognize computer-related crimes.
- Grasp the fundamental concepts of computer networking, including network topologies, OSI layers, and internet technologies.
- Familiar with the principles of biometric systems, including their technologies, processes, and performance measures.
- Apply their knowledge to perform practical tasks related to computer systems and biometric technologies.

Assessment Model:

- Average of best four out of six Quizzes (20 Marks)-20 Marks
- Average of Two Mid-Terms (50 Marks) –15 Marks
- Attendance Marks(05 Marks)-05 Marks
- End-Term (100 Marks) – 60 marks

Total Assessment (Out of 100 Marks)

Preferred Reading:

- Operating Systems: Internals and Design Principles, 9th Edition by William Stallings– Comprehensive overview of operating systems
- Modern Operating Systems by Andrew S. Tanenbaum– Detailed introduction to operating system principles.
- Structured Computer Organization, 6th Edition, by Andrew S. Tanenbaum Fundamental concepts in computer architecture.
- Computer Networks: A Top-Down Approach by James Kurose and Keith Ross Introduction to networking concepts and technologies.
- TCP/IP Protocol Suite, 4th Edition by Behrouz A. Forouzan– In-depth coverage of TCP/IP protocols and internet technologies

Course Code	Course Title	L	T	P	Credit
UFS-203	**Forensic Food Chemistry & Public Health**	**4**	**0**	**0**	**4**

Prerequisites: This course provides an in-depth understanding of food adulteration, focusing on the analysis of adulterants in food products. Students will learn about the detection techniques, health implications, and legal frameworks associated with food adulteration. Through theoretical knowledge and practical projects, the course aims to equip students with the skills necessary to identify and analyze food adulterants effectively

Course Objectives:

- To understand the various types of food adulterants and their health implications.
- To learn different techniques for detecting and analyzing food adulterants.
- To gain knowledge of the legal and regulatory frameworks related to food safety and adulteration.

Teaching Hours-40

Unit-I (Teaching Hours-10)

Introduction to Food chemistry: definition, scope, major food components, nutritional significance and health impact, food additives and preservatives, classification, natural v/s synthetic additives, preservatives, anti-oxidants, coloring and flavoring agents.

Unit-II (Teaching Hours-11)

Food Adulteration: Definition and types, Commonly adulterated foods and their impact on health, Analytical Techniques in Food Adulteration Chemical methods for detecting adulterants; Physical and sensory evaluation techniques; Chromatographic and spectroscopic methods; Use of biosensors in food adulteration analysis,

Unit-III (Teaching Hours-9)

Legal Framework and Food Safety Regulations National and international food safety laws; Standards and guidelines for food quality control; Role of agencies like FSSAI, WHO, and Codex Alimentarius; Legal consequences of food adulteration, Chronic and acute Public health impacts, Risk assessment and management strategies.

Unit-IV (Teaching Hours-10)

Emerging Trends in Food Adulteration and Detection Advances in detection technology; Nanotechnology in food safety; The role of AI and machine learning in adulteration analysis; Future challenges and opportunities in ensuring food safety, Forensic examination of food samples.

Course Outcomes:

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

- Identify common adulterants in various food products.
- Apply analytical techniques to detect and quantify food adulterants.
- Understand the health risks associated with different types of food adulteration.
- Interpret and comply with food safety regulations and standards.
- Conduct a comprehensive analysis of food products for adulteration and prepare detailed reports

Assessment Model:

- Average of best four out of six Quizzes (20 Marks)-20 Marks
- Average of Two Mid-Terms (50 Marks) –15 Marks
- Attendance Marks(05 Marks)-05 Marks
- End-Term (100 Marks) – 60 marks

Total Assessment (Out of 100 Marks)

- **Preferred Reading:**
- Food Adulteration: Detection and Control" by James S. Bus
- Chemical Analysis of Food: Techniques and Applications" by Yolanda Picó
- Food Safety and Protection: Protecting the Food Supply" by Vickie A. Vaclavik
- Food Adulteration and Contamination" by H.D. Singh
- Principles of Food Toxicology" by Tõnu Püssa.

Course Code	Course Title	L	T	P	Credit
UFS-204	Fundamentals of Question Document Examination	4	0	2	5

Prerequisites: Nil

Course Objectives:

- Introduce students to the foundational principles and scope of questioned document examination in forensic science.
- Develop a critical understanding of handwriting analysis, ink and paper examination, forgery detection, and document authentication techniques.
- Equip students with applied knowledge of analytical tools, legal frameworks, and professional practices involved in forensic document examination.

Teaching Hours: 41

Unit-I (Teaching Hours-9)

Introduction to Questioned Documents: Definition, scope and significance, History of questioned document examination, Types of questioned documents, Principles of handwriting identification, Class and individual characteristics, Natural variations and disguise, Signature and initials analysis, Types of forgery – freehand, traced, simulated, Hand-printed and numeral examination.

Unit-II (Teaching Hours-9)

Tools for handwriting comparison– magnifiers, microscopes, VSC, Collection and preservation of documents, Legal aspects and admissibility, Indian Evidence Act relevance, Self-study on handwriting and signature.

Ink, Paper, and Printing Analysis**:** Types of inks – writing, printing, stamp pad, Ink analysis – chromatography, spectrometry, VSC, Ink age estimation, Paper types and characteristics, Watermarks and fiber analysis, Brightness and thickness assessment, Printer types – inkjet, laser, dot-matrix.

Unit-III (Teaching Hours -10)

Typewriting and computer-generated documents, Detection of alterations – erasures, obliterations, Deciphering charred and indented documents, Tools – ESDA, oblique and IR/UV light, Digital tools in document examination, Font and typeface comparison, Chain of custody for document evidence, Self-study on forgery and ink.

Unit-IV (Teaching Hours-13)

Counterfeit documents– currency, passports, cheques, Security features – watermarks, holograms, UV, Authentication of certificates and banknotes, Examination of photocopied and scanned documents, Document dating and sequencing, Electrostatic detection techniques, Software tools – FISH, CEDAR-FOX, Role of expert witness, Report writing and case documentation, Indian legal provisions – IPC, CrPC, Evidence Act, Ethics in document examination, Case studies on frauds and forgeries, Self-study on security features and counterfeit detection.

Course Outcomes:

By the end of the course, students should be able to:

- Define the scope and importance of questioned document examination and

handwriting characteristics, forgery techniques, and signature identification and the historical development and classification of documents.

- Perform practical analyses of inks, papers, and printed materials using tools like VSC, chromatography, and spectrometry.
- Identify and evaluate advanced techniques such as ink dating, detection of erasures, obliterations, and counterfeit document analysis.
- Apply forensic procedures to analyze digital and photocopied documents and understand the use of electrostatic detection and software tools like FISH and CEDAR-FOX.
- Develop report writing and case documentation skills relevant for expert testimony in court.

Assessment Model:

- Average of best four out of six Quizzes (20 Marks)-20 Marks
- Average of Two Mid-Terms (50 Marks) –15 Marks
- Attendance Marks(05 Marks)-05 Marks
- End-Term (100 Marks) – 60 marks

Total Assessment (Out of 100 Marks)

Preferred reading:

- Morris, R. N. (2000). *Forensic* Handwriting Identification: Fundamental Concepts and Principles. Academic Press.
- Ellen, D. (2006). Scientific Examination of Documents: Methods and Techniques (3rd ed.). CRC Press.
- Kelly, J. S., & Lindblom, B. S. (2006). Scientific Examination of Questioned Documents. CRC Press.
- Roy, T. K., & Nabar, B. S. (2009). Forensic Science in Criminal Investigation and Trials. LexisNexis.
- Sharma, B. R. (2014). Forensic Science in Criminal Investigation & Trials (5th ed.). Universal Law Publishing.

Practicals:

1. Ink analysis- separation and comparison
2. Study of typewritten and printer generated documents
3. Handwriting writing identification
4. Natural variation in handwriting
5. Comparative handwriting analysis
6. Forgery detection-simulated and traced forgeries
7. Detection of alterations, erasures and obliterations
8. Examination of security features in documents

Assessment and Evaluation:

- Lab work:10 marks
- Record:10 marks
- Viva-voce:10 marks

Total Assessment: Average of best seven practical's out of all the weekly practical's(30 Marks)

Course Code	Course Title	L	T	P	Credit
UFS-205	Disaster Management	2	0	0	2

Prerequisites: Basic idea of the concept of disaster

Course Objectives: This course aims at enabling students to understand the various disasters and its management.

Teaching Hours-32

Unit-I (Teaching Hours-8)

Identifying the risk- probability of happening risk, Emerging risks, Government regulations. Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, Volcanic eruptions, Heat and cold waves, Climatic change: global warming, Sea level rise, ozone depletion.

Unit-II (Teaching Hours-7)

Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents.

Unit-III (Teaching Hours-8)

Disaster Management- Effect to migrate natural disaster at national and global levels. International strategy for disaster reduction. Concept of disaster management, Emerging approaches in Disaster Management - Three stages- Pre-disaster Stage (preparedness), Emergency Stage, Post Disaster stage – Rehabilitation

Unit-IV (Teaching Hours-9)

National disaster management framework; financial arrangements; role of NGOs, community –based organizations and media. Central, state, district and local administration; Armed forces in disaster response; Disaster response; Police and other organizations. Preplanning for a disaster, Eliminating, minimizing and shifting risk, Role of coordination in disaster management. Media relations and external communication during a disaster. After a disaster- minimizing the damage.

Course Outcomes:

By the end of the course, students should be able to:

- Understand natural, man-made and national disasters and their management.

Assessment Model:

- Average of best four out of six Quizzes (20 Marks)-20 Marks
- Average of Two Mid-Terms (50 Marks) –15 Marks
- Attendance Marks(05 Marks)-05 Marks
- End-Term (100 Marks) – 60 marks

Total Assessment (Out of 100 Marks)

Preferred Reading:

- Larry R. Collins: Disaster Management and Preparedness
- Jack Pinkowski: Disaster Management Handbook.

- R. B. Singh (1990): (ed) Environmental Geography, Heritage Publishers New Delhi.
- Savinder Singh (1997): Environmental Geography, Prayag Pustak Bhawann 1997
- Kates, B. I and White, G. F (1978): The Environment as Hazards, oxford, New York.
- R. B. Singh (2000): (ed) Disaster Management, Rawat Publication, New Delhi.
- H. K. Gupta (2003): (ed) Disaster Management, Universities Press, India.

Course Code	Course Title	L	T	P	Credit
UFS-206	Biology III	3	0	2	4

Prerequisites: Nil

Course Objectives:

- Understand key principles of plant ecology and ecosystem dynamics.
- Understand plant taxonomy concepts, plant structure and development.
- Analyze major physiological processes in plants
- Apply botanical knowledge to interpret functional adaptations.

Teaching Hours: 36

Unit-I (Teaching Hours-7)

Plant ecology & taxonomy: Introduction, soil origin, formation, composition, soil profile. General account on adaptions in xerophytes and hydrophytes.

Plant communities: characters, ecotone and edge effects, succession, hydrosere and Xerosere, Energy flow, Food chain and food webs, ecological pyramids, biogeochemical cycling (C, N, P, S).

