

SEMESTER III

B.Sc -II Forensic Science

Year	Semester	Paper No.	Title of Paper
Second	III	BFST : 301	Criminalistics I
		BFST : 302	Forensic Chemistry III
		BFST : 303	Forensic Biology III
		BFST : 304	Forensic Physics III
		BFST : 305	Microscopy
		BFST : 306	Computer Forensic and Incident Response
		BFST : 307	Environmental Science
	IV	BFST : 401	Criminalistics II
		BFST : 402	Forensic Chemistry IV
		BFST : 403	Forensic Biology IV
		BFST : 404	Forensic Physics IV
		BFST : 405	Spectroscopy
		BFST : 406	Computer Forensic Investigation
		BFST: 407	Environmental Science

YASHAVANTRAO CHAVAN INSTITUTE OF SCIENCE ,SATARA								
COURSE STRUCTURE UNDER AUTONOMY								
B. Sc. FORENSIC SCIENCE (ENTIRE)								
B. Sc. II SEMESTER– III (Duration – 6 Months)								
Sr. No.	SUBJECT CODE	TEACHING SCHEME						
		Theory			Practical			
		No. of lectures	Hours	Credits	Subject	No. of lectures	Hours	Credits
1	BFST : 301	3	2.4	2	BFSP : 307	8	6.4	4
2	BFST : 302	3	2.4	2				
3	BFST : 303	3	2.4	2	BFