YEAR II, SEMESTER III

COURSE CODE	COURSE TITLE	COURSE CATEGORY	HOURS			EVALUATION SCHEME		SUBJECT TOTAL	CREDIT
			L	T	P	CA	EE		
FST301	Tools & Techniques in Forensic Science	CORE	3	1	0	30	70	100	4
FST302	Criminalistics	CORE	3	1	0	30	70	100	4
FST303	Chemistry-III	CORE	3	1	0	30	70	100	4
FST304	Physics-III								
FST305	Zoology-III	GE	3	1	0	30	70	100	4
FST306	Computer Science-III								
FST307	Botany-III	GE	3	1	0	30	70	100	4
FST351	Instrumentation Lab	PRACTICAL	0	0	4	15	35	50	2
FST352	Crime Scene Management	PRACTICAL	0	0	4	15	35	50	2
FST353	Chemistry Lab-III	PRACTICAL	0	0	4	15	35	50	2
FST354	Physics Lab-III								
FST355	Zoology Lab-III	PRACTICAL	0	0	4	15	35	50	2
FST356	Computer Lab-III								
FST357	Botany Lab-III	PRACTICAL	0	0	4	15	35	50	2
Total			15	5	20	225	525	750	30

L - Lecture, T - Tutorial, P - Practical, GE- Generic Elective; AECC-Ability Enhancement Compulsory Course;
DSE- Discipline Specific Elective; AEEC- Ability Enhancement Elective Course (Skill Based Course)

COURSE CODE	COURSE TITLE	COURSE CATEGORY	HOURS			EVALUATION SCHEME		SUBJECT TOTAL	CREDIT
			L	T	P	CA	EE		
FST401	Forensic Ballistics	CORE	3	1	0	30	70	100	4
FST402	Forensic Biology and Serology	CORE	3	1	0	30	70	100	4
FST403	Chemistry- IV	CORE	3	1	0	30	70	100	4
FST404	Physics- IV								
FST405	Zoology- IV	GE	3	1	0	30	70	100	4
FST406	Computer Science- IV								
FST407	Botany- IV	GE	3	1	0	30	70	100	4
FST451	Examination of Firearms and GSR	PRACTICAL	0	0	4	15	35	50	2
FST452	Examination of Biological Evidences	PRACTICAL	0	0	4	15	35	50	2
FST453	Chemistry Lab-IV	PRACTICAL	0	0	4	15	35	50	2
FST454	Physics Lab- IV								
FST455	Zoology Lab- IV	PRACTICAL	0	0	4	15	35	50	2
FST456	Computer Lab-IV								
FST457	Botany Lab- IV	PRACTICAL	0	0	4	15	35	50	2
Total			15	5	20	225	525	750	30

L - Lecture, T - Tutorial, P - Practical, GE- Generic Elective; AECC-Ability Enhancement Compulsory Course; DSE- Discipline Specific Elective; AEEC- Ability Enhancement Elective Course (Skill Based Course)

B.Sc. Forensic Science: Semester-III FST301: Tools & Techniques in Forensic Science	
Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment – 6 Marks
Credits: 4	Attendance – 12 Marks
	End Semester Exam – 70 marks

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

a. The importance of chromatographic and spectroscopic techniques in processing crime scene evidence.
b. The utility of electrophoresis and Centrifugation in analysis of chemical and biological materials.
c. The significance of microscopy in visualizing trace evidence and comparing it with control samples.
d. The usefulness of photography and videography for recording the crime scenes.

Unit 1: Chromatography
Fundamental principles, instrumentation and forensic application of Paper Chromatography, TLC, GC and LC.
Unit 2: Spectroscopy
Fundamental principles, instrumentation and forensic applications of Ultraviolet- Visible spectroscopy, Infrared spectroscopy, Atomic Absorption spectroscopy, Atomic Emission spectroscopy and Mass spectroscopy. X-ray spectrometry. Raman spectroscopy.
Unit 3: Microscopy
Fundamental principles, Instrumentation and forensic application of different types of microscopes – Optical and Electron microscopes.
Unit 4: Electrophoresis and Centrifugation
Fundamental principles, Instrumentation and forensic applications of Electrophoresis. Fundamental principles, Instrumentation and forensic applications of Centrifuge.
Unit 5: Photography
Basic principles and applications of photography in forensic science. 3D photography. Infrared and ultraviolet photography. Digital photography. Videography. Crime scene photography. Functioning of DSLR

Suggested Readings :

1. D.A. Skoog, D.M. West and F.J. Holler, *Fundamentals of Analytical Chemistry*, 6th Edition, Saunders College Publishing, Fort Worth (1992).
2. W. Kemp, *Organic Spectroscopy*, 3rd Edition, Macmillan, Hampshire (1991).
3. J.W. Robinson, *Undergraduate Instrumental Analysis*, 5th Edition, Marcel Dekker, Inc., New York (1995).
4. D.R. Redsicker, *The Practical Methodology of Forensic Photography*, 2nd Edition, CRC Press, Boca Raton (2000).

B.Sc. Forensic Science: Semester-III FST302: Criminalistics	
Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment – 6 Marks
Credits: 4	Attendance – 12 Marks
	End Semester Exam – 70 marks

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

a. The methods of securing, searching and documenting crime scenes.
b. The art of collecting, packaging and preserving different types of physical and trace evidence at crime scenes.
c. The legal importance of chain of custody.
d. The tools and techniques for analysis of different types of crime scene evidence

Unit 1: Crime Scene Management
Types of crime scenes – indoor and outdoor, primary and secondary. Securing and isolating the crime scene. Crime scene search methods. Legal considerations at crime scenes. Documentation of crime scenes – photography, videography, sketching and recording notes.
Unit 2: Crime Scene Evidence
Classification of crime scene evidence – physical, biological and trace evidence. Locard`s principle. Collection, labeling, sealing of evidence. Hazardous evidence. Preservation of evidence.
Unit 3: Investigation
Duties of first responding officer at crime scenes. Coordination between police personnel and forensic scientists at crime scenes. The evaluation of 5Ws (who?, what?, when?, where?, why?) and 1H (how?). Chain of custody. Reconstruction of crime scene.
Unit 4: Forensic Physics
Glass evidence – collection, packaging, analysis. Matching of glass samples by mechanical fit and refractive index measurements. Analysis by spectroscopic methods. Fracture analysis and direction of impact. Paint evidence – collection, packaging and preservation. Analysis by destructive and non- destructive methods. Importance of paint evidence in hit and run cases. Fiber evidence – artificial and natural fibers. Collection of fiber evidence. Identification and comparison of fibers. Soil evidence – importance, location, collection and comparison of soil samples. Cloth evidence – importance, collection, analysis of adhering material. Matching of pieces.
Unit 5: Tool marks
Classification of tool marks. Forensic importance of tool marks. Collection, preservation and matching of tool marks. Restoration of erased serial numbers and engraved marks.

Suggested Readings:

1. M. Byrd, *Crime Scene Evidence: A Guide to the Recovery and Collection of Physical Evidence*, CRC Press, Boca Raton (2001).
2. T.J. Gardener and T.M. Anderson, *Criminal Evidence*, 4th Ed., Wadsworth, Belmont (2001).
3. S.H. James and J.J. Nordby, *Forensic Science: An Introduction to Scientific and Investigative Techniques*, 2nd Edition, CRC Press, Boca Raton (2005).
4. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's, *Techniques of Crime Scene Investigation*, CRC Press, Boca Raton (2013).

B.Sc. Forensic Science: Semester-III FST303: Chemistry-III	
Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment – 6 Marks
Credits: 4	Attendance – 12 Marks
	End Semester Exam – 70 marks

Course Objective

a. *On the completion of this course the students will be able to understand the basic concepts of organic chemistry*
b. *The student will be able to describe and understand the Atomic orbitals and their properties, hybridization.*
c. *Students will gain knowledge about the hydrocarbons*

Unit 1: Concepts
Atomic orbitals, hybridization, orbital representation of methane, ethane, ethyne and benzene. Polarity of bonds: Inductive, resonance and steric effects hyper conjugation, and their influence on acidity and basicity of organic compounds.
Unit 2: Hydrocarbons
Akanes: Chlorination of methane, Alkenes: Addition reactions (Electrophilic and Free radical), Hydration, hydroxylation, hydroboration, epoxidation and ozonolysis. Alkynes: Reduction, Electrophilic addition, acidity and metal acetylides. Conjugated and isolated Dienes: 1,2- verses 1,4-addition. Diels - Alder reaction.
Unit 3: Alkyl Halides
Nucleophilic substitution: SN1 , SN2 mechanisms; Eliminations reactions: E1and E 2 mechanisms, Elimination versus substitution reactions; energy profile diagrams-transition states (general considerations). Grignard reagents: Preparation and synthetic applications.
Unit 4: Alcohols
Comparative study of substitution, dehydration, oxidation, and esterification of primary, secondary and tertiary alcohols
Unit 5: Stereochemistry
Fischer, Saw-horse and Newman projection formulae, Chirality-optical activity, enantiomersim and diasteroisomerism involving one and two chiral centres. Configuration; D/L, erythrose, threose and R/S nomenclatures. Geometrical isomerism and E/Z nomenclatures. Conformations of n-butane.