Unit-II (Teaching Hours-8)

Introduction to plant taxonomy: identification, classification, nomenclature, taxonomic hierarchy, Botanical nomenclature: principles and rules (ICN) ranks and names, binominal system, typification, author citation, valid publication, rejection of names, principle of priority and its limitation, functions and importance of Herbarium, biometrics, numerical taxonomy and cladistics.

Unit-III (Teaching Hours -10)

Meristematic and permanent tissues of plant: root and shoot apical meristems, organs: structure of dicot and monocot root, stem and leaf, adaptive and protective systems (epidermis, cuticle, stomata), secondary growth in root and stem: vascular cambium Structural organization of flower, pollination, double fertilization, seed structure, appendages and dispersal mechanisms.

Unit-IV (Teaching Hours-11)

Plant physiology & metabolism: Introduction, Plant-water relation, mineral nutrition, translocation of phloem, photosynthesis: photosynthetic pigments, PS I and II, electron transport and mechanism of ATP synthesis, C3, C4 and CAM pathways of C fixation, photorespiration, glycolysis, anaerobic respiration, TCA cycle, oxidative phosphorylation, enzymes, plant growth regulators.

Course Outcomes:

By the end of the course, students should be able to:

- Discuss ecological principles and plant- environment interactions, community dynamics and nutrient cycling.
- Apply taxonomy rules to identify and classify plants, justify nomenclature decisions.
- Differentiate plant tissues and organs.
- Illustrate physiological processes and adaptive strategies in plants.

Assessment Model:

- Average of best four out of six Quizzes (20 Marks)-20 Marks
- Average of Two Mid-Terms (50 Marks) –15 Marks
- Attendance Marks(05 Marks)-05 Marks
- End-Term (100 Marks) – 60 marks

Total Assessment (Out of 100 Marks)

Preferred Reading:

- Supplementary physiology; Introduction to Plant Physiology (2002): Hopkins and Hunar.
- Plant physiology ecology (2019): Lambers, Chapin and Pons; Springer.
- Plant physiology and development (2022): L. Taiz, E. Zeiger, I. M. Mollar and A Murphy; Sinauer Associates, Oxford University Press.

Practicals:

1. Study of Soil Profile and Soil Analysis
2. Comparative study of xerophytic and hydrophytic plants
3. Study of Plant Communities and Ecological Parameters
4. Herbarium Techniques and Plant Identification Using Taxonomic Keys
5. Numerical Taxonomy/Biometrics and Cladistic Analysis
6. Study of Plant Tissues and Anatomy (Dicot & Monocot)
7. Study of Flower Structure, Pollination Mechanisms and Seed Dispersal
8. Physiological Experiments in Plants

Assessment and Evaluation:

- Lab work:10 marks
- Record:10 marks
- Viva-voce:10 marks

Total Assessment: Average of best seven practical's out of all the weekly practical's(30 Marks)

Course Code	Course Title	L	T	P	Credit
UFS-207	Physics III	3	0	2	4

Prerequisites: Nil

Course Objectives:

- Introduce the origin and development of quantum theory and its departure from classical physics.
- Explain the quantum nature of radiation and matter, including blackbody radiation, photoelectric effect, and matter waves.
- Develop understanding of wave–particle duality, uncertainty principle, and Schrödinger wave equation.
- Enable students to analyze one-dimensional quantum mechanical problems such as particle in a box and potential barriers.
- Provide knowledge of quantum tunneling and scattering, with relevance to modern physical and forensic technologies.

Teaching Hours-37

Unit-I (Teaching Hours-10)

Origin of Quantum Theory: Planck's quantum, Planck's constant and light as a collection of photons; Blackbody Radiation: Quantum theory of Light; Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves, Wave description of particles by wave packets. Group and Phase velocities and relation between them. Probability.

Unit-II (Teaching Hours-11)

Wave-Particle Duality & Schrodinger Wave Equation: Wave-particle duality, Heisenberg uncertainty principle, Derivation from Wave Packets impossibility of a particle following a trajectory. Two slit interference experiments with photons, atoms and particles, linear superposition principle as a consequence; Matter waves and wave amplitude. Schrodinger time independent equation; physical interpretation of a wave function, probabilities and normalization; Probability and probability current densities in one dimension.

Unit-III (Teaching Hours-8)

One dimensional problem: One dimensional infinitely rigid box- energy eigenvalues and eigenfunctions, normalization; Quantum dot as example; Quantum mechanical scattering and tunneling in one dimension- across a step potential & rectangular potential barrier.

Unit-IV (Teaching Hours-8)

Lasers & its applications: Einstein's A and B coefficients. Metastable states. Spontaneous and Stimulated emissions. Ruby Laser and He-Ne Laser, Basic lasing. Principle of Holography. Recording and Reconstruction Method. Theory of Holography as Interference between two Plane Waves. Point source holograms.

Course Outcome

By the end of the course, students should be able to:

- Understand the theory of quantum measurements, wave packets and uncertainty principle
- Understanding of good knowledge of lasing action (stimulated emission of radiation,

optical pumping and population inversion), construction of different laser systems and their working with specific examples in various fields

- Learning the quantum concepts of particle being in different potentials with a few specific cases of potential shapes

Assessment Model:

- Average of best four out of six Quizzes (20 Marks)-20 Marks
- Average of Two Mid-Terms (50 Marks) –15 Marks
- Attendance Marks(05 Marks)-05 Marks
- End-Term (100 Marks) – 60 marks

Total Assessment (Out of 100 Marks)

Preferred Reading:

- Introduction to Modern Physics (2002): Rich Meyer, Kennard, Coop,Tata Mc-Graw Hill
- Introduction to Quantum Mechanics (2005): David J. Griffith, Pearson Education
- Modern Physics for Scientists and Engineers (2004): J.R. Taylor, C.D. Zafiratos, M.A. Dubson, PHI Learning
- Schaum`s outline of Theory and Problems of Modern Physics (1999): R. Gautreau and W. Savin, 2nded, Tata McGraw-Hill Publishing Co. Ltd.

Practicals:

2. To determine the wavelength of the emission line of sodium lamp.
3. To study the Photo-electric effect.
4. To determine (i) wavelength and (ii) angular spread of He-Ne laser using plan diffraction grating.
5. Study the characteristics of a laser (laser diode): monochromaticity, divergence directionality, etc.
6. Determine the diameter of a thin wire by studying the diffraction (and interference pattern produced by it.
7. Determine the value of Planck's constant (h) using a photocell.
8. Conversion of a galvanometer into ammeter and voltmeter.
9. High resistance measurement using substitution method.

Assessment and Evaluation:

- Lab work:10 marks
- Record:10 marks
- Viva-voce:10 marks

Total Assessment: Average of best seven practical's out of all the weekly practical's(30 Marks)

SEMESTER IV

Course Code	Course Title	L	T	P	Credit
UFS-251	Chemistry IV	4	0	2	5

Prerequisites: This course explores the fundamental principles governing the behavior of non-carbon-based compounds, including atomic structure, chemical bonding, coordination chemistry, and the properties of main group and transition elements. Students will delve into the diverse applications of inorganic chemistry in fields such as materials science, biochemistry, and environmental science.

Course objectives :

- Understand the principles of atomic structure, chemical bonding, and periodic trends governing the behavior of inorganic compounds.
- Explore the complexities of coordination chemistry, including ligand binding, isomerism, and bonding theories.
- Analyze the properties and reactions of main group and transition elements, including their coordination chemistry and applications.
- Apply knowledge gained to solve problems in various interdisciplinary fields, such as materials science, bioinorganic chemistry, and environmental science.

Teaching Hours-47

Unit-I (Teaching Hours-12)

Transition metals: general properties of transition elements-electronic configuration, atomic and ionic radii, variable oxidation states, magnetic properties and colour; catalytic activity and alloy formation. Complex formation: stability constants, factors affecting stability, chelate effect, coordination number and coordination geometry. Transition metal complexes: synthesis, bonding, stability and applications; ligand field strength and spectrochemical series; metal–ligand bonding and back bonding; isomerism in transition metal complexes; applications of transition metal complexes in catalysis, biological systems and industrial processes.

Unit-II (Teaching Hours-11)

Organometallic chemistry: introduction to organometallic compounds-definition, nomenclature and classification; nature and types of metal-carbon bonds. Synthesis and reactions of organometallic compounds: methods of metal-carbon bond formation; fundamental organometallic reactions including oxidative addition, reductive elimination and migratory insertion; ligand substitution and β-hydride elimination (introductory). Applications of organometallic compounds in homogeneous catalysis and organic synthesis.

Unit-III (Teaching Hours-12)

Solid state chemistry: crystal structures-crystal systems, Bravais lattices and unit cells; Miller indices and interplanar spacing. Types of solids: ionic, metallic, covalent network and molecular solids; classification based on bonding and properties. Defects in solids: point defects (Schottky and Frenkel), line defects and planar defects; non-stoichiometric defects and impurity defects. Electrical and magnetic properties of solids; band theory of solids and

semiconductors (introductory).

Unit-IV (Teaching Hours-12)

Bioinorganic chemistry and its applications: role of essential and trace elements in biological systems; metal ions in biological processes. Bioinorganic chemistry of metalloproteins and metalloenzymes-hemoglobin and myoglobin, hemocyanin, cytochrome P_{450}, vitamin B_{12}, carboxypeptidase A and chlorophyll; structure-function relationships. Biological role of alkali and alkaline earth metal ions; nitrogen fixation; sodium-potassium pump and ion transport mechanisms. Metal ion toxicity and detoxification; medicinal and environmental applications of bioinorganic chemistry.

Course Outcomes:

By the end of the course, students should be able to:

- Demonstrate an understanding of the general properties of transition metals, including their electronic configurations, various oxidation states, and magnetic properties.
- Define organometallic compounds, apply appropriate nomenclature, and classify them based on their structures and properties.
- Equipped with the knowledge of crystal structures, including crystal systems, Bravais lattices, and Miller indices.

Assessment Model:

- Average of best four out of six Quizzes (20 Marks)-20 Marks
- Average of Two Mid-Terms (50 Marks) –15 Marks
- Attendance Marks(05 Marks)-05 Marks
- End-Term (100 Marks) – 60 marks

Total Assessment (Out of 100 Marks)

Preferred Reading:

- Inorganic Chemistry (2016): James E. Huheey, Ellen A. Keiter, and Richard L. Keiter, Pearson Education Limited.

Practicals:

1. To investigate oxidation state and Characterize transition metal ions using spectroscopic methods.
2. To determine the transition metals in given sample through redox titration.
3. To determine the metal complexes in given sample using techniques like UV- Visible spectroscopy.
4. To prepare organocopper compounds and characterize them by techniques like NMR, XRD.
5. To Prepare sodium trioxalate ferrate (III), $[Na_3[Fe(C_2O_4)_3]$ and determination of its composition by permaganatometry.
6. To prepare and submit Mercuric tetrathiocyanato cobaltate (II), $Hg[Co(SCN)_4]$.
7. To estimate the crystal structure of simple solids using X-Ray diffraction Technique.
8. To prepare organometallic compounds like Grignard Reagent and characterize them by techniques like NMR, XRD.
9. To study different parameters and crystallographic directions using crystallography software.
10. Application-oriented experiments, such as testing the properties of solid-state

materials in devices like solar cells, batteries.

Assessment and Evaluation:

- Lab work:10 marks
- Record:10 marks
- Viva-voce:10 marks

Total Assessment: Average of best seven practical's out of all the weekly practical's(30 Marks)

Course Code	Course Title	L	T	P	Credit
UFS-252	Fundamentals of Forensic Biology	4	0	2	5

Prerequisites: This course provides a foundational exploration of the fundamental principles of biology and serology, emphasizing the biological basis of forensic science. Students will delve into the study of living organisms, cellular structures, genetics, and the application of serological techniques in forensic investigations.

Course Objectives:

- Develop a comprehensive understanding of basic biological concepts, including cell biology, genetics, and the molecular basis of life.
- Explore the principles and techniques of serology, focusing on the identification and analysis of biological fluids and their forensic significance.
- Gain hands-on experience with laboratory methods commonly used in serological analysis.
- Understand the role of biology and serology in forensic investigations and its application in solving criminal cases.
- Foster critical thinking skills in the integration of biological principles into the field of forensic science.

Teaching Hours-46

Unit-I (Teaching Hours-10)

Overview of Forensic Biology, Definition and scope of forensic biology, Historical development and milestones in forensic biology, Branches, role and importance of forensic biology in criminal investigations. Types of biological evidence.

Unit-II (Teaching Hours-12)

Introduction to Hair as forensic evidence, definition and significance, types of hair evidence, human v/s animal, associative v/s individual evidence, limitation of hair evidence, structure and morphology of hair, anatomy, types, growth and life cycle, microscopic examination, hair damage and alteration, DNA analysis from hair, legal and reporting aspects.

Unit-III (Teaching Hours-12)

Wildlife forensic: Introduction, definition, scope and importance, types of wildlife crime, role of forensic science in wildlife conservation, national and international wildlife crime agencies, wildlife laws and legal framework, wildlife evidence and crime scene management, forensic identification of wildlife species, case studies and recent trends.

Unit-IV (Teaching Hours-12)

Animal and Plant evidence: Introduction to biological trace evidence, definition, types, characteristics, domestic v/s wild animal evidence, veterinary forensic relevance, skeletal and heart tissue evidence, plant evidence, forensic botany techniques, macro and microscopic examination, plant growth patterns and seasonal indicators, legal and ethical aspects.

Course Outcomes:

By the end of the course, students should be able to:

- Apply serological techniques to identify and analyze biological fluids in forensic samples.
- Utilize laboratory equipment and protocols for the examination of biological

evidence.

- Analyze and interpret serological findings to draw conclusions in the context of forensic investigations.
- Assess the significance of biological and serological evidence in legal proceedings.
- Develop critical thinking skills in the application of biological principles to real-world forensic scenarios.

Assessment Model:

- Average of best four out of six Quizzes (20 Marks)-20 Marks
- Average of Two Mid-Terms (50 Marks) –15 Marks
- Attendance Marks(05 Marks)-05 Marks
- End-Term (100 Marks) – 60 marks

Total Assessment (Out of 100 Marks)

Preferred Reading:

- Scientific Evidence in Civil and Criminal Cases, 4th Edition (1995): Moenssens, A.A., Starrs, J., Henderson, C.E., and Inbau, The Foundation Press, Inc., New York.
- Criminalistics, 8th Edition (2004): Saferstein, R, Prentice Hall, New Jersey.
- Techniques of Crime Scene Investigation (2013): Tilstone, W.J., Hastrup, M.L., and Hald, C. Fisher's, CRC Press, Boca Raton.
- Basic Principles of Forensic Chemistry (2013): Ballou, S., Houck, M., Siegel, J.A., Crouse, C.A., Lentini, J.J., and Palenik, S, Wiley-Blackwell, Chichester.

Practicals:

1. To determine blood group from fresh blood samples.
2. To determine blood group from dried blood sample.
3. To carry out the crystal test on a blood sample.
4. To identify blood samples by chemical tests.
5. To identify the given stain as saliva.
6. To identify the given stain as urine.
7. To carry out cross-over electrophoresis.
8. To study the Blood Pattern Analysis.
9. To perform DNA extraction.
10. Differentiate between human and non-human blood.

Assessment and Evaluation:

- Lab work:10 marks
- Record:10 marks
- Viva-voce:10 marks

Total Assessment: Average of best seven practical's out of all the weekly practical's(30 Marks)

Course Code	Course Title	L	T	P	Credit
UFS-253	Technological Methods in Forensic Science	3	0	2	4

Prerequisites: Nil

Course Objectives: This course provides a foundational exploration of the fundamental principles of analytical techniques and instrumentation, emphasizing the biological basis of forensic science. Students will delve into the study of principle and applications of various analytical techniques used in forensic investigations.

Teaching Hours-39

Unit-I (Teaching Hours-11)

Laboratory Accreditation and Validation of Methods, Instrumentation Sample preparation for chromatographic and spectroscopic evidence. Chromatographic methods. Fundamental principles and forensic applications of thin layer chromatography, gas chromatography and liquid chromatography. Electrophoresis – principles and forensic applications. Neutron activation analysis – principles and forensic applications.

Unit-II (Teaching Hours-9)

Spectroscopic methods, principles and forensic applications of Ultraviolet-visible spectroscopy, infrared spectroscopy, atomic absorption spectroscopy, atomic emission spectroscopy and mass spectroscopy. X-ray spectrometry. Colorimetric analysis and Lambert-Beer law.

Unit-III(Teaching Hours-11)

Microscopy: Introduction, Principles and Importance of Microscopy, Microscopic Techniques, Types and Applications in Forensic Examination, Comparison and Limitations of Microscopic Methods, Principles and Qualitative Analysis, Microscopy and Imaging Techniques, Types and Applications in Forensic Examination, Electrochemical Analysis Methods, Principles and Applications, Sample Preparation and Preservation Techniques, Extraction, Cleanup, Concentration Methods and Storage.

Unit-IV (Teaching Hours-8)

Forensic photography Basic principles and applications of photography in forensic science. 3D photography. Photographic evidence. Infrared and ultraviolet photography. Digital photography. Videography. Crime scene and laboratory photography.

Assessment Model:

- Average of best four out of six Quizzes (20 Marks)-20 Marks
- Average of Two Mid-Terms (50 Marks) –15 Marks
- Attendance Marks(05 Marks)-05 Marks
- End-Term (100 Marks) – 60 marks

Total Assessment (Out of 100 Marks)

Preferred Reading:

- Fundamentals of Analytical Chemistry, 6th Edition (1992):D.A. Skoog, D.M. West and F.J. Holler, Saunders College Publishing, Fort Worth.
- Organic Spectroscopy, 3rd Edition (1991):W. Kemp, Macmillan, Hampshire.
- Undergraduate Instrumental Analysis, 5th Edition (1995): J.W. Robinson, Marcel

Dekker, Inc., New York.

- The Practical Methodology of Forensic Photography, 2nd Edition (2000):D.R. Redsicker, CRC Press, Boca Raton.

Practicals:

1. Analyse and compare trace evidence such as hair, fibers, soil or glass fragments by using a comparison or high-powered digital microscope.
2. Use of various photographic techniques such as infrared and ultraviolet (UV) photography.
3. Use of cyanoacrylate fuming to visualize, lift and photograph invisible fingerprints from different surfaces.
4. Use of magnetic or fluorescent to visualize, lift and photograph invisible fingerprints from different surfaces.
5. Performing thin layer chromatography or paper chromatography to separate different color components of ink samples.
6. Extraction of DNA from a biological sample (fruit, cheek cells).
7. Separation of DNA fragments by performing gel electrophoresis.
8. Performing rapid chemical spot tests to indicate presence of specific illicit substances on a sample.

Assessment and Evaluation:

- Lab work:10 marks
- Record:10 marks
- Viva-voce:10 marks

Total Assessment: Average of best seven practical's out of all the weekly practical's(30 Marks)

Course Code	Course Title	L	T	P	Credit
UFS-254	Forensic Dermatoglyphics	4	0	2	5

Prerequisites: This course provides an in-depth exploration of the fundamentals of fingerprints and their crucial role in forensic science. Students will learn the principles of fingerprint identification, classification systems, and the use of advanced technologies in fingerprint analysis.

Course Objectives:

- Understand the anatomy of fingerprints and the various classification systems.
- Learn techniques for pattern recognition and ridge counting.
- Explore methods for lifting, preserving, and comparing fingerprints.
- Utilize fingerprint databases and automated identification systems.
- Familiarize students with cutting-edge technologies such as digital fingerprinting and biometric applications.
- Understand the role of fingerprints in forensic casework and crime scene investigations.

Teaching Hours-46

Unit-I (Teaching Hours-12)

Introduction and history, with special reference to India. Biological basis of fingerprints. Formation of ridges. Fundamental principles of fingerprinting. Types of fingerprints. Fingerprint patterns. Fingerprint characters/minutiae. Plain and rolled fingerprints. Classification and cataloguing of fingerprint record. Automated Fingerprint Identification System. Significance of poroscopy and edgeoscopy. Types of patterns and classification

Unit-II (Teaching Hours-12)

Latent prints. Constituents of sweat residue. Latent fingerprints' detection by physical and chemical techniques. Mechanism of detection of fingerprints by different developing reagents. Application of light sources in fingerprint detection. Preservation of developed fingerprints. Digital imaging for fingerprint enhancement. Fingerprinting the deceased. Developing fingerprints on gloves. Classification and Methods,

Unit-III (Teaching Hours-9)

Importance of footprints, Casting of foot prints in different mediums. Photography of footprints, Gait pattern, examination of gait pattern and its types. Electrostatic lifting of latent foot print.

Unit-IV (Teaching Hours-13)

Introduction to lip prints and its classification, history of lip pints & its collection , Introduction to ear prints-pattern of ear prints, Introduction to Palatal rugae, development, collection and identification, Brief Introduction of Digital Dermatoglyphic- , Introduction to iris and facial identification, modern methods for utilization of fingerprints, lip prints and ear prints, Digital Dermatoglyphics, Forensic criminal profiling using dermatoglyphics.

Course Outcomes:

By the end of the course, students should be able to:

- The fundamental principles on which the science of fingerprinting is based.
- Fingerprints are the most infallible means of identification.
- The world's first fingerprint bureau was established in India.
- The method of classifying criminal record by fingerprints was worked out in India, and by Indians. e. The physical and chemical techniques of developing fingerprints on crime scene evidence.
- The significance of foot, palm, ear and lip prints.

Assessment Model:

- Average of best four out of six Quizzes (20 Marks)-20 Marks
- Average of Two Mid-Terms (50 Marks) –15 Marks
- Attendance Marks(05 Marks)-05 Marks
- End-Term (100 Marks) – 60 marks

Total Assessment (Out of 100 Marks)

Preferred readings:

- Quantitative-Qualitative Friction Ridge Analysis (2000): D.A. Ashbaugh, CRC Press, Boca Raton.
- Fingerprints and other Ridge Skin Impressions (2004): C. Champod, C. Lennard, P. Margot, and M. Stoilovic, CRC Press, Boca Raton.
- Advances in Fingerprint Technology (2013): R.S. Ramotowski, Lee and Gaensleen, CRC Press, Boca Raton.