Suggested Readings

1. Organic Chemistry, Paula Y. Bruice, 2nd Edition, Prentice-Hall, International Edition (1998).
2. Organic Chemistry, I. L. Finar, Vol. I, 6th Edition (1973), ELBS and Longman Ltd., New Delhi.
3. Organic Chemistry, R. T. Morrison and R. N. Boyd, 6th Edition (1992), Prentice-Hall of India (P) Ltd., New Delhi.
4. Organic Chemistry, Paula Y. Bruice, 2nd Edition, Prentice-Hall, International Edition (1998).
5. Organic Chemistry, I. L. Finar, Vol. I, 6th Edition (1973), ELBS and Longman Ltd., New Delhi.
6. Organic Chemistry, R. T. Morrison and R. N. Boyd, 6th Edition (1992), Prentice-Hall of India (P) Ltd., New Delhi.
7. Organic Chemistry, J. Clayden, N. Greeves, S. Warren, and E. Wothers, , Oxford Univ. Press, Oxford (2001).

B.Sc. Forensic Science: Semester-III FST304: Physics-III	
Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment – 6 Marks
Credits: 4	Attendance – 12 Marks
	End Semester Exam – 70 marks

Course outcomes:

- Better understanding of electrical and magnetic phenomenon in daily life.
- To troubleshoot simple problems related to electrical devices.
- Comprehend the powerful applications of ballistic galvanometer.
- Study the fundamental physics behind reflection and refraction of light (electromagnetic waves).
- Study the working and applications of Michelson and Fabry-Perot interferometers.
- Recognize the difference between Fresnel's and Fraunhofer's class of diffraction.
- Comprehend the use of polarimeters.
- Study the characteristics and uses of lasers.

Unit I – Electrostatics
• Electric charge & charge densities, electric force between two charges. General expression for Electric field in terms of volume charge density (divergence & curl of Electric field), general expression for Electric potential in terms of volume charge density and Gauss law (applications included). Study of electric dipole. Electric fields in matter, polarization, auxiliary field D (Electric displacement), electric susceptibility and permittivity.
Unit II – Magnetostatics
• Electric current & current densities, magnetic force between two current elements. General expression for Magnetic field in terms of volume current density (divergence and curl of Magnetic field), General expression for Magnetic potential in terms of volume current density and Ampere's circuital law (applications included). Study of magnetic dipole (Gilbert & Ampere model). Magnetic fields in matter, magnetization, auxiliary field H, magnetic susceptibility and permeability.
Unit III – Time Varying Electromagnetic Fields
• Faraday's laws of electromagnetic induction and Lenz's law. Displacement current, equation of continuity and Maxwell-Ampere's circuital law. Self and mutual induction (applications included). Derivation and physical significance of Maxwell's equations. Theory and working of moving coil ballistic galvanometer (applications included).
Unit IV – Electromagnetic Waves
• Electromagnetic energy density and Poynting vector. Plane electromagnetic waves in linear infinite dielectrics, homogeneous & inhomogeneous plane waves and dispersive & non-dispersive media. Reflection and refraction of homogeneous plane electromagnetic waves, law of reflection, Snell's law, Fresnel's formulae (only for normal incidence & optical frequencies) and Stoke's law.

Unit V – Interference
• Conditions for interference and spatial & temporal coherence. Division of Wavefront - Fresnel's Biprism and Lloyd's Mirror. Division of Amplitude - Parallel thin film, wedge shaped film and Newton's Ring experiment. Interferometer - Michelson and Fabry-Perot.

Suggested Readings:

1. D.J. Griffiths, ―Introduction to Electrodynamics‖, Prentice-Hall of India Private Limited, 2002, 3e
2. E.M. Purcell, ―Electricity and Magnetism (In SI Units): Berkeley Physics Course Vol 2‖, McGraw Hill, 2017, 2e
3. Richard P. Feynman, Robert B. Leighton, Matthew Sands, ―The Feynman Lectures on Physics - Vol. 2‖, Pearson Education Limited, 2012
4. D.C. Tayal, ―Electricity and Magnetism‖, Himalaya Publishing House Pvt. Ltd., 2019, 4e
5. Francis A. Jenkins, Harvey E. White, ―Fundamentals of Optics‖, McGraw Hill, 2017, 4e
6. Samuel Tolansky, ―An Introduction to Interferometry‖, John Wiley & Sons Inc., 1973, 2e
7. A. Ghatak, ―Optics‖, McGraw Hill, 2017, 6e

B.Sc. Forensic Science: Semester-III FST305: Zoology-III	
Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment – 6 Marks
Credits: 4	Attendance – 12 Marks
	End Semester Exam – 70 marks

Course outcomes:

The student at the completion of the course will be able to have:

- A detailed and conceptual understanding of molecular processes viz. DNA to trait.
- A clear understanding of the processes of central dogma viz. transcription, translation etc. underlying survival and propagation of life at molecular level.
- Understanding of how genes are ultimately expressed as proteins which are responsible for the structure and function of all organisms.
- Learn how four sequences (3 letter codons) generate the transcripts of life and determine the phenotypes of organisms.

Unit I – Process of Transcription and Translation
• Fine structure of gene • RNA polymerases • Transcription factors and machinery • Formation of initiation complex • Initiation, elongation and termination of transcription in prokaryotes and eukaryotes • The Genetic code • Ribosome • Factors involved in translation • Aminoacylation of tRNA, tRNA-identity, aminoacyltRNAsynthetase • Initiation, elongation and termination of translation in prokaryotes and eukaryotes
Unit II – Principle and Types of Microscopes
• Principle of Microscopy and Applications • Types of Microscopes: light microscopy, dark field microscopy, phase-contrast microscopy, Fluorescence microscopy, confocal microscopy, electron microscopy
Unit III – Centrifugation and Chromatography
• Principle of Centrifugation • Types of Centrifuges: high speed and ultracentrifuge • Types of rotors: Vertical, Swing-out, Fixed-angle etc. • Principle and Types of Chromatography: paper, ion exchange, gel filtration, HPLC, affinity
Unit IV – Spectrophotometry and Biochemical Techniques
• Biochemical techniques: Measurement of pH, Preparation of buffers and solutions • Principle of Colorimetry/Spectrophotometry: Beer-Lambert law • Measurement, applications and safety measures of radio-tracer techniques

Unit V – Molecular Techniques
• Detection of nucleic acid by gel electrophoresis • DNA sequencing DNA fingerprinting, RFLP • Polymerase Chain Reaction (PCR) • Detection of proteins, PAGE, ELISA, Western blotting

Suggested Readings:

1. Lodish et al: Molecular Cell Biology: Freeman & Co, USA (2004).
2. Alberts et al: Molecular Biology of the Cell: Garland (2002).
3. Cooper: Cell: A Molecular Approach: ASM Press (2000).
4. Karp: Cell and Molecular Biology: Wiley (2002).
5. Watson et al. Molecular Biology of the Gene. Pearson (2004).
6. Lewin. Genes VIII. Pearson (2004).
7. Pierce B. Genetics. Freeman (2004).
8. Sambrooket al .Molecular Cloning Vols I, II, III. CSHL (2001).
9. Primrose. Molecular Biotechnology. Panima (2001).
10. Clark & Switzer. Experimental Biochemistry. Freeman (2000)

B.Sc. Forensic Science: Semester-III	
FST306: Computer Science-III	
Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment – 6 Marks
	Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Course outcomes:

- After the completion of the course the students will be able:
- Understand role, responsibilities, features, and design of operating system.
- Analyze memory management schemes and process scheduling algorithms.
- Apply process synchronization techniques to formulate solution for critical section problems.
- Illustrate concept of disk scheduling.
- Evaluate process deadlock handling techniques.

Unit I – Introduction to Operating System

- Operating system and functions, Classification of Operating systems: Batch, Interactive, Time-sharing, Real-Time System, Multiprocessor Systems, Multiuser Systems, Multithreaded Systems, Operating System Structure, System Components, Operating System Services, Kernels, Monolithic and Microkernel Systems.

Unit II – Process Management

- Process Concept, Process States, Process Synchronization, Critical Section, Mutual Exclusion, Classical Synchronization Problems, Process Scheduling, Process States, Process Transitions, Scheduling Algorithms Interprocess Communication, Threads and their management, Security Issues.