Practicals:

1. To record plain and rolled fingerprints.
2. To carry out ten-digit classification of fingerprints.
3. To identify different fingerprint patterns.
4. To carry out ridge tracing and ridge counting.
5. To develop latent fingerprint by physical and chemical method
6. To study dermatoglyphic pattern and atd angle in palm prints.
7. To study and compare the details of muddy or colored footprints with known sample.
8. Taking of lip prints and pattern determination along with minute.

Assessment and Evaluation:

- Lab work:10 marks
- Record:10 marks
- Viva-voice:10 marks

Total Assessment: Average of best seven practical's out of all the weekly practical's(30 Marks)

Course Code	Course Title	L	T	P	Credit
UFS-255	Biology IV	3	0	2	4

Prerequisites: This course provides an introduction to the principles and diversity of animal life, covering topics such as animal classification, morphology, physiology, behavior, and ecology. Students will explore the fundamental concepts underlying the structure, function, and behavior of animals, as well as their interactions with the environment.

Course Objectives:

- Introduce students to the basic concepts and principles of zoology.
- Familiarize students with the diversity of animal life and their classification.
- Develop an understanding of animal physiology, behavior, and ecological relationships.
- Instill an awareness of the importance of conservation and sustainable management of animal resources.

Teaching Hours-38

Unit-I (Teaching Hours-9)

Introduction to zoology: Definition and scope of zoology, History of zoology, Levels of organization in animals, Concepts of evolution and adaptation

Unit-II (Teaching Hours-10)

Animal diversity & classification: Principles of animal classification, Classification of major animal phylum, Morphological characteristics and evolutionary relationships, Diversity of invertebrates and vertebrates

Unit-III (Teaching Hours-12)

Animal Physiology & behavior: Principles of animal physiology Systems of the animal body: digestive, circulatory, respiratory, excretory, nervous, and reproductive.

Animal behavior: types, mechanisms, and adaptive significance. Ecological interactions: predation, competition, symbiosis

Unit-IV (Teaching Hours-7)

Animal ecology & conservation: Principles of animal ecology, Habitat and niche, Population dynamics and community ecology

Conservation biology: threats to biodiversity, conservation strategies, and initiatives

Course Outcomes:

By the end of the course, students should be able to:

- Demonstrate understanding of fundamental concepts in zoology, including animal classification, morphology, physiology, and behavior.
- Identify and describe the major animal phyla and their evolutionary relationships.
- Explain the physiological processes and behavioral adaptations of animals in various environments.
- Analyze ecological interactions and apply principles of conservation biology to address conservation challenges.

Assessment Model:

- Average of best four out of six Quizzes (20 Marks)-20 Marks

- Average of Two Mid-Terms (50 Marks) –15 Marks
- Attendance Marks(05 Marks)-05 Marks
- End-Term (100 Marks) – 60 marks

Total Assessment (Out of 100 Marks)

Preferred Reading:

- Zoology (2014): Dr. T.N. Ananthakrishnan, S. Chand & Company Ltd.
- Introduction to Zoology (2014): Dr. K.C. Choudhary, CBS Publishers & Distributors Pvt. Ltd.
- Principles of Animal Biology (2010): Dr. A. Saha, New Central Book Agency (P) Ltd.

Practicals:

1. Study of the development of frog from permanent slides.
2. Window preparation and identification of stages of development in chick egg.
3. Study of the development of chick embryo from permanent slides up to 96 hours.
4. Study of the following permanent slides: Stages of gametogenesis, structure of egg and sperm of a mammal.
5. Study of Larva of Herdmania.
6. Study of metamorphosis of Herdmania and Frog through charts/video.
7. Grass frog autopsy.

Assessment and Evaluation:

- Lab work:10 marks
- Record:10 marks
- Viva-voce:10 marks

Total Assessment: Average of best seven practical's out of all the weekly practical's(30 Marks)

Course Code	Course Title	L	T	P	Credit
UFS-256	Physics IV	3	0	2	4

Prerequisites: This course introduces students to the principles and theories governing the behavior of atoms and molecules. Starting from the basic concepts of atomic structure and spectroscopy, the course progresses to cover molecular structure, interactions, and spectroscopic techniques. Students will learn about quantum mechanics applied to atoms and molecules, as well as their relevance in various scientific fields.

Course Objectives:

- Understand the fundamental concepts of atomic and molecular physics.
- Analyze the structure, properties, and behavior of atoms and molecules.
- Explore the principles of spectroscopy and its applications in atomic and molecular systems.
- Apply quantum mechanical principles to describe atomic and molecular phenomena.

Teaching Hours-38

Unit-I (Teaching Hours-11)

Historical Development of Atomic Theory, Bohr's Model of the Hydrogen Atom, Quantum Mechanical Model of the Atom, Atomic Orbitals and Quantum Numbers, Electronic Configurations of Atoms, Atomic Spectra and Spectral Lines, Types of Spectroscopy (Absorption, Emission, Fluorescence), Interaction of Light with Matter, Zeeman Effect and Stark Effect, Photoelectron and Applications of Atomic Spectroscopy.

Unit-II (Teaching Hours-10)

Elastic and Inelastic Collisions, Kinematics of Collisions, Cross Sections and Reaction Rates, Electron-Ion Collisions, Electron-Molecule Collisions, Ion-Molecule Collisions, Energy Transfer in Collisions, Reaction Dynamics, Collision-Induced Absorption, Applications of Collision Theory in Astrophysics and Plasma Physics

Unit-III (Teaching Hours-9)

Postulates of Quantum Mechanics, Schrödinger Equation and its Interpretation, wavefunctions and Probability Density, Operators and Observables. Quantum Mechanical Harmonic Oscillator, Hydrogen Atom in Quantum Mechanics Perturbation Theory, Approximation Methods and applications of Quantum Mechanics.

Unit-IV (Teaching Hours-8)

Laser and X-ray spectroscopy and its applications, Quantum dynamics of atomic and molecular systems, Quantum information and computation, Applications in condensed matter physics and biophysics.

Course Outcomes:

By the end of the course, students should be able to:

- Describe the structure of atoms and molecules using quantum mechanical models.
- Analyze atomic and molecular spectra to determine electronic and vibrational transitions.
- Explain the principles of molecular bonding and molecular symmetry.
- Apply theoretical concepts to interpret experimental data and solve problems in

atomic and molecular physics.

Assessment Model:

- Average of best four out of six Quizzes (20 Marks)-20 Marks
- Average of Two Mid-Terms (50 Marks) –15 Marks
- Attendance Marks(05 Marks)-05 Marks
- End-Term (100 Marks) –60marks

Total Assessment (Out of 100 Marks)

Preferred Reading:

- Atomic Physics" by Max Born. (2020), Publisher: Dover Publications.
- Molecular Physics" by Peter W. Atkins. (2018), Publisher: Oxford University Press.
- Atomic and Molecular Physics: Quantum Theory and Applications" by Immanuel Bloch and Jean Dalibard. (2017), Publisher: Oxford University Press.
- Introduction to Atomic and Molecular Spectroscopy" by Rita Kakkar. (2021), Publisher: Springer.
- "Atomic and Molecular Physics" by Raj Kumar. (2019), Publisher: S. Chand & Company Ltd., India.
- "Introduction to Atomic and Molecular Physics" by G. S. Agarwal. (2016), Publisher: Cambridge University Press.

Practicals:

1. Set up the Franck-Hertz experiment to demonstrate quantized energy levels in mercury atoms.
2. Determine low resistance using Carey Foster bridge.
3. Study of solar cell characteristics.
4. Find the width of a slit using LASER diffraction.
5. Determine the dispersive and resolving power of the material of a given prism using a mercury lamp.
6. Measure the wavelength of light from a given source using Michelson's interferometer.
7. Determine the value of Planck's constant (h) using a photocell.
8. Determine self-inductance using Anderson's bridge.

Assessment and Evaluation:

- Lab work:10 marks
- Record:10 marks
- Viva-voice:10 marks

Total Assessment: Average of best seven practical's out of all the weekly practical's(30 Marks)

SEMESTER V

Course Code	Course Title	L	T	P	Credit
UFS-301	Chemistry V	4	0	2	5

Prerequisites: This course provides a comprehensive introduction to the principles and applications of physical chemistry. Topics covered include thermodynamics, kinetics, quantum chemistry, and spectroscopy. Practical experiments complement theoretical concepts, enhancing students' understanding of experimental techniques and data analysis.

Course Objectives:

- Understand the fundamental principles of thermodynamics, kinetics, surface chemistry, and electrochemistry.
- Apply mathematical and conceptual tools to solve problems related to physical chemistry.
- Develop practical skills in experimental techniques, data analysis, and interpretation.
- Explore the applications of physical chemistry in various scientific and technological fields.

Teaching Hours-46

Unit-I (Teaching Hours-10)

Chemical thermodynamics: chemical potential and its significance; partial molar properties-partial molar free energy, partial molar volume and partial molar heat content and their significance; determination of partial molar quantities. Concept of fugacity and methods of determination; fugacity coefficient. Laws of thermodynamics; thermodynamic systems and processes. Internal energy and enthalpy; entropy and Gibbs free energy and their applications to spontaneity and equilibrium.

Unit-II (Teaching Hours-12)

Chemical equilibrium: law of mass action; equilibrium constant and its significance; relationship between Kp and Kc; application of equilibrium concepts to homogeneous and heterogeneous equilibria; Le Chatelier’s principle and its applications to chemical equilibrium. Effect of temperature, pressure and concentration on equilibrium; equilibrium involving acids, bases and salts (introductory). Surface chemistry: adsorption-physical and chemical adsorption; adsorption isotherms-Freundlich, Langmuir and Gibbs adsorption isotherms; B.E.T. theory and surface area determination; applications of adsorption in catalysis and environmental processes.

Unit-III (Teaching Hours-12)

Chemical kinetics: reaction rate and rate laws; order and molecularity of reactions; zero-, first-, second- and third-order reactions with integrated rate equations and derivations; methods for determination of order of reaction. Complex reactions-opposing, consecutive and side reactions with reference to first-order kinetics. Effect of temperature on reaction velocity; Arrhenius equation; energy of activation; collision theory of reaction rates; concept of activated complex and transition state (introductory).

Unit-IV (Teaching Hours-12)

Electrochemistry: reversible and irreversible electrochemical cells; electromotive force (EMF) of a cell and its relation to free energy change; Nernst equation and its applications; equilibrium constant and standard electrode potential. Types of reversible electrodes; electrochemical series and its significance. Applications of EMF measurements-determination of solubility product, pH, dissociation constant of acids, hydrolysis constant and solubility of sparingly soluble salts; potentiometric titrations and reference electrodes (introductory).

Course Outcomes:

By the end of the course, students should be able to:

- Analyze and interpret thermodynamic properties, chemical equilibria, and phase behavior.
- Evaluate reaction rates, mechanisms, and factors influencing chemical kinetics.
- Explain the structure and function of metal-containing biomolecules such as hemoglobin, cytochromes, and chlorophyll.
- Apply bioinorganic chemistry concepts to biological processes and forensic interpretations involving metals and metal ions.

Assessment Model:

- Average of best four out of six Quizzes (20 Marks)-20 Marks
- Average of Two Mid-Terms (50 Marks) –15 Marks
- Attendance Marks(05 Marks)-05 Marks
- End-Term (100 Marks) – 60 marks

Total Assessment (Out of 100 Marks)

Preferred Readings:

- Physical Chemistry: A Molecular Approach (1997): Donald A. McQuarrie and John D. Simon, University Science Books.
- Physical Chemistry: Principles and Applications in Biological Sciences (2000): Gilbert W. Castellan, Pearson Education.
- Physical Chemistry: A Molecular Approach (2014): Peter Atkins and Julio de Paula, Oxford University Press**.**

Practicals:

1. Determination of heat of neutralization of a strong acid and strong base using calorimetry (First Law).
2. To determine the surface tension of a given liquid by drop number method.
3. To determine the viscosity of a given liquid**.**
4. To study the kinetics of hydrolysis of methyl acetate in presence of hydrochloric acid.
5. Determination of critical solution temperature for phenol-water system and study effect of impurities.
6. Conductometeric titration of a strong acid, a weak acid, mixture of a strong and weak acid and a dibasic acid with alkali.
7. Chemical Kinetics: Reaction Rate Determination
8. Spectroscopy: UV-Visible Absorption Spectra
9. Electrochemistry: Redox Titrations
10. Perform the potentiometric titrations of (i) Strong acid vs strong base, (ii) Weak acid

vs strong base and (iii) Mohr's salt vs $KMnO_4$.

Assessment and Evaluation:

- Lab work:10 marks
- Record:10 marks
- Viva-voce:10 marks

Total Assessment: Average of best seven practical's out of all the weekly practical's(30 Marks)

Course Code	Course Title	L	T	P	Credit
UFS-302	Forensic Biology & Serology	3	0	0	3

Prerequisites: Nil

Course Objectives:

- Introduce students to the nature, composition, and forensic significance of biological fluids and their role in criminal investigations.
- Develop the ability to identify and analyze various types of body fluids and stains using classical and modern forensic methods.
- Equip students with the skills to examine trace evidence such as hair, fibres, botanical specimens, and their forensic applications.
- Provide comprehensive knowledge on the extraction, quantification, and analysis of genetic material for forensic purposes.
- Familiarize students with the application of serological and biochemical techniques in solving forensic cases including paternity disputes and individual identification.

Teaching Hours: 37

Unit-I (Teaching Hours-9)

Introduction to forensic biology and serology, definition and scope, role and criminal investigation, types, individual v/s class characteristics, biological evidence at crime scene, blood, semen, saliva, urine, sweat, vaginal secretions. Collection techniques for wet and dry stains.

Unit-II (Teaching Hours-8)

Blood and its composition, Haemoglobin, Location and importance of body fluids, Nature and collection of body fluids, Identification of body fluids by tests, Blood grouping from stains of blood, Absorption-inhibition method, Mixed agglutination method, Absorption-elution method, Identification of seminal and other body fluid stains.

Unit-III (Teaching Hours -10)

DNA and RNA, Collection of biological samples for DNA analysis, Preservation of biological samples, DNA isolation techniques, DNA quantitation methods, Methods for DNA extraction from different biological samples, Quantification of DNA using various techniques, DNA Profiling Techniques, Polymerase Chain Reaction (PCR), Short Tandem Repeat (STR) analysis, DNA sequencing and its applications in forensic biology.

Unit-IV (Teaching Hours-10)

ABO blood grouping from stains, Paternity disputes and causes, Paternity index and probability calculation, Serological techniques, Biochemical methods in forensic analysis. Cellular antigens, ABO blood groups, Extracellular proteins and intracellular enzymes, Typing of Biochemical Markers, Forensic Significance of Biochemical markers for identification and individualization.

Course Outcomes:

By the end of the course, students should be able to:

- Understand and explain the forensic relevance of body fluids, their composition, and techniques used for their collection and identification.

- Apply blood grouping and serological techniques for the identification of body fluid stains and infer relevant biological information.
- Examine and interpret trace evidence such as hair, fibres, seeds, leaves, and pollen using morphological and microscopic techniques.
- Demonstrate the ability to collect, preserve, and analyze biological materials for DNA and RNA profiling.
- Evaluate forensic applications of genetic markers, serological techniques, and biochemical tests in crime investigation and paternity determination.

Assessment Model:

- Average of best four out of six Quizzes (20 Marks)-20 Marks
- Average of Two Mid-Terms (50 Marks) –15 Marks
- Attendance Marks(05 Marks)-05 Marks
- End-Term (100 Marks) – 60 marks

Total Assessment (Out of 100 Marks)

Preferred Reading:

- Inman, K., & Rudin, N. (2001). Principles and Practice of Criminalistics: The Profession of Forensic Science. CRC Press.
- White, P. C. (2004). Crime Scene to Court: The Essentials of Forensic Science (2nd ed.). Royal Society of Chemistry.
- Nordby, J. J. (2005). *Forensic Science:* An Introduction to Scientific and Investigative Techniques (2nd ed.). CRC Press.
- James, S. H., & Nordby, J. J. (2014). *Forensic Science:* An Introduction to Scientific and Investigative Techniques. CRC Press.
- Ballantyne, K. N., van Oorschot, R. A. H., & Mitchell, R. J. (2017). *Forensic DNA Typing Protocols*. Springer Protocols.
- Saferstein, R. (2018). Criminalistics: An Introduction to Forensic Science (12th ed.). Pearson.
- Sharma, B. R. (2019). Forensic Science in Criminal Investigation and Trials (6th ed.). Universal Law Publishing.

Course Code	Course Title	L	T	P	Credit
UFS-303	Cyber Forensics	3	0	2	4

Prerequisites: This course focuses on the investigation of digital crimes and the application of forensic techniques to digital evidence. Students will learn about digital forensic tools, cybercrime investigation, and the legal aspects of digital evidence.

Course Objectives:

- Develop skills in the proper collection and preservation of digital evidence.
- Understand the challenges of handling electronic evidence.
- Explore techniques for investigating cybercrimes, including hacking and digital fraud.
- Understand the role of digital forensics in solving cyber-related cases.
- Learn about the legal considerations and admissibility of digital evidence in court.
- Understand the ethical responsibilities of digital forensic investigators.

Teaching Hours-37

Unit-I (Teaching Hours-8)

Introduction to Cyber Forensics, Computer crime and Cyber-crime, Classification of cyber-crimes, Different types of attacks in cyber-crime. Cybercrime and digital evidence types, File systems (FAT, NTFS, exFAT) and data storage basics

Unit-II (Teaching Hours-10)

Acquisition of digital evidence (imaging and hashing), Chain of custody and evidence handling in cyber cases, Introduction to write blockers, Anti-forensics and countermeasures, Standards and guidelines (NIST, ISO), Role of forensic labs and CERT-In in digital crime cases, Software tools: FTK Imager, Autopsy, Belkasoft Evidence Center (overview)

Unit-III (Teaching Hours-7)

Software piracy, Hacking and its types. Investigating Information-hiding, Scrutinizing E-mail, Validating E-mail header information, Tracing Internet access, Tracing memory in real-time. IT act, cyber stalking, email bombing, various online frauds.

Unit-IV (Teaching Hours-12)

Cyber Forensics: AI for Malware and Intrusion Detection, AI in DNA Profiling and Genetic Data Interpretation, AI-driven Toxicological and Chemical Analysis, Crime Scene Reconstruction using Virtual Reality and AI, Predictive Policing and Crime Pattern Analysis, Case Studies of AI Applications in Global Forensic Investigations.

Course Outcomes:

By the end of the course, students should be able to:

- Fundamental Principles of Digital Forensics
- Categories of Cases Within the Domain of Digital Crimes
- Varieties of Digital Crimes
- Components in the Investigation of Digital Crimes

Assessment Model:

- Average of best four out of six Quizzes (20 Marks)-20 Marks
- Average of Two Mid-Terms (50 Marks) –15 Marks
- Attendance Marks(05 Marks)-05 Marks

- End-Term (100 Marks) – 60 marks

Total Assessment (Out of 100 Marks)

Preferred Reading:

- Digital Evidence and Computer Crime (2000): Casey, E.Academic Press, London.
- Computer Crimes and Computer Forensics (2003): Tiwari, R.K., Sastry, P.K., & Ravikumar, K.V., Select Publishers, New Delhi.
- Criminalistics, 8th Edition (2004): R. Saferstein, Prentice Hall, New Jersey.

Practicals:

1. Study of components of computers, various parts and functions of CPU.
2. Introduction to command prompt methods to get physical and logical address of computer
3. Use of command prompt methods to retrieve Browser History.
4. Study and Practice extension to identify computer viruses and other harmful other unwanted
5. Programs in computer systems computer viruses without and anti-virus and program.
6. Study and practice computer viruses deletion using Linux Platform without and anti-virus and program
7. Analysis of Altered File using Hash Algorithm.
8. Demonstration of Forensic Tool Kit imager to create DISK image
9. Practice FTK for Evidence Analysis for extraction of data.

Assessment and Evaluation:

- Lab work:10 marks
- Record:10 marks
- Viva-voce:10 marks

Total Assessment: Average of best seven practical's out of all the weekly practical's(30 Marks)

Course Code	Course Title	L	T	P	Credit
UFS-304	**Forensic Psychology**	**4**	**0**	**0**	**4**

Prerequisites: This course provides an in-depth exploration of criminal profiling as a specialized investigative technique in law enforcement. Students will examine the history, methodologies, and ethical considerations associated with profiling offenders based on behavioral analysis. The course integrates psychological, criminological, and forensic perspectives to develop an understanding of the profiling process and its application in criminal investigations.

Course Objectives:

- Develop a comprehensive understanding of the theories and methodologies of criminal profiling.
- Analyze crime scenes and behavioral evidence to construct offender profiles.
- Understand the ethical considerations and legal implications of profiling.
- Enhance critical thinking skills in assessing and interpreting offender characteristics.
- Apply profiling techniques to real-world cases and scenarios.