Unit III – CPU Scheduling

- Scheduling Concepts, Techniques of Scheduling, Preemptive and Non- Preemptive Scheduling: First-Come-First-Serve, Shortest Request Next, Highest Response Ration Next, Round Robin, Least Complete Next, Shortest Time to Go, Long, Medium, Short Scheduling, Priority Scheduling. Deadlock: System model, Deadlock characterization, Prevention, Avoidance and detection, Recovery from deadlock.

Unit IV – The Internet

- Introduction to cyber-crimes and their classifications, Spamming, Web Jacking, Phishing, Spoofing,
- Types of Virus and Worms
- Cyber Criminals and their Targets
- Tools for Cyber Forensic Analysis

Unit V – Memory Management

- Memory allocation, Relocation, Protection, Sharing, Paging, Segmentation, Virtual Memory, Demand Paging, Page Replacement Algorithms, Thrashing.

I/O Management and Disk Scheduling

- I/O devices, and I/O subsystems, I/O buffering, Disk storage and disk scheduling, RAID.

Suggested Readings:

1. Andrew S. Tanenbaum and Herbert Bos,"Modern Operating Systems," Fourth Edition, Pearson, 2014.
2. Abraham Silberschatz, Greg Gagne, and Peter B. Galvin, "Operating System Concepts," Tenth Edition, Wiley, 2018.
3. William Stallings, "Operating Systems: Internals and Design Principles," Seventh Edition, Prentice Hall, 2011.
4. Dhanjay Dhamdhere, "Operating Systems," First Edition, McGraw-Hill, 2008
5. Milan Milankovic "Operating systems, Concepts and Design" McGraw Hill

B.Sc. Forensic Science: Semester-III FST307: Botany-III	
Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment – 6 Marks
Credits: 4	Attendance – 12 Marks
	End Semester Exam – 70 marks

Course outcomes:

After the completion of the course the students will be able to:

- To gain an understanding of the history and concepts underlying various approaches to plant taxonomy and classification.
- To learn the major patterns of diversity among plants, and the characters and types of data used to classify plants.
- To compare the different approaches to classification with regard to the analysis of data.
- To become familiar with major taxa and their identifying characteristics, and to develop in depth knowledge of the current taxonomy of a major plant family.
- To discover and use diverse taxonomic resources, reference materials, herbarium collections, publications.
- For the entrepreneur career in plants, one can establish a nursery, Start a landscaping business, Set up a farm Or Run a plantation consultancy firm

Unit I – Flowering Plants Identification & Aesthetic Characteristics
• Taxonomic Resources & Nomenclature • Components of taxonomy (identification, nomenclature, classification); Taxonomic resources: Herbarium- functions& important herbaria, Botanical gardens, Flora, Keys- single access and multi-access. Botanical Nomenclature- Principles and rules of ICN (ranks and names; principle of priority, binomial system; type method, author citation, valid-publication).
Unit II – Types of classification & Evidences
• Artificial, natural and phylogenetic. Bentham and Hooker (upto series), Engler and Prantl (upto series) angiosperm phylogeny group (APG III) classification. • Taxonomic evidences from palynology, cytology , phytochemistry &Molecular biology data (Protein and Nucleic acid homology).
Unit III – Identification of Angiospermic families –I
• A study of the following families with emphasis on the morphological peculiarities and economic importance of its members (based on Bentham & Hooker's system) -- Ranunculaceae, Malvaceae , Rutaceae , Fabaceae, Myrtaceae , Cucurbitaceae , Rubiaceae Asteraceae , Apocynaceae , Acanthaceae, Asclepiadiaceae, Solanaceae
Unit IV – Identification of Angiospermic families -II
• A study of the following families with emphasis on the morphological peculiarities and economic importance of its members (based on Bentham & Hooker's system)- Amaranthaceae, Euphorbiaceae, Papaveraceae, Scrophulariaceae , Orchidaceae, Liliaceae Arecaceae, Poaceae

Unit V – Modern trends in Plant taxonomy
• Phenetics and Cladistics: Brief idea on Phenetics, Numerical taxonomy- methods, Operational Taxonomic Units, Cladistics- construction of dendrogram and primary analysis; Monophyletic, polyphyletic and paraphyletic groups; Plesiomorphy and apomorphy.

Suggested Readings:

1. Singh, G. 1999. Plant Systematics: Theory and Practice. Oxford and IBH, New Delhi.
2. Dutta A.C. 2016. Botany for Degree Students. Oxford University Press.
3. Davis, P. H. and V. H. Heywood. 1963. Principles of Angiosperm Taxonomy. Oliver and Boyd,London.
4. Heywood, V. H. and D. M. Moore (Eds). 1984. Current Concepts in Plant Taxonomy. Academic Press, London.
5. Austin, R. 2002. Elements of planting design. New York: John Wiley & Sons.
6. Bertauski, T. 2005. Designing the landscape: An introductory guide for the landscape designer. Upper Saddle River, NJ: Pearson Prentice Hall.
7. Thomas, H., and S. Wooster. 2008. The complete planting design course: Plans and styles for every garden. London: Octopus Publishing Group.
8. Scarfone, S. 2007. Professional planting design: An architectural and horticultural approach for creating mixed bed plantings. New York: John Wiley & Sons.
9. Randhawa, G.S. and Mukhopadhyay, A. 1986. Floriculture in India. Allied Publishers.

B.Sc. Forensic Science: Semester-III FST351: Instrumentation Lab	
Teaching Scheme	**Examination Scheme**
Practicals: 4 hr/Week Credits: 2	Internal Assessment – 15 Marks
	External Assessment – 35 Marks
	End Semester Exam – 50 marks

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

a. The importance of chromatographic and spectroscopic techniques in processing crime scene evidence.
b. The utility of electrophoresis and Centrifugation in analysis of chemical and biological materials.
c. The significance of microscopy in visualizing trace evidence and comparing it with control samples.
d. The usefulness of photography and videography for recording the crime scenes.

Experiment Details

1. To determine the concentration of a colored compound by colorimetry analysis.
2. To carry out thin layer chromatography of ink samples.
3. To carry out separation of organic compounds by paper chromatography.
4. To identify drug samples using UV-Visible spectroscopy.
5. To take photographs using different filters.
6. To take photographs of crime scene exhibits at different angles.
7. To record videography of a crime scene

Suggested Readings

1. D.A. Skoog, D.M. West and F.J. Holler, Fundamentals of Analytical Chemistry, 6th Edition, Saunders College Publishing, Fort Worth (1992).
2. W. Kemp, Organic Spectroscopy, 3rd Edition, Macmillan, Hampshire (1991).
3. J.W. Robinson, Undergraduate Instrumental Analysis, 5th Edition, Marcel Dekker, Inc., New York (1995).
4. D.R. Redsicker, The Practical Methodology of Forensic Photography, 2nd Edition, CRC Press, Boca Raton (2000).

B.Sc. Forensic Science: Semester-III FST352: Crime Scene Management	
Teaching Scheme	**Examination Scheme**
Practical: 4 hr/Week Credits: 2	Internal Assessment – 15 Marks
	External Assessment – 35 Marks
	End Semester Exam – 50 marks

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

a. The methods of securing, searching and documenting crime scenes.
b. The art of collecting, packaging and preserving different types of physical and trace evidence at crime scenes.
c. The legal importance of chain of custody.
d. The tools and techniques for analysis of different types of crime scene evidence.

Experiment Details

1. To investigate an indoor crime scene.
2. To investigate an outdoor crime scene.
3. To prepare a report on evaluation of crime scene.
4. To reconstruct a crime scene (outdoor and indoor).
5. To compare soil samples by density gradient method.
6. To compare paint samples by physical matching method.
7. To compare paint samples by thin layer chromatography method.
8. To compare glass samples by refractive index method.
9. To identify and compare tool marks.
10. To compare cloth samples by physical matching.

Suggested Readings

1. M. Byrd, Crime Scene Evidence: A Guide to the Recovery and Collection of Physical Evidence, CRC Press, Boca Raton (2001).
2. T.J. Gardener and T.M. Anderson, Criminal Evidence, 4th Ed., Wadsworth, Belmont (2001).
3. S.H. James and J.J. Nordby, Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton (2005).
4. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's, Techniques of Crime Scene Investigation, CRC Press, Boca Raton (2013).
5. M.S. Rao, Crime Scene Management, SSP, New Delhi

B.Sc. Forensic Science: Semester-III FST353: Chemistry Lab - III	
Teaching Scheme	**Examination Scheme**
Practicals: 4 hr/Week Credits: 2	Internal Assessment – 15 Marks
	External Assessment – 35 Marks
	End Semester Exam – 50 marks

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

a. The methods of detection of elements in exhibits
b. How to detect different functional groups
c. The process of identification of organic compounds

Experiment Details

1. Detection of elements (X, N, S)
2. Detection of functional groups: PhOH, -COOH, C=O, -CHO, Ar-NH2, Ar-NO2, -CONH2
3. Identification of simple organic compounds.
4. Systematic identification of organic compounds (monofunctional and bi-functional) and preparation of their derivatives

Suggested Readings

1. Organic Chemistry, Paula Y. Bruice, 2nd Edition, Prentice-Hall, International Edition (1998).
2. Organic Chemistry, I. L. Finar, Vol. I, 6th Edition (1973), ELBS and Longman Ltd., New Delhi.
3. Organic Chemistry, R. T. Morrison and R. N. Boyd, 6th Edition (1992), Prentice-Hall of India (P) Ltd., New Delhi.
4. Organic Chemistry, Paula Y. Bruice, 2nd Edition, Prentice-Hall, International Edition (1998).
5. Organic Chemistry, I. L. Finar, Vol. I, 6th Edition (1973), ELBS and Longman Ltd., New Delhi.
6. Organic Chemistry, R. T. Morrison and R. N. Boyd, 6th Edition (1992), Prentice-Hall of India (P) Ltd., New Delhi.
7. Organic Chemistry, J. Clayden, N. Greeves, S. Warren, and E. Wothers, , Oxford Univ. Press, Oxford (2001).

B.Sc. Forensic Science: Semester-III FST354: Physics Lab - III	
Teaching Scheme	**Examination Scheme**
Practicals: 4 hr/Week Credits: 2	Internal Assessment – 15 Marks
	External Assessment – 35 Marks
	End Semester Exam – 50 marks

Course outcomes:

- Experimental physics has the most striking impact on the industry wherever the instruments are used to study and determine the electric and magnetic properties. Measurement precision and perfection is achieved through Lab Experiments. Online Virtual Lab Experiments give an insight in simulation techniques and provide a basis for modeling.

Lab Experiment List
• Variation of magnetic field along the axis of single coil • Variation of magnetic field along the axis of Helmholtz coil • Ballistic Galvanometer: Ballistic constant, current sensitivity and voltage sensitivity • Ballistic Galvanometer: High resistance by Leakage method • Ballistic Galvanometer: Low resistance by Kelvin's double bridge method • Ballistic Galvanometer: Self-inductance of a coil by Rayleigh's method • Ballistic Galvanometer: Comparison of capacitances • Carey Foster Bridge: Resistance per unit length and low resistance • Deflection and Vibration Magnetometer: Magnetic moment of a magnet and horizontal component of earth's magnetic field • Earth Inductor: Horizontal component of earth's magnetic field

Suggested Readings:

1. B.L. Worsnop, H.T. Flint, ‒Advanced Practical Physics for Students‖, Methuen & Co., Ltd., London, 1962, 9e
2. S. Panigrahi, B. Mallick, ‒Engineering Practical Physics‖, Cengage Learning India Pvt. Ltd., 2015, 1e
3. R.K. Agrawal, G. Jain, R. Sharma, ‒Practical Physics‖, Krishna Prakashan Media (Pvt.) Ltd., Meerut, 2019
4. S.L. Gupta, V. Kumar, ‒Practical Physics‖, Pragati Prakashan, Meerut, 2014, 2e

B.Sc. Forensic Science: Semester-III FST355: Zoology Lab - III	
Teaching Scheme	**Examination Scheme**
Practicals: 4 hr/Week Credits: 2	Internal Assessment – 15 Marks
	External Assessment – 35 Marks
	End Semester Exam – 50 marks

Course outcomes:

The student at the completion of the course will be able to:

- Understand the basic principles of microscopy, working of different types of microscopes
- Understand the basic techniques of centrifugation and chromatography for studying cells and separation of biomolecules
- Understand the principle of measuring the concentrations of macromolecules in solutions by colorimeter and spectrophotometer and use them in Biochemistry.
- Learn about some of the commonly used advance DNA testing methods.

Unit I
• To study the working principle and Simple, Compound and Binocular microscopes. • To study the working principle of various lab equipment such as pH Meter, Electronic balance, use of glass and micropipettes, Laminar flow, Incubator, Waterbath, Centrifuge, Chromatography apparatus, etc.
Unit II
• To prepare solutions and buffers. • To measure absorbance in Colorimeter or Spectrophotometer. • Demonstration of differential centrifugation to fractionate different components in a mixture.
Unit III
• To prepare dilutions of Riboflavin and verify the principle of spectrophotometry. • To identify different amino acids in a mixture using paper chromatography. • Demonstration of DNA extraction from blood or tissue samples. • To estimate amount of DNA using spectrophotometer.

Suggested Readings:

1. Sambrook et al .Molecular Cloning Vols I, II, III. CSHL (2001).
2. Primrose. Molecular Biotechnology. Panima (2001).
3. Clark & Switzer. Experimental Biochemistry. Freeman (2000)

B.Sc. Forensic Science: Semester-III FST356: Computer Lab - III	
Teaching Scheme	**Examination Scheme**
Practicals: 4 hr/Week Credits: 2	Internal Assessment – 15 Marks
	External Assessment – 35 Marks
	End Semester Exam – 50 marks

Course outcomes:

Ability to:

- Use of Linux operating system and able to write shell programs.
- Simulate and demonstrate the concepts of operating systems..

Lab Experiment List
• Usage of following commands: ls, pwd, tty, cat, who, who am I, rm, mkdir, rmdir, touch, cd.
• Usage of following commands: cal, cat(append), cat(concatenate), mv, cp, man, date.
• Usage of following commands: chmod, grep, tput (clear, highlight), bc.
• Write a shell script to check if the number entered at the command line is prime or not.
• Write a shell script to modify –cal‖ command to display calendars of the specified months.
• Write a shell script to modify –cal‖ command to display calendars of the specified range of months.
• Write a shell script to accept a login name. If not a valid login name display message – –Entered login name is invalid‖.
• Write a shell script to display date in the mm/dd/yy format.
• Write a shell script to display on the screen sorted output of –who‖ command along with the total number of users.
• Write a shell script to display the multiplication table any number,

Suggested Readings:

1. Sumitabh Das, ―Your Unix/Linux: The Ultimate Guide,‖ McGraw Hill, 2012.
2. Richard Blum and Christine Bresnahan, –Linux Command Line and Shell Scripting Bible,‖ Wiley, 2015.
3. Stroustrup, Bjarne, Programming: Principles and Practice Using C++, Addison Wesley, USA, 2014, 2nd ed.
4. E Balagurusamy, Object Oriented Programming with C++, McGraw Hill Education (India) Pvt. Ltd., India, 2013, 6th ed.

B.Sc. Forensic Science: Semester-III FST357: Botany Lab - III	
Teaching Scheme	**Examination Scheme**
Practicals: 4 hr/Week Credits: 2	Internal Assessment – 15 Marks
	External Assessment – 35 Marks
	End Semester Exam – 50 marks

Course outcomes:

After the completion of the course the students will be able:

1. To learn how plant specimens are collected, documented, and curated for a permanent record.
2. To observe, record, and employ plant morphological variation and the accompanying descriptive terminology.
3. To gain experience with the various tools and means available to identify plants.
4. To develop observational skills and field experience.
5. To identify a taxonomically diverse array of native plants.
6. To recognize common and major plant families.
7. To Understand aesthetic characters of flowering plants by making-landscapes, gardens, bonsai, miniatures
8. Comprehend the concepts of plant taxonomy and classification of Angiosperms.

Unit I – Taxonomic Identification using plant structure
• Classify 25 plants on the basis of Taxonomic description (Plant Morphology, Anatomy, Reproductive parts, Habit, adaptation anomalies) according to Benthum Hooker system of classification in the following families: Malvaceae, Fabaceae (Papilionaceae), Solanaceae, Scrophulariaceae, Acanthaceae, Labiatae (Lamiaceae), Rubiaceae.
Unit II -
• Conducting Spot identification (Binomial, Family) of common wild plants from families included in the theoretical syllabus (list to be provided) and making FIELD NOTE BOOK and filling Sample of a page of field-book, used in Botanical Survey of India.
Unit III
• Describe/compare flowers in semi-technical language giving V.S. of flowers, T.S. of ovaries, floral diagrams and Floral Formulae. Identify and assign them to their respective families giving reasons.

Suggested Readings:

1. Day, S.C. (2003)Complete Home Gardening. (2003) Agrobias, Jodhpur, India.
2. Dhopte, A.M. (2003) Principles and Techniques for Plant Scientists. - Agrobios,Jodhpur, India.
3. Khan, M.R. (1995) Horticulture and Gardening.- NiraliPrakashan, Pune. India.
4. PramilaMehra Gardening for every one-. Hind pocket book private limited, NewDehli.
5. Kumarsen V. Horticulture ,Saras Publication
6. Ramesh Bangia Learning Computer Fundamentals.,., Khanna Book Publishers
7. Bose T.K. & Mukherjee, D., 1972, Gardening in India, Oxford & IBH PublishingCo., New Delhi.
8. Sandhu, M.K., 1989, Plant Propagation, Wile Eastern Ltd., Bangalore, Madras.
9. Randhawa, G.S. and Mukhopadhyay, A. 1986. Floriculture in India. Allied Publishers.