Teaching Hours-48

Unit-I (Teaching Hours-12)

Overview of forensic psychology and its applications in the criminal justice system, Introduction to criminal profiling: history, theories, and methodologies, Understanding the role of forensic psychologists in criminal investigations, Ethical considerations and professional standards in forensic psychology and profiling. Introducing Offender Profiling and Investigative Psychology, The Evolution of Criminal Profiling, Induction and Deduction in Criminal Profiling, Behavioral Consistency, the Homology Assumption, & the Problem of Induction, Criminal Profiling Methods

Unit-II (Teaching Hours-13)

Psychosocial assessment techniques for evaluating suspects, witnesses, and victims, Understanding behavioural indicators of deception and truthfulness, Application of psychological tests and assessments in criminal investigations, Case studies and practical exercises on psychological assessment in criminal contexts, Geographical Profiling, The Fallacy of Accuracy, Offender Signature and Case Linkage, Staged Crime Scenes, "Serial murders, Case studies of seven offenders. Criminal Theories and Psychological Profiling, Personal Narratives of Crime

Unit-III (Teaching Hours-12)

Metacognition in Criminal Profiling, Serial harassment and Bullying, Rape and sexual assault in investigative psychology, Serial Rape– Understanding Serial Sexual Murder, A Biopsychosocial Approach Motive Theories of criminal behaviors: psychodynamic, biological, sociocultural perspectives, Psychological profiling methodologies: offender typologies, crime scene analysis, victimology, Linkage analysis and geographical profiling techniques, Case studies and hands-on exercises in applying profiling techniques to real-world cases actions: Offender and Victim Perspectives

Unit-IV (Teaching Hours-11)

Role of forensic psychologists in court proceedings: expert testimony, competency evaluations, insanity defense, Understanding the psychology of criminal behaviors in legal contexts, psychological interventions and treatment approaches for offenders, Emerging trends and future directions in forensic psychology and criminal profiling research History of Profiling. Behavioral Evidence Analysis. Criminal History and Criminal Motivation. Crime Scene Investigation Victim Profiling and Psychological Autopsy. Male and Female Serial Killers Mass Homicide Domestic Homicide. Serial Sexual Offences Criminal Behavior on the Internet Geographical Profiling Case Studies Analyze

Course Outcomes:

By the end of the course, students should be able to:

- Gain an appreciation of the scientific and non-scientific methods of profiling violent crimes
- Apply contemporary methods of criminology to the art of profiling
- Analyze crime scene evidence and other data to a criminal profile
- Demonstrate popular theory and research in the field of profiling
- Apply profiling methods to an academic essay
- Distinguish signature and method of operation in crime scene review and apply to a criminal profile

Assessment Model:

- Average of best four out of six Quizzes (20 Marks)-20 Marks
- Average of Two Mid-Terms (50 Marks) -15 Marks
- Attendance Marks(05 Marks)-05 Marks
- End-Term (100 Marks) – 60 marks

Total Assessment (Out of 100 Marks)

Preferred Readings:

- Investigative Forensic Hypnosis (1999): J. Niehaus, CRC Press, Boca Raton.
- Encyclopedia of Forensic Science, Volume 2 (2000): E. Elaad, in J.A. Siegel, P.J. Saukko, and G.C. Knupfer, Academic Press, London.
- Criminalistics, 8th Edition (2004): R. Saferstein, Prentice Hall, New Jersey

Course Code	Course Title	L	T	P	Credit
UFS-305	**Professional Ethics**	**3**	**0**	**0**	**3**

Prerequisites: This course provides a comprehensive exploration of ethical considerations and professional responsibilities in the practice of forensic science. Students will examine ethical dilemmas specific to forensic science, develop critical thinking skills, and understand the importance of ethical decision-making in the context of criminal investigations. Case studies, ethical frameworks, and real-world scenarios will be used to enhance students' awareness and understanding of the ethical challenges inherent in the field.

Course Objectives:

- Develop a deep understanding of ethical principles and considerations in forensic science.
- Apply ethical frameworks to analyze and resolve ethical dilemmas in real-world scenarios.
- Enhance critical thinking and decision-making skills in the context of forensic investigations.
- Foster a commitment to professional responsibility, integrity, and accountability.
- Understand the broader implications of ethical conduct in maintaining public trust in forensic science.

Teaching Hours-35

Unit-I (Teaching Hours-10)

Basic Concepts, Governing Ethics, Personal & Professional Ethics, Life Skills, Emotional Intelligence, Thoughts of Ethics, Value Education, Dimensions of Ethics, Profession and professionalism, Professional Associations, Professional Risks, Professional Accountabilities, Professional Success, Ethics and Profession

Unit-II (Teaching Hours-9)

Basic Ethical Principles, Moral development, Moral Absolution, Moral Rationalism, Moral Pluralism, Ecal Egoism, Moral Issues, Moral Dilemmas, Moral Autonomy, Importance of codes of Professional Ethics, Legal vs scientific practices

Unit-III (Teaching Hours-8)

Ethical considerations in evidence collection, preservation, and analysis, maintaining integrity and objectivity in forensic examinations and reporting, Confidentiality, privacy, and informed consent in forensic practice, Ethical issues related to the use of emerging technologies in forensic science.

Unit-IV (Teaching Hours-8)

Ethical responsibilities of forensic experts in providing testimony and expert opinions, Impartiality and neutrality in presenting forensic evidence in court, avoiding bias and conflicts of interest in forensic testimony, Ethical challenges and dilemmas encountered in courtroom settings

Course Outcomes:

By the end of the course, students should be able to:

- To know about the importance of Codes of Professional Ethics
- To know about the interaction between the Forensic Scientist and the Client
- To understand the role, responsibilities and ethics for forensic expert
- To examine the types of cases received in forensic laboratories.
- To document and other important things in lab that needed to be kept within.

Assessment Model:

- Average of best four out of six Quizzes (20 Marks)-20 Marks
- Average of Two Mid-Terms (50 Marks) –15Marks
- Attendance Marks(05 Marks)-05 Marks
- End-Term (100 Marks) – 60 marks

Total Assessment (Out of 100 Marks)

Preferred Reading:

- Principles and Practices of Criminalistics: The Profession of Forensic Science (2004): KeithInman and Norah Rudin, CRC Press, Boca Raton
- Ethics in Forensic Science: Professional Standards for the Practice of Criminalistics (2013): Peter D. Barnett, CRC Press, Boca Raton
- Indian Ethos and Modern Management (2004): B L Bajpai, New Royal Book Co., Lucknow

Course Code	Course Title	L	T	P	Credit
UFS-306	**Biology V**	**3**	**0**	**2**	**4**

Prerequisites: Nil

Course Objectives:

- Impart knowledge about the general characteristics, classification, and organ systems of chordates and protochordates through representative type studies.
- Enable students to compare anatomical systems across major vertebrate groups including fishes, amphibians, reptiles, birds, and mammals.
- Help students understand vertebrate diversity, adaptations, and evolutionary relationships among different chordate classes.

Teaching Hours: 42

Unit-I (Teaching Hours-12)

Protochordates and Chordate Basics: General characteristics and classification of Chordates and protochordates, Urochordata type study – Herdmania: body wall, skeletal system, coelom, digestive system, blood vascular system, respiratory system, nervous system, sense organs, excretory system, reproductive system, Cephalochordata type study – Amphioxus: body wall, skeletal system, coelom, digestive system, blood vascular system, respiratory system, nervous system, sense organs, excretory system, reproductive system.

Unit-II (Teaching Hours-9)

Fishes and Aves: General characteristics and classification of class Aves up to orders, type study – Labeo: body wall, skeletal system, digestive system, blood vascular system, respiratory system, nervous system, sense organs, excretory system, urinogenital system.

Unit-III (Teaching Hours -12)

Amphibia, Reptilia: General characteristics and classification of class Amphibia, type study – Frog: body wall, skeletal system, digestive system, blood vascular system, respiratory system, nervous system, sense organs, excretory system, urinogenital system, endocrine system, general characteristics and classification of class Reptilia, type study – Uromastix: body wall, digestive system, blood vascular system, respiratory system, nervous system, sense organs, excretory system, urinogenital system.

Unit-IV (Teaching Hours-9)

Mammalia: Introduction, definition, general characteristics, evolutionary origin, distribution, diversity and classification of class Mammalia up to orders, type study – Rat: body wall, skeletal system, digestive system, blood vascular system, respiratory system, nervous system, sense organs, excretory system, urinogenital system

Course Outcomes:

By the end of the course, students should be able to:

- Explain the general features and classification of chordates and protochordates, with type studies of *Herdmania* and *Amphioxus*.
- Describe the organ systems and adaptations of bony fishes, with a study of *Labeo*.
- Illustrate the structure and physiology of birds, especially the classification of Aves and their evolutionary significance

- Analyze anatomical and physiological systems in amphibians and reptiles using *Frog* and *Uromastix* as type examples.
- Compare the complex organ systems in mammals through the study of *Rat* and understand their evolutionary advancements.

Assessment Model:

- Average of best four out of six Quizzes (20 Marks)-20 Marks
- Average of Two Mid-Terms (50 Marks) –15 Marks
- Attendance Marks(05 Marks)-05 Marks
- End-Term (100 Marks) – 60 marks

Total Assessment (Out of 100 Marks)

Preferred readings:

- E.L. Jordan & P.S. Verma – *Chordate Zoology*, S. Chand Publishing
- Kotpal, R.L. – *Modern Textbook of Zoology: Vertebrates*, Rastogi Publications
- Saxena, R.K. & Saxena, S. – *Comparative Anatomy of Vertebrates*, Viva Books
- Ekambaranatha Ayyar & T.N. Ananthakrishnan – *Manual of Zoology Vol. II: Chordata*, S. Viswanathan
- Arumugam, N. – *Chordate Zoology*, Saras Publications
- Pough, F.H., Janis, C.M., & Heiser, J.B. – *Vertebrate Life*, Pearson Kent, G.C. & Carr, R.K. – *Comparative Anatomy of the Vertebrates*, McGraw-Hill

Practicals:

1. Study of general characters of chordates and classification of protochordates up to orders using charts, models, and preserved specimens.
2. study of external morphology and internal systems *(*body wall, coelom, digestive, circulatory, respiratory, nervous, excretory, and reproductive systems*)*
3. Study of structural organization and organ systems *(*body wall, skeletal system, digestive, circulatory, respiratory, nervous, excretory, and reproductive systems*)* with the help of charts and models.
4. Examination of general characters and classification of fishes up to orders, along with a detailed type study of *Labeo* focusing on external morphology and internal systems.
5. Study of general characters and classification of Amphibia up to orders; detailed type study of frog including digestive, circulatory, respiratory, nervous, excretory, urinogenital, and endocrine systems.
6. Examination of general characters and classification of reptiles
7. Study of general characteristics and classification of class Aves up to orders using charts, models, and museum specimens.
8. Study of Class Mammalia with type study of Rat

Assessment and Evaluation:

- Lab work:10 marks
- Record:10 marks
- Viva-voce:10 marks

Total Assessment: Average of best seven practical's out of all the weekly practical's(30 Marks)

Course Code	Course Title	L	T	P	Credit
UFS-307	Physics V	3	0	2	4

Prerequisites: Nil

Course Objectives:

- Provide fundamental understanding of semiconductor physics and the working principles of various junction diodes and their applications.
- Introduce the operating principles, characteristics, and applications of Field Effect Transistors (FETs) and MOSFETs in electronic circuits.
- Develop conceptual clarity on amplifiers**,** feedback mechanisms, and the role of feedback in improving amplifier performance and stability.
- Explain the principles, classification, and working of different types of oscillators and operational amplifiers, emphasizing their practical applications.
- Enable students to analyze basic electronic circuits and relate theoretical concepts to real-world electronic devices and systems.

Teaching Hours: 40

Unit-I (Teaching Hours-12)

Junction Diodes: Introduction, Fermi levels in Semiconductors, current conduction in semiconductors, P-N junction, resistance of a p-n junction diode, ideal diode model, transition and diffusion capacitance, Zener diode, tunnel diode, light emitting diode (LEDs), low capacitance diodes (LCD), Solar cell (Photovoltage cell), Diode as a circuit diagram.

Unit-II (Teaching Hours-10)

Field effect transistors: Introduction, advantages and disadvantages of FET, junction field effect transistor (JFET), FET operation, characteristics curves of the JFET, drain current, Applications and parameters of JFET, difference between FET and BJT, Metal-oxide semiconductor FET, difference between JFET and MOSFET, handling precautions for MOSFET.