B.Sc. Forensic Science: Semester-IV FST401: Forensic Ballistics	
Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment – 6 Marks
Credits: 4	Attendance – 12 Marks
	End Semester Exam – 70 marks

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

a. The classification of firearms and their firing mechanisms.
b. The methods of identifying firearms.
c. The characteristics of ammunition.
d. The importance of firearm evidence.
e. The nature of firearm injuries.
f. The methods for characterization of gunshot residue.

Unit 1: Introduction to Forensic Ballistics
Definition, Scope, and Significance of Forensic Ballistics. Gun powder – Definition, History and Development. Firearms – Definition according to Indian Arms Act. History and Development. Improvised & country made firearms. Formation of gunshot residues. Methods of analysis of gunshot residues from shooting hands and targets, with special reference to clothing.
Unit 2: Classification of Small Firearms and Ammunition
Weapon types and their operation. Firing mechanisms of different firearms. Types of ammunition. Constructional features and characteristics of different types of cartridges and bullets. Primers and priming compounds. Projectiles. Headstamp markings on ammunitions. Different types of marks produced during firing process on cartridge – firing pin marks, breech face marks, chamber marks, extractor and ejector marks.
Unit 3: Internal ballistics
Definition, ignition of propellants, shape and size of propellants, manner of burning, and various factors affecting the interna ballistics: lock time, ignition time, barrel time, erosion, corrosion and gas cutting
Unit 4: External Ballistics
Vacuum trajectory, effect of air resistance on trajectory, base drag, drop, drift, yaw, shape of projectile and stability, trajectory computation, ballistics coefficient and limiting velocity, Measurements of trajectory parameters, introduction to automated system o trajectory computation and automated management of ballistic data.

Unit 5: Terminal Ballistics
Effect of projectile on hitting the target: function of bullet shape, striking velocity, striking angle and nature of target, tumbling of bullets, effect of instability of bullet, effect of intermediate targets, influence of range. Ricochet and its effects. Stopping power. Identification and nature of firearms injuries.

Suggested Readings

1. B R Sharma, *Firearms in Criminal Investigation and Trials*, Universal Law Publishing - An imprint of LexisNexis
2. K Kumar, *Forensic Ballistics in Criminal Justice*, Eastern Book Company, Lucknow
3. B.J. Heard, *Handbook of Firearms and Ballistics*, Wiley and Sons, Chichester (1997).
4. W.F. Rowe, Firearms identification, *Forensic Science Handbook*, Vol. 2, R. Saferstein (Ed.), Prentice Hall, New Jersey (1988).
5. A.J. Schwoeble and D.L. Exline, *Current Methods in Forensic Gunshot Residue Analysis*, CRC Press, Boca Raton (2000).

B.Sc. Forensic Science: Semester-IV FST402: Forensic Biology & Serology	
Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment – 6 Marks
Credits: 4	Attendance – 12 Marks
	End Semester Exam – 70 marks

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

a. The significance of biological evidence.
b. The forensic importance of hair evidence.
c. The importance of biological fluids – blood, urine, semen, saliva, sweat and milk – in crime investigations.
d. How wildlife forensics aid in conserving natural resources.
e. How forensic entomology assists in death investigations.

Unit 1: Biological Evidence
Nature and importance of biological evidence. Types of biological evidence. Significance of hair evidence. Transfer, persistence and recovery of hair evidence. Structure of human hair. Comparison of hair samples. Morphology and biochemistry of human hair. Comparison of human and animal hair. Identification and examination of human body fluids like blood, semen, saliva, urine, etc. Bloodstain characteristics. Impact bloodstain patterns. Cast-off bloodstain patterns. Projected bloodstain patterns. Contact bloodstain patterns. Blood trails. Bloodstain drying times. Documentation of bloodstain pattern evidence. Crime scene reconstruction with the aid of bloodstain pattern analysis.
Unit 2: Microbial Forensics
Introduction. Types and identification of microbial organisms of forensic significance.
Unit 3: Botanical Evidences
Identification of wood, leaves, pollens and juices as botanical evidence. Diatoms and their forensic significance.
Unit 4: Wildlife Forensics
Introduction and Significance of wildlife forensic. Protected and endangered species of animals and plants. Illegal trading in wildlife items, such as skin, fur, bone, horn, teeth, tusk, claws, flowers and plants. Identification of physical evidence pertaining to wildlife forensics. Identification of pug marks of various animals.
Unit 5: Forensic Entomology
Introduction to forensic entomology. Insects of forensic importance. Collection of entomological evidence during death investigations.

Suggested Readings:

1. L. Stryer, Biochemistry, 3rd Edition, W.H. Freeman and Company, New York (1988).
2. R.K. Murray, D.K. Granner, P.A. Mayes and V.W. Rodwell, Harper's Biochemistry, APPLETON & Lange, Norwalk (1993).
3. S. Chowdhuri, Forensic Biology, BPRD, New Delhi (1971).
4. R. Saferstein, Forensic Science Handbook, Vol. III, Prentice Hall, New Jersey (1993).
5. G.T. Duncan and M.I. Tracey, Serology and DNA typing in, Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (Ed.), CRC Press, Boca Raton (1997).

B.Sc. Forensic Science: Semester-IV FST 403: Chemistry- IV	
Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment – 6 Marks
Credits: 4	Attendance – 12 Marks
	End Semester Exam – 70 marks

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

a. The methods of analyzing trace amounts of petroleum products in crime scene evidence.
b. The methods of analyzing contaminants in petroleum products.
c. The method of searching, collecting, preserving and analyzing arson evidence.
d. The classification of explosives, including the synthesis and characterization of representative analogs.
e. The significance of explosion scene management.
f. The techniques of locating hidden explosives.

Unit 1: Petroleum and Petroleum Products
Distillation and fractionation of petroleum. Commercial uses of different petroleum fractions. Analysis of petroleum products. Analysis of traces of petroleum products in forensic exhibits. Comparison of petroleum products. Adulteration of petroleum products.
Unit 2: Arson
Chemistry of fire. Conditions for fire. Fire scene patterns. Location of point of ignition. Recognition of type of fire. Searching the fire scene. Collection and preservation of arson evidence.
Unit 3: Analysis of Fire Debris
Analysis of ignitable liquid residue. Post-flashover burning. Scientific investigation and evaluation of clue materials. Information from smoke staining.
Unit 4: Explosives
Classification of explosives – low explosives and high explosives. Homemade explosives. Military explosives. Detonators. Synthesis and characteristics of TNT, PETN and RDX. Explosion process. Shock waves.
Unit 5: Explosion Scene Management
Searching the scene of explosion. Mechanism of explosion. Post blast residue collection and analysis. Blast injuries. Detection of hidden explosives.

Suggested Readings

1. J.D. DeHaan, Kirk's Fire Investigation, 3rd Edition, Prentice Hall, New Jersey (1991).
2. A.A. Moenssens, J. Starrs, C.E. Henderson and F.E. Inbau, Scientific Evidence in Civil and Criminal Cases, 4th Edition, The Foundation Press, Inc., New York (1995).
3. R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004).
4. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's, Techniques of Crime Scene Investigation, CRC Press, Boca Raton (2013).
5. S. Ballou, M. Houck, J.A. Siegel, C.A. Crouse, J.J. Lentini and S. Palenik in Forensic Science, D.H. Ubelaker (Ed.), Wiley-Blackwell, Chichester (2013).

B.Sc. Forensic Science: Semester-IV FST 404: Physics- IV	
Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment – 6 Marks
Credits: 4	Attendance – 12 Marks
	End Semester Exam – 70 marks

Course outcomes:

- Recognize the difference between the structure of space & time in Newtonian & Relativistic mechanics.
- Understand the physical significance of consequences of Lorentz transformation equations.
- Comprehend the wave-particle duality.
- Develop an understanding of the foundational aspects of Quantum Mechanics.
- Study the comparison between various biasing techniques.
- Study the classification of amplifiers.
- Comprehend the use of feedback and oscillators.
- Comprehend the theory and working of optical fibers along with its applications.

Unit I – Relativity-Experimental Background
• Structure of space & time in Newtonian mechanics and inertial & non-inertial frames. Galilean transformations. Newtonian relativity. Galilean transformation and Electromagnetism. Attempts to locate the Absolute Frame: Michelson-Morley experiment and significance of the null result. Einstein's postulates of special theory of relativity.
Unit II – Relativity-Relativistic Kinematics
• Structure of space & time in Relativistic mechanics and derivation of Lorentz transformation equations (4-vector formulation included). Consequences of Lorentz Transformation Equations (derivations & examples included): Transformation of Simultaneity (Relativity of simultaneity); Transformation of Length (Length contraction); Transformation of Time (Time dilation); Transformation of Velocity (Relativistic velocity addition); Transformation of Acceleration; Transformation of Mass (Variation of mass with velocity). Relation between Energy & Mass (Einstein's mass & energy relation) and Energy & Momentum.
Unit III – Inadequacies of Classical Mechanics
• Particle Properties of Waves: Spectrum of Black Body radiation, Photoelectric effect, Compton effect and their explanations based on Max Planck's Quantum hypothesis. Wave Properties of Particles: Louis de Broglie's hypothesis of matter waves and their experimental verification by Davisson-Germer's experiment and Thomson's experiment.
Unit IV – Introduction to Quantum Mechanics
• Matter Waves: Mathematical representation, Wavelength, Concept of Wave group, Group (particle) velocity, Phase (wave) velocity and relation between Group & Phase velocities. Wave Function: Functional form, Normalization of wave function, Orthogonal & Orthonormal wave functions and Probabilistic interpretation of wave function based on Born Rule.
Unit V – Transistor Biasing
• Faithful amplification & need for biasing. Stability Factors and its calculation for transistor biasing circuits for CE configuration: Fixed Bias (Base Resistor Method), Emitter Bias (Fixed Bias with

Emitter Resistor), Collector to Base Bias (Base Bias with Collector Feedback) &, Voltage Divider Bias. Discussion of Emitter-Follower configuration.

Suggested Readings:

1. A. Beiser, Shobhit Mahajan, ―Concepts of Modern Physics: Special Indian Edition‖, McGraw Hill, 2009, 6e
2. John R. Taylor, Chris D. Zafiratos, Michael A.Dubson, ―Modern Physics for Scientists and Engineers‖, Prentice-Hall of India Private Limited, 2003, 2e
3. R.A. Serway, C.J. Moses, and C.A. Moyer, ―Modern Physics‖, Cengage Learning India Pvt. Ltd, 2004, 3e
4. R. Resnick, ―Introduction to Special Relativity‖, Wiley India Private Limited, 2007
5. R. Murugeshan, Kiruthiga Sivaprasath, ―Modern Physics‖, S. Chand Publishing, 2019, 18e
6. R.L. Boylestad, L. Nashelsky, ―Electronic Devices and Circuit Theory‖, Prentice-Hall of India Pvt. Ltd., 2015, 11e
7. J. Millman, C.C. Halkias, Satyabrata Jit, ―Electronic Devices and Circuits‖, McGraw Hill, 2015, 4e
8. B.G. Streetman, S.K. Banerjee, ―Solid State Electronic Devices‖, Pearson Education India, 2015, 7e
9. J.D. Ryder, ―Electronic Fundamentals and Applications‖, Prentice-Hall of India Private Limited, 1975, 5e
10. John M. Senior, ―Optical Fiber Communications: Principles and Practice‖, Pearson Education Limited, 2010, 3e
11. John Wilson, John Hawkes, ―Optoelectronics: Principles and Practice‖, Pearson Education Limited, 2018, 3e
12. S.L. Gupta, V. Kumar, ―Hand Book of Electronics‖, Pragati Prakashan, Meerut, 2016, 43e

B.Sc. Forensic Science: Semester-IV FST 405: Zoology- IV	
Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment – 6 Marks
Credits: 4	Attendance – 12 Marks
	End Semester Exam – 70 marks

Course outcomes:

The student at the completion of the course will be able to:

- Understand the principles of genetic engineering, how genes can be cloned in bacteria and the various technologies involved in it.
- Know the applications of biotechnology in various fields like agriculture, industry and human health.
- To have an in depth understanding about Immune System & its mechanisms.
- Get introduced to DNA testing and utility of genetic engineering in forensic sciences.
- Get introduced to computers and use of bioinformatics tools.
- Enable students to get employment in pathology/Hospital.
- Take up research in biological sciences.

Unit I – Principles of Gene Manipulation

- Recombinant DNA Technology
- Selection and identification of recombinant cells
- Restriction Enzymes, DNA modifying enzymes, Cloning Vectors, Ligation
- Gene transfer techniques, Gene therapy

Unit II – Applications of Genetic Engineering

- Single cell proteins
- Biosensors, Biochips
- Crop and livestock improvement, development of transgenics
- Development of DNA drugs and vaccines

Unit III – DNA Diagnostics

- Genetic analysis of human diseases, detection of known and unknown mutations
- Concept of pharmacogenomics and pharmacogenetics

Unit IV – Immune System and its Components

- Historical perspective of Immunology, Innate and Adaptive Immunity, clonal selection, complement system
- Structure and functions of different classes of immunoglobulins, Hypersensitivity
- Humoral immunity and cell mediated immunity
- HLA complex: organization, class I and II HLA molecules

Unit V – Biostatistics

- Calculations of mean, median, mode, variance, standard deviation
- Concepts of coefficient of variation, Skewness, Kurtosis
- Elementary idea of probability and application
- Data summarizing: frequency distribution, graphical presentation—bar, pie diagram, histogram
- Tests of significance: one and two sample tests, t-test and Chisquare test

Suggested Readings:

1. Primrose & Twyman. Principles of Genome Analysis and Genomics. Blackwell (2003)
2. Hartl & Jones. Genetics: principles & Analsysis of Genes & Genomes. Jones & Bartlett (1998)
3. Smbrook et al .Molecular Cloning Vols I, II, III. CSHL (2001).
4. Primrose. Molecular Biotechnology. Panima (2001).
5. Clark & Switzer. Experimental Biochemistry. Freeman (2000)
6. Sudbery. Human Molecular Genetics. Prentice-Hall (2002).
7. Wilson. Clinical Genetics-A Short Course, Wiley (2000).
8. Pasternak. An Introduction to Molecular Human Genetics. Fritzgerald (2000).
9. Biostatistical Analysis (Fourth Edition) by Jerrold H. Zarr, Pearson Education Inc., Delhi.
10. Statistical Methods (Eighth Edition) by G. W. Snecdecor and W. G. Cochran, Willey Blackwell
11. Biostatistics (Tenth Edition) by W.W. Daniel and C. L. Cross, Wiley
12. Introductory Biological Statistics (Fourth Edition) by John E. Havel, Raymond E. Hampton and Scott J. Meiners
13. Westheadet al Bioinformatics: Instant Notes. Viva Books (2003).

B.Sc. Forensic Science: Semester-IV FST 406: Computer Science- IV	
Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment – 6 Marks
Credits: 4	Attendance – 12 Marks
	End Semester Exam – 70 marks

Course outcomes:

The student will be able to understand

- the basic arithmetic of a Computer System;
- how the data is represented,
- how the various operation are performed on the data, the basic circuits to perform these operations,
- how instructions are formatted and how these instructions are executed to accomplish a particular operation.
- Student can also learn the organization of the peripheral devices, the interface between these devices to the system.
- Student can also understand the architecture of a basic computer, its registers, bus system and the interaction flow among them.

Unit I – Data Representation and basic Computer Arithmetic
• Number systems, complements, fixed and floating point representation, character representation, addition, subtraction, magnitude comparison. • Logic gates and circuits: logic gates, boolean algebra, combinational circuits, circuit simplification, introduction to flip-flops and sequential circuits, decoders, multiplexers, registers, counters.
Unit II – Basic Computer Organization and Design
• Computer registers, bus system, instruction set, timing and control, instruction cycle, memory reference, input-output and interrupt. • Central Processing Unit: Register organization, arithmetic and logical micro-operations, stack organization, Hardwired vs. micro programmed control. Pipeline control: Instruction pipelines, pipeline performance, super scalar processing, Pipelining, RISC & CISC
Unit III – Programming the Basic Computer
• Instruction formats, addressing modes, instruction codes, assembly language • Memory Organization: Memory device characteristics, random access memories, serial access memories, Multilevel memories, address translation, memory allocation, Main features, address mapping, structure versus performance.
Unit IV – Input-output Organization
• Peripheral devices, I/O interface, Modes of data transfer: Programmed, Interrupt Driven and Direct Memory Access.
Unit V – Parallel processing
• Processor-level parallelism, multiprocessor architecture

Suggested Readings:

1. M. Mano, –Computer System Architecture‖, Pearson Education, New Jersey, 2017, Third Edition.
2. W. Stallings, –Computer Organization and Architecture Designing for Performance‖, Prentice Hall of India, 2015, Tenth Edition.
3. M. Mano, –Digital Design‖, Pearson Education, New Jersey, 2018, Sixth Edition.
4. Vranasic and Hamacher, Computer Organization, TMH"

B.Sc. Forensic Science: Semester-IV FST 407: Botany- IV	
Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment – 6 Marks
Credits: 4	Attendance – 12 Marks
	End Semester Exam – 70 marks

Course outcomes:

The student at the completion of the course will be able to:

- Understand the principles of genetic engineering, how genes can be cloned in bacteria and the various technologies involved in it.
- Know the applications of biotechnology in various fields like agriculture, industry and human health.
- To have an in depth understanding about Immune System & its mechanisms.
- Get introduced to DNA testing and utility of genetic engineering in forensic sciences.
- Get introduced to computers and use of bioinformatics tools.
- Enable students to get employment in pathology/Hospital.
- Take up research in biological sciences.