Unit-III (Teaching Hours-9)

Feedback in Amplifiers: Introduction, Feedback concept, feedback circuits (general theory of feedback), different feedback amplifier topologies, advantages of negative feedback, emitter follower (an example of negative feedback). Single stage amplifiers, multi stage amplifiers, noise in electronic circuits.

Unit-IV (Teaching Hours-9)

Oscillators: Introduction, oscillators, oscillatory circuit, classification of oscillators, alternator and oscillator, Fundamental principle of oscillators, feedback requirement for an oscillator, feedback oscillators, tuned collector oscillator, R.C. Oscillators, phase-shift oscillator, Operational amplifier, Applications of OP-AMP.

Course Outcomes:

By the end of the course, students should be able to:

- Explain the concepts of energy bands, Fermi levels, current conduction, and

working of P–N junction diodes, including special-purpose diodes such as Zener, tunnel, LED, LCD, and solar cells.

- Analyze the electrical characteristics, parameters, and applications of junction diodes and demonstrate their use in simple electronic circuits.
- Describe the construction, operation, characteristics, and applications of JFETs and MOSFETs, and compare their performance with BJTs.
- Understand and evaluate the role of feedback in amplifiers, classify feedback topologies, and explain the advantages of negative feedback in electronic circuits.
- Analyze the working of single-stage and multistage amplifiers, identify sources of **noise**, and explain methods to improve signal quality.

Assessment Model:

- Average of best four out of six Quizzes (20 Marks)-20 Marks
- Average of Two Mid-Terms (50 Marks) –15 Marks
- Attendance Marks(05 Marks)-05 Marks
- End-Term (100 Marks) – 60 marks

Total Assessment (Out of 100 Marks)

Preferred Reading:

- Robert L. Boylestad & Louis Nashelsky (2023): Electronic Devices and Circuit Theory 14th edition, Pearson Education.
- J. B. Gupta (2016): Electronic Devices and Circuits 6th edition, S.K. Kataria & Sons.
- Paul Horowitz & Winfield Hill (2015): The Art of Electronics 3rd edition, Cambridge University Press.

Practicals:

1. To study the V–I characteristics of a Light Emitting Diode (LED) and to understand its operation, efficiency, and applications in electronic display and indication systems.
2. To study the working principle and characteristics of a solar cell (photovoltaic cell) and to analyze its performance under different illumination conditions.
3. To study the drain and transfer characteristics of a Junction Field Effect Transistor (JFET), to understand its operation as a voltage-controlled device, and to determine important parameters such as drain resistance, trans-conductance, and amplification factor.
4. To study the characteristics of a Metal Oxide Semiconductor Field Effect Transistor (MOSFET), to understand the difference between JFET and MOSFET, and to learn proper handling precautions and protection techniques for MOSFET devices.
5. To study the operation of a single-stage amplifier, to observe the effect of negative feedback on gain and bandwidth, and to understand the role of feedback in improving stability and reducing noise in electronic circuits.
6. To study the working of an emitter follower circuit as an example of a negative feedback amplifier, and to determine its voltage gain, current gain, and impedance characteristics.
7. To design and study an RC phase shift oscillator, to understand the fundamental

principle of oscillations, and to verify the feedback and phase conditions required for sustained oscillations.

8. To study the characteristics of an operational amplifier and to design basic OP-AMP circuits such as inverting amplifier, non-inverting amplifier, integrator, and differentiator, and to understand their practical applications in electronic systems.

Assessment and Evaluation:

- Lab work:10 marks
- Record:10 marks
- Viva-voce:10 marks

Total Assessment: Average of best seven practical's out of all the weekly practical's(30 Marks)

SEMESTER VI

Course Code	Course Title	L	T	P	Credit
UFS-351	Forensic Ballistics	4	0	2	5

Prerequisites: This course provides an in-depth exploration of forensic ballistics, focusing on the analysis of firearms, ammunition, and their role in criminal investigations. Students will gain a comprehensive understanding of the principles and techniques used in the examination of ballistic evidence to support legal proceedings.

Course objectives:

- Develop a foundational knowledge of firearms, ammunition, and related components.
- Understand the principles of firearm operation and the physics of projectile motion.
- Explore the techniques used in the identification, comparison, and analysis of ballistic evidence.
- Gain proficiency in the use of forensic tools and technologies for examining firearms-related materials.
- Investigate the role of forensic ballistics in criminal cases and its impact on legal outcomes.
- Foster critical thinking skills in the application of forensic ballistics principles to real-world scenarios.

Teaching Hours-45

Unit-I (Teaching Hours-11)

Introduction to forensic Ballistics, History and development of firearms; Classification of firearms, firing mechanisms of different firearms, various components of small arms, Ammunition and its types; classification and constructional features of different types of cartridges, Propellants and their compositions.

Unit-II (Teaching Hours-12)

Principle of firearms identification; matching of bullets and cartridge cases in regular firearms, Matching of cartridge cases in regular firearms, Identification of fired bullets, pellets and wads, Identification of bullets, pellets and wads fired from improvised, country-made firearms. ABIS, Mechanisms of formation of gunshot residues, Methods of analysis of gunshot residues from shooting hands and targets with special reference to clothing

Unit-III (Teaching Hours-12)

Bullet trajectory, determination of range and time of fire. Terminal ballistics; identification and nature of firearms injuries. Reconstruction of the crime scene with respect to accident, suicide, murder and self-defense.

Unit-IV (Teaching Hours-10)

The responsibilities and ethical considerations of forensic ballistics experts in the legal system, cover the admissibility of evidence, expert testimony challenges, and courtroom procedures. Case Studies

Course Outcomes:

By the end of the course, students should be able to:

- Identify various types of firearms, ammunition, and their components.
- Explain the fundamental principles of firearm operation and the factors influencing

projectile motion.

- Demonstrate proficiency in the use of forensic tools and technologies for examining ballistic evidence.
- Analyze and compare ballistic evidence to establish connections in criminal investigations.
- Evaluate the significance of forensic ballistics in legal proceedings and its impact on case resolution.
- Apply critical thinking skills to solve practical problems related to forensic ballistics.

Assessment Model:

- Average of best four out of six Quizzes (20 Marks)-20 Marks
- Average of Two Mid-Terms (50 Marks) –15 Marks
- Attendance Marks(05 Marks)-05 Marks
- End-Term (100 Marks) – 60 marks

Total Assessment (Out of 100 Marks)

Preferred Reading:

- Current Methods in Forensic Gunshot Residue Analysis (2000): A.J. Schwoeble and D.L. Exline, CRC Press, Boca Raton.
- Handbook of Firearms and Ballistics: Examining and Interpreting Forensic Evidence (2008): Brian J. Heard, Wiley.
- Firearms, the Law, and Forensic Ballistics (2011): Tom Warlow, CRC Press
- Forensic Ballistics in Court: Interpretation and Presentation of Firearms Evidence (2013): Brian J. Heard, Wiley Blackwell

Practicals:

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

Assessment and Evaluation:

- Lab work:10 marks
- Record:10 marks
- Viva-voce:10 marks

Total Assessment: Average of best seven practical's out of all the weekly practical's(30 Marks)

Course Code	Course Title	L	T	P	Credit
UFS-352	Applied Biochemistry	4	0	0	4

Prerequisites: Nil

Course Objectives:

- Introduce the fundamental principles of biochemistry relevant to forensic chemistry.
- Provide knowledge of biomolecules and their chemical properties used in forensic investigations.
- Explain the biochemical basis of body fluids and tissues examined in forensic laboratories.
- Develop understanding of nucleic acids and their role in forensic identification.
- Familiarize students with biochemical aspects of toxicology and drug metabolism.

Teaching Hours: 43

Unit-I (Teaching Hours-9)

Basics of Biochemistry: Definition, scope, and importance of biochemistry. Chemical composition of living systems. Water and its properties; pH, buffers, and buffer systems in biological fluids. Classification, structure, properties, and forensic significance of biomolecules: carbohydrates, lipids, proteins, and nucleic acids.

Unit-II (Teaching Hours-10)

Amino Acids, Proteins and Enzymes: Amino acids: classification, structure, properties, zwitter ion concept, isoelectric point. Peptide bond and levels of protein structure (primary to quaternary). Enzymes: classification, specificity, mechanism of enzyme action (lock and key and induced fit models), factors affecting enzyme activity, enzyme inhibition. Forensic applications of enzymes in identification of biological stains.

Unit-III (Teaching Hours -13)

Nucleic Acids and Forensic DNA Analysis: Structure and properties of DNA and RNA. Types of RNA and their functions. Basic concepts of replication, transcription, and translation. Genetic mutations. Introduction to forensic DNA analysis: DNA profiling, STRs, PCR technique, electrophoresis, and their applications in criminal investigation, paternity testing, and disaster victim identification

Unit-IV (Teaching Hours-11)

Biochemistry of Body Fluids: Biochemical composition of blood, semen, saliva, urine, sweat, and vaginal secretions. Presumptive and confirmatory biochemical tests for body fluid identification. Blood grouping systems (ABO and Rh factor). Importance of biochemical examination of body fluids in crime investigation.

Course Outcomes:

By the end of the course, students should be able to:

- Explain basic biochemical concepts and the role of biomolecules in forensic chemistry.
- Describe the structure and function of proteins, enzymes, and nucleic acids.
- Understand the biochemical basis of forensic DNA analysis.
- Identify and interpret biochemical characteristics of body fluids used as forensic

evidence and apply biochemical principles in toxicological and forensic investigations.

Assessment Model:

- Average of best four out of six Quizzes (20 Marks)-20 Marks
- Average of Two Mid-Terms (50 Marks) –15 Marks
- Attendance Marks(05 Marks)-05 Marks
- End-Term (100 Marks) – 60 marks

Total Assessment (Out of 100 Marks)

Preferred Reading:

- Forensic Science Handbook, Volume I (2001): Saferstein R., Prentice Hall.
- Principles of Biochemistry (2017): Lehninger A.L., Nelson D.L. and Cox M.M., W.H. Freeman & Company.
- Forensic Biology (2014): Butler J.M., Academic Press (Elsevier).
- Essentials of Forensic Science (2015): Siegel J.A., Saukko P.J. and Knupfer G.C., Academic Press (Elsevier).
- Biochemistry (2018): Berg J.M., Tymoczko J.L. and Stryer L., W.H. Freeman.

Course Code	Course Title	L	T	P	Credit
UFS-353	Forensic Anthropology	3	0	2	4

Prerequisites: This course introduces students to the field of forensic anthropology, focusing on the analysis of human skeletal remains in medico-legal contexts. Students will learn about skeletal biology, identification methods, and the role of forensic anthropology in death investigations.

Course objectives

- Understand the anatomy and biology of the human skeleton.
- Explore the processes of bone formation, growth, and aging.
- Develop skills in the identification of skeletal remains, including age, sex, and ancestry estimation.
- Explore methods for determining the cause and manner of death from skeletal evidence.
- Understand the applications of forensic anthropology in crime scene investigations.
- Explore the role of forensic anthropologists in mass disaster recovery efforts

Teaching Hours-40

Unit-I (Teaching Hours-9)

Scope of forensic anthropology. Introduction and forensic significance of osteometry and craniometry in personal identification Study of human skeleton. Nature, formation, types and identification of human bones. Comparative skeletal anatomy of human and non-human bones. Determination of age, sex, stature and side (long bones) from skeletal material.