Unit I – Origin and domestication of cultivated plants

- Centers of diversity of plants, origin of crop plants. Domestication and introduction of crop plants. Concepts of sustainable development; cultivation, production and uses of Cereals, legumes, Spices & beverages.
- **Botany of oils, Fibers, timber yielding plants & dyes**
  Study of the plants with Botanical names, Family, part used, and economic uses yielding Edible & essential oils; Sugar , Starch; Fibers; Paper, Fumitories & Masticatories, Rubber ,Dyes, Timber, biofuel crops

Unit II – Commercial production of Flowers, Vegetables, and fruits

- Commercial greenhouse cultivation of rose, Gerbera, Gladiolus, Anthurium/lilium/lily, tomato, bell pepper, cucumber, strawberry & Exotic leafy vegetables using Hydroponics.

Unit III – Medicinal aspects

- Study of common plants used by tribes (*Aegle marmelos, Ficus religiosa, Cynadon dactylon, Eclipta alba, Oxalis, Ocimum sanctum* and *Trichopus zeylanicus*) Ethnobotanical aspect of conservation and management of plant resources, Preservation of primeval forests in the form of sacred groves of individual species and Botanical uses depicted in our epics. Plants in primary health care: common medicinal plants: Tinospora, Acorus, Ocimum, Turmeric and Aloe..Indian Pharmacopeia, Quality Evaluation of crude drugs & adulteration

Unit IV – Pharmacognosy

- Preparation of drugs for commercial market - Organoleptic evaluation of drugs – Microscopic evaluation of drugs - Physical evaluation of drugs - Active and inert constituents of drugs – Classification of drug plants - individual drugs - drug adulteration. Sources of crude drugs – roots, rhizome, bulb, corm, leaves, stems, flowers, fruits and seeds ; organoleptic study of *Adhatoda vasica, Andrographis paniculata, Azadirachta indica, Coriandrum sativum, Datura metal, Eclipta alba, Emblica officinalis, Ocimum sanctum, Phyllanthus amarus, Ricinus communis, Vinca rosea* and *Zingiber officinale.*

Unit V – Herbal Preparations & Phytochemistry
• Collection of wild herbs - Capsules - compresses - Elixirs - Glycerites - Hydrotherapy or Herbal bath - Herbal oils - Liquid extracts or Tincture - Poultices - Salves - Slippery elm slurry and gruel - Suppositories - Teas. Plant natural products , general detection, extraction and characterization procedures. Glycosides and Flavonoids and therapeutic applications. Anthocyanins and Coumarins and therapeutic applications, Lignans, Terpenes, Volatile oils and Saponins, Carotenoids and Alkaloids Carotenoids and pharmacological activities.

Suggested Readings:

1. Kochhar, S.L. (2011). Economic Botany in the Tropics, MacMillan Publishers India Ltd., New Delhi. 4th edition.
2. Sambamurthy, AVSS & Subrahmanyam, NS (2000). Economic Botany of Crop Plants. Asiatech Publishers. New Delhi.
3. Singh, D.K and K.V. Peter. 2014. Protected cultivation of horticultural crops. New India Publishing Agency, India.
4. Reddy P. Parvatha. 2016. Sustainable crop protection under protected cultivation. Springer, Singapore.
5. Amit Deogirikar. 2019. A Text Book on Protected Cultivation and Secondary Agriculture. Rajlaxmi Prakashan, Aurangabad, India.
6. Singh, B., B. Singh, N. Sabir and M Hasan. 2014. Advances in protected cultivation. New India Publishing Agency, India.

B.Sc. Forensic Science: Semester-IV FST451: Examination of Firearms and GSR	
Teaching Scheme	**Examination Scheme**
Lectures: 4 hr/Week Credits: 2	Internal Assessment – 15 Marks
	External Assessment – 35 Marks
	End Semester Exam – 50 marks

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

a. The classification of firearms and their firing mechanisms.
b. The methods of identifying firearms.
c. The characteristics of ammunition.
d. The importance of firearm evidence.
e. The nature of firearm injuries.
f. The methods for characterization of gunshot residue.

Experiment Details

1. To describe, with the aid of diagrams, the firing mechanisms of different types of firearms.
2. To correlate the velocity of bullet with the impact it produces on the target.
3. To correlate the striking angle of the bullet with the impact on the target.
4. To estimate the range of fired bullets.
5. To carry out the comparison of fired bullets.
6. To carry out the comparison of fired cartridge cases.
7. 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.

Suggested Readings

1. B R Sharma, *Firearms in Criminal Investigation and Trials*, Universal Law Publishing - An imprint of LexisNexis
2. K Kumar, *Forensic Ballistics in Criminal Justice*, Eastern Book Company, Lucknow
3. B.J. Heard, *Handbook of Firearms and Ballistics*, Wiley and Sons, Chichester (1997).
4. W.F. Rowe, Firearms identification, *Forensic Science Handbook*, Vol. 2, R. Saferstein (Ed.), Prentice Hall, New Jersey (1988).
5. A.J. Schwoeble and D.L. Exline, *Current Methods in Forensic Gunshot Residue Analysis*, CRC Press, Boca Raton (2000).

B.Sc. Forensic Science: Semester-IV FST452: Examination of Biological Evidences	
Teaching Scheme	**Examination Scheme**
Practical: 4 hrs/Week Credits: 2	Internal Assessment – 15 Marks
	External Assessment – 35 Marks
	End Semester Exam – 50 marks

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

a. The significance of biological evidence.
b. The forensic importance of hair evidence.
c. The importance of biological fluids – blood, urine, semen, saliva, sweat and milk – in crime investigations.
d. How wildlife forensics aid in conserving natural resources.
e. How forensic entomology assists in death investigations.

Experiment Details

1. To examine hair morphology and determine the species to which the hair belongs.
2. To prepare slides of scale pattern of human hair.
3. To examine human hair for cortex and medulla.
4. To carry out microscopic examination of pollen grains.
5. To carry out microscopic examination of diatoms.
6. To cite a crime case in which diatoms have served as forensic evidence.
7. To prepare a case report on forensic entomology.
8. To prepare a case report on problems of wildlife forensics.
9. Examination of blood.
10. Examination of various body fluids.

Suggested Reading

1. L. Stryer, *Biochemistry*, 3rd Edition, W.H. Freeman and Company, New York (1988).
2. R.K. Murray, D.K. Granner, P.A. Mayes and V.W. Rodwell, *Harper's Biochemistry*, APPLETON & Lange, Norwalk (1993).
3. S. Chowdhuri, *Forensic Biology*, BPRD, New Delhi (1971).
4. R. Saferstein, *Forensic Science Handbook*, Vol. III, Prentice Hall, New Jersey (1993).
5. G.T. Duncan and M.I. Tracey, Serology and DNA typing in, *Introduction to Forensic Sciences*, 2nd Edition, W.G. Eckert (Ed.), CRC Press, Boca Raton (1997).

B.Sc. Forensic Science: Semester-IV FST453: Chemistry Lab - IV	
Teaching Scheme	**Examination Scheme**
Practical: 4 hrs/Week Credits: 2	Internal Assessment – 15 Marks
	External Assessment – 35 Marks
	End Semester Exam – 50 marks

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

a. The methods of analyzing trace amounts of petroleum products in crime scene evidence.
b. The methods of analyzing contaminants in petroleum products.
c. The method of searching, collecting, preserving and analyzing arson evidence.
d. The classification of explosives, including the synthesis and characterization of representative analogs.
e. The significance of explosion scene management.
f. The techniques of locating hidden explosives.

Experiment Details:

1. To carry out analysis of gasoline.
2. To carry out analysis of diesel.
3. To carry out analysis of kerosene oil.
4. To analyze arson accelerators.
5. To prepare a case report on a case involving arson.
6. To carry out analysis of explosive substances.
7. To separate explosive substances using thin layer chromatography.
8. To prepare a case report on bomb scene management.

Suggested Readings

1. J.D. DeHaan, *Kirk's Fire Investigation*, 3rd Edition, Prentice Hall, New Jersey (1991).
2. A.A. Moenssens, J. Starrs, C.E. Henderson and F.E. Inbau, *Scientific Evidence in Civil and Criminal Cases*, 4th Edition, The Foundation Press, Inc., New York (1995).
3. R. Saferstein, *Criminalistics*, 8th Edition, Prentice Hall, New Jersey (2004).
4. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's, *Techniques of Crime Scene Investigation*, CRC Press, Boca Raton (2013).
5. S. Ballou, M. Houck, J.A. Siegel, C.A. Crouse, J.J. Lentini and S. Palenik in *Forensic Science*, D.H. Ubelaker (Ed.), Wiley-Blackwell, Chichester (2013).

B.Sc. Forensic Science: Semester-IV FST454: Physics Lab - IV	
Teaching Scheme	**Examination Scheme**
Practical: 4 hrs/Week Credits: 2	Internal Assessment – 15 Marks
	External Assessment – 35 Marks
	End Semester Exam – 50 marks

Course outcomes:

- Basic Electronics instrumentation has the most striking impact on the industry wherever the components / instruments are used to study and determine the electronic properties. Measurement precision and perfection is achieved through Lab Experiments. Online Virtual Lab Experiments give an insight in simulation techniques and provide a basis for modeling.

List of Experiments

- Transistor Bias Stability
- Comparative Study of CE, CB and CC amplifier
- Clippers and Clampers
- Study of Emitter Follower
- Frequency response of single stage RC coupled amplifier
- Frequency response of single stage Transformer coupled amplifier
- Effect of negative feedback on frequency response of RC coupled amplifier
- Study of Schmitt Trigger
- Study of Hartley oscillator
- Study of Wein Bridge oscillator

Suggested Readings:

1. R.L. Boylestad, L. Nashelsky, ―Electronic Devices and Circuit Theory‖, Prentice-Hall of India Pvt. Ltd., 2015, 11e
2. J. Millman, C.C. Halkias, Satyabrata Jit, ―Electronic Devices and Circuits‖, McGraw Hill, 2015, 4e
3. B.G. Streetman, S.K. Banerjee, ―Solid State Electronic Devices‖, Pearson Education India, 2015, 7e
4. J.D. Ryder, ―Electronic Fundamentals and Applications‖, Prentice-Hall of India Private Limited, 1975, 5e
5. John M. Senior, ―Optical Fiber Communications: Principles and Practice‖, Pearson Education Limited, 2010, 3e
6. John Wilson, John Hawkes, ―Optoelectronics: Principles and Practice‖, Pearson Education Limited, 2018, 3e
7. S.L. Gupta, V. Kumar, ―Hand Book of Electronics‖, Pragati Prakashan, Meerut, 2016, 43e

B.Sc. Forensic Science: Semester-IV FST455: Zoology Lab - IV	
Teaching Scheme	**Examination Scheme**
Practical: 4 hrs/Week Credits: 2	Internal Assessment – 15 Marks
	External Assessment – 35 Marks
	End Semester Exam – 50 marks

Course outcomes:

The student at the completion of the course will be able to:

- Understand the principles of genetic engineering with hands-on experiments in mutation detection, testing of infectious diseases like Covid 19.
- Get introduced to DNA testing and utility of genetic engineering in forensic sciences.
- Apply knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics existing software effectively to extract information from large databases and to use this information in computer modeling.
- Use bioinformatics tools to find out evolutionary/phylogenetic relationship of organisms using gene sequences.
- Get employment in Hospitals/Diagnostic and forensic labs/Counsel families with genetic disorders.
- Enable students to take up research in biological sciences.

Unit I
• Measure the pre and post clitellar lengths of earthworms and calculate mean, median, mode, standard deviation etc. • Measure the height and weight of all students in the class and apply statistical measures.
Unit II
• Determination of ABO Blood group • To perform bacterial culture and calculate generation time of bacteria. • To study Restriction enzyme digestion using teaching kits. • To detect genetic mutations by Polymerase Chain Reaction (PCR) using teaching kits. • Demonstration of agarose gel electrophoresis for detection of DNA. • Demonstration of Polyacrylamide Gel Electrophoresis (PAGE) for detection of proteins. • To calculate molecular weight of unknown DNA and protein fragments from gel pictures.

Suggested Readings:

1. Primrose &Twyman. Principles of Genome Analysis and Genomics. Blackwell (2003).
2. Hartl& Jones. Genetics: principles &Analsysis of Genes & Genomes. Jones & Bartlett (1998).
3. Sambrooket al .Molecular Cloning Vols I, II, III. CSHL (2001).
4. Primrose. Molecular Biotechnology. Panima (2001)

B.Sc. Forensic Science: Semester-IV FST456: Computer Lab - IV	
Teaching Scheme	**Examination Scheme**
Practical: 4 hrs/Week Credits: 2	Internal Assessment – 15 Marks
	External Assessment – 35 Marks
	End Semester Exam – 50 marks

Course outcomes:

An ability to understand:

- The functions of various hardware components and their building blocks
- Boolean algebraic expressions to digital design
- And implementation of different sequential and Combinational circuits
- computer buses and input/output peripherals
- memory hierarchy and design of primary memory

Unit

- Create the micro operations and associate with instructions as given in the chapter (except interrupts). Design the register set, memory and the instruction set. Use this machine for the assignments of this section.
- Create a Fetch routine of the instruction cycle.
- Simulate the machine to determine the contents of AC, E, PC, AR and IR registers in hexadecimal after the execution of each of following register reference instructions:
  a. CLA e. CIR i. SNA
  b. CLE f. CIL j. SZA
  c. CMA g. INC k. SZE
  d. CME h. SPA l. HLT
  Initialize the contents of AC to (A937)16, that of PC to (022)16 and E to 1.
- Simulate the machine for the following memory-reference instructions with I= 0 and address part = 82. The instruction to be stored at address 022 in RAM. Initialize the memory word at address 082 with the operand B8F2 and AC with A937. Determine the contents of AC, DR, PC, AR and IR in hexadecimal after the execution.
  a. ADD f. BSA
  b. AND g. ISZ
  c. LDA
  d. STA
  e. BUN
- Simulate the machine for the memory-reference instructions referred in above question with I= 1 and address part = 082. The instruction to be stored at address 026 in RAM. Initialize the memory word at address 082 with the value 298. Initialize the memory word at address 298 with operand B8F2 and AC with A937. Determine the contents of AC, DR, PC, AR and IR in hexadecimal after the execution.

Suggested Readings:

1. M. Mano, –Computer System Architecture‖, Pearson Education, New Jersey, 2017,Third Edition.
2. W. Stallings, –Computer Organization and Architecture Designing for Performance‖, Prentice Hall of India, 2015, Tenth Edition.
3. M. Mano, –Digital Design‖, Pearson Education, New Jersey, 2018, Sixth Edition.
4. Vranasic and Hamacher, Computer Organization, TMH"

B.Sc. Forensic Science: Semester-IV FST457: Botany Lab - IV	
Teaching Scheme	**Examination Scheme**
Practical: 4 hrs/Week Credits: 2	Internal Assessment – 15 Marks
	External Assessment – 35 Marks
	End Semester Exam – 50 marks

Course outcomes:

After the completion of the course the students will be able to:

- Know about the commercial products produced from plants.
- Gain the knowledge about cultivation practices of some economic crops.
- Understand about the ethnobotanical details of plants.
- Learn about the chemistry of plants &herbal preparations
- Can become a protected cultivator, aromatic oil producer, Pharmacologist or quality analyst in Drug Company.

Unit - Economic Botany & Microtechniques

- Cereals: Wheat (habit sketch, L.S./T.S. of grain, starch grains, micro-chemical tests); rice (habit sketch, study of paddy and grain, starch grains, micro-chemical tests)
- Legume: Pea or ground nut (habit, fruit, seed structure, micro-chemical tests)
- Source of sugars and starches: Sugarcane (habit sketch; cane juice- micro-chemical tests); potato (habit sketch, tuber morphology, T.S. of tuber to show localization of starch grains, W.M. of starch) grains, micro-chemical tests.
- Tea- tea leaves, tests for tannin
- Mustard- plant specimen, seeds, tests for fat in crushed seeds
- Timbers: section of young stem.
- Jute- specimen, transverse section of stem, tests for lignin on T.S. of stem and study off fiber following maceration technique.
- Study of specimens of economic importance.

Suggested Readings:

1. Wallis, T. E. 1946. Text book of Pharmacognosy, J & A Churchill Ltd.
2. Roseline, A. 2011. Pharmacognosy. MJP Publishers, Chennai.
3. Jain S. K. 1989. Methods and approaches in Ethnobotany, Society of Ethnobotanists, Lucknow.
4. Pal, D.C. & Jain, S.K., 1998. Tribal Medicine. Naya Prakash Publishers, Calcutta.
5. Datta & Mukerji, 1952. Pharmacognosy of Indian roots of Rhizome drugs. Bulletin No.1 Ministry of Health, Govt. of India.
6. Young Ken, H.W., 1948. Text Book of Pharmacognosy. Blakiston C., Philadelphia.
7. Shukla, R.S., 2000. Forestry for tribal development. A.H. Wheeler & Co. Ltd., India.
8. Raychudhuri, S.P., 1991. (Ed.) Recent advances in Medicinal aromatic and spice crops. Vol.1, Today & Tomorrow's printers and publishers, New Delhi.