Unit-II (Teaching Hours-10)

Development and scope. Role in mass disaster and personal identification. Types of teeth and their functions. Structural variation in human and non-human teeth. Dental anomalies and their importance in personal identification. Eruption sequence, Gustafson's method. Age and sex determination from teeth. Bite marks its forensic significance and role in personal identification.

Unit-III (Teaching Hours-11)

Somatoscopy – Introduction and forensic significance in personal identification. Observation of hair on head, forehead, eyes, root of nose, nasal bridge, nasal tip, chin, Darwin's tubercle, ear lobes, supra-orbital ridges, physiognomic ear breadth, circumference of head. Scar marks and occupational marks. Somatometry – Introduction and forensic significance in personal identification. Measurements of head, face, nose, cheek, ear, hand and foot, body weight, height. Indices – cephalic index, nasal index, cranial index, upper facial index.

Unit-IV (Teaching Hours-10)

Portrait Parle/ Bertillon system. Photofit/identify kit. Facial superimposition techniques. Cranio facial super imposition techniques – photographic super imposition, video superimposition, Roentgenographic superimposition. Use of somatoscopic and craniometric methods in reconstruction. Importance of tissue depth in facial reconstruction. Genetic and congenital anomalies – causes, types, identification and their forensic significance.

Course Outcomes:

By the end of the course, students should be able to:

- Explain the significance of forensic anthropology in the process of identifying individuals.
- Demonstrate the various methods of facial reconstruction and their relevance in forensic applications.
- Explain the importance of somatoscopy and somatometry in forensic contexts.

Assessment Model:

- Average of best four out of six Quizzes (20 Marks)-20 Marks
- Average of Two Mid-Terms (50 Marks) –15 Marks
- Attendance Marks(05 Marks)-05 Marks
- End-Term (100 Marks) – 60 marks

Total Assessment (Out of 100 Marks)

Preferred Reading:

- The Extent of Forensic Anthropology (1997): M.Y. Iscan and S.R. Loth, CRC Press, Boca Raton.
- Bone Voyage: An Expedition in Forensic Anthropology (1998): S. Rhine, University of Mexico press, Mexico.
- Bones (2000): D. Ubelaker and H. Scammell, M. Evans & Co., New York.

Practicals:

1. Examination of skeletal system.
2. Determination of age from teeth.
3. Determination of sex from pelvis.
4. Determination of long and short bone.
5. Anthropometric measurements of arm bones.
6. Examination of skull sutures.
7. Determination of male and female skull.
8. Determination of age from bone.

Assessment and Evaluation:

- Lab work:10 marks
- Record:10 marks
- Viva-voce:10 marks

Total Assessment: Average of best seven practical's out of all the weekly practical's(30 Marks)

Course Code	Course Title	L	T	P	Credit
UFS-354	Forensic Toxicology	3	0	2	4

Prerequisites: This course provides a comprehensive exploration of forensic medicine, focusing on the application of medical principles in legal investigations. Students will learn the intricacies of post-mortem examinations, injury interpretation, and the role of forensic pathologists in contributing to the resolution of legal cases.

Course Objectives:

- Understand the principles and techniques of conducting medicolegal examinations on living and deceased individuals.
- Explore the documentation of injuries and the collection of relevant forensic evidence.
- Develop expertise in interpreting injuries, including blunt force trauma, sharp force injuries, and gunshot wounds.
- Understand the forensic significance of patterned injuries and their implications for legal investigations.
- Explore the methods employed in determining the cause and manner of death in forensic medicine.
- Understand the role of forensic pathology in establishing the circumstances surrounding a death.
- Examine the legal and ethical considerations inherent in forensic medicine practices.

Teaching Hours-40

Unit-I (Teaching Hours-10)

Introduction, Principles, Applications, Nature of cases, Role of the Forensic Toxicologist, Information required by the toxicologist. Analysis of Samples, Interpretations of results and report writing. Significance of toxicological findings, Classification of poisons. Physico-chemical and mode of action of poisons. Accidental, suicidal and homicidal poisonings. Alternative Specimen analysis, Hair analysis, Drugs in oral fluid, Detection of drugs in sweat etc.

Unit-II (Teaching Hours-10)

Body fluid analysis, Collection and preservation of viscera, blood and urine for various poison cases Drug identification in body fluids, Identification of narcotics, barbiturates, biocides and metal salts in body fluids immunoassay, Metabolism and excretion of poisons. Application of immunoassays in forensic work.

Unit-III (Teaching Hours-11)

Forensic medicine and related terminologies, inquest and its types, Forensic pathology.

Death- Somatic Death, Brain death, Medico legal aspect of Death, Causes of death, Medico-legal Autopsy, exhumation, obscure autopsy, anaphylactic deaths and artefact's, Signs of death, Determination of time since death, Investigation of physical offences, Asphyxia and its types- smothering, mugging, bansdola, burking, choking, garroting, strangulation and its types, Drowning deaths. Sexual Offences. Signs of death, Determination of time since death, Investigation of sexual offences.

Unit-IV (Teaching Hours-9)

Injuries-Types and classification, Anti mortem and post mortem injuries, Aging of injuries Starvation, electrocution, Accidents, Custody related torture and deaths Principle and scope of disaster management, Forensic implications.

Course Outcomes:

By the end of the course, students should be able to:

- The duties of the first responding officer who receives a call on homicide or suicide case.
- The steps involved in processing the death scene.
- The importance of ascertaining whether the crime was staged to appear as suicide or accident.
- The importance of bloodstain patterns in reconstructing the crime scene.
- The importance of autopsy.
- The importance of forensic odontology

Assessment Model:

- Average of best four out of six Quizzes (20 Marks)-20 Marks
- Average of Two Mid-Terms (50 Marks) –15 Marks
- Attendance Marks(05 Marks)-05 Marks
- End-Term (100 Marks) – 60 marks

Total Assessment (Out of 100 Marks)

Preferred Reading:

- Introduction to Forensic Sciences (1997): M. Bernstein, CRC Press, Boca Raton
- Encyclopedia in Forensic Science, Volume 1 (2000): H.B. Baldwin and C.P. May, Academic Press in London.
- Practical Homicide Investigation (2006): V.J. Geberth, CRC Press in Boca Raton.
- Bloodstain Pattern Analysis (2008): T. Bevel and R.M. Gardner, CRC Press in Boca Raton.

Practicals:

1. Morphological features of animal and plant poisons.
2. Alcohol analysis with various color tests.
3. Analysis by UV-vis spectrophotometer.
4. Alcohol analysis with various color tests.
5. Analysis by UV-vis spectrophotometer.
6. Microscopic examination of Arsenic.
7. Microscopic examination of Mercury

Assessment and Evaluation:

- Lab work:10 marks
- Record:10 marks
- Viva-voce:10 marks

Total Assessment: Average of best seven practical's out of all the weekly practical's(30 Marks)

Course Code	Course Title	L	T	P	Credit
UFS-355	**Statistics and Research Methodology**	**4**	**0**	**0**	**4**

Prerequisites: This course provides a comprehensive introduction to statistics and research methodology in various disciplines. It covers the principles, techniques, and tools used in designing, conducting, analyzing, and reporting research studies. Emphasis is placed on developing critical thinking skills, ethical considerations, and practical application of research methods.

Course Objectives:

- Understand the fundamental concepts and principles of research methodology.
- Develop skills in formulating research questions, hypotheses, and objectives.
- Learn various research designs and data collection methods, including qualitative and quantitative approaches.
- Explore techniques for data analysis, interpretation, and presentation of research findings.
- Understand ethical considerations and research integrity in conducting research studies.
- Enhance critical thinking and problem-solving abilities in research contexts.
- Gain hands-on experience in designing and conducting research projects.
- Develop effective communication skills for presenting research results orally and in writing.

Teaching Hours-46

Unit-I (Teaching Hours-12)

Data types (discrete, Continuous and categorical) Data collection and graphical presentation, Descriptive Statistics: Measures of central tendency: Arithmetic Mean, median, and mode, Measures of dispersion: Range, Standard Deviation and Variance. Definitions of Probability, Random experiment, Sample space, Events, Addition theorem of Probability Conditional Probability, Multiplication theorem, Independent Events - Bayes' theorem.

Unit-II (Teaching Hours-11)

Correlation, Scatter diagram, Karl pearson's coefficient of correlation, Linear regression, Skewness and Kurtosis. Hypothesis testing: the basic idea of significance test. Null and alternative hypothesis, type 1 and type 2 error, likelihood ratio test, chi square and F distribution, One way and two way anova (ANOVA), Analysis of variance.

Unit-III (Teaching Hours-10)

Objectives and Types of Research: Research methods vs. Methodology. Types of Research, Defining and Formulating the Research problem, Literature review- Primary and secondary sources- Reviews, treatise, monographs- patents- web as a source- searching the web- Critical literature review- Identifying gap areas from literature review-Development of working hypothesis.

Unit-IV (Teaching Hours-13)

Research design- Basic Principles, Need, Features of good design- Important concepts, Observation and fax, Laws and theories, prediction and Explanation Induction, Deduction,

Development and Models, Developing a Research Plan, Data Collection and Analysis: Execution of the research- Observation and collection of data, Sampling methods- Application of ANOVA and students t-test, Discussion and Interpretation of results, Report writing, Criteria for the evaluation of the Research Report. Use of tools, techniques, software, programs for Research

Course Outcomes:

By the end of the course, students should be able to:

- Demonstrate knowledge of different research paradigms, approaches, and methods.
- Design research studies with appropriate methodologies and sampling techniques.
- Apply statistical and qualitative analysis methods to analyze research data.
- Interpret research findings accurately and draw valid conclusions.
- Evaluate the ethical implications of research and adhere to ethical standards.
- Communicate research findings effectively through written reports and oral presentations.
- Apply research skills and techniques to real-world problems or scenarios.
- Understand the concept of data collection, representation, and measures of central tendency
- Apply the concept of dispersion, skewness, correlation, and regression of the given data

Assessment Model:

- Average of best four out of six Quizzes (20 Marks)-20 Marks
- Average of Two Mid-Terms (50 Marks) –15 Marks
- Attendance Marks(05 Marks)-05 Marks
- End-Term (100 Marks) – 60 marks

Total Assessment (Out of 100 Marks)

Preferred Reading:

- The Craft of Research (2008): Wayne C. Booth, Gregory G. Colomb, Joseph M. Williams, University of Chicago Press.
- Research Design Qualitative, Quantitative, and Mixed Methods Approaches (2017): John W. Creswell, SAGE Publications.
- Research Methodology A Step-by-Step Guide for Beginners (2019): Ranjit Kumar, SAGE Publications.
- Probability and Statistics for Engineers and Scientistse ed. (2010): Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, Keying E. Ye, Pearson.
- Probability and Statistics for Science and Engineering (2011): G Shanker Rao, Universities Press
- Fundamentals of Mathematical Statistics (2000): SC Gupta, VK Kapoor, Sultan Chand & Sons Private Limited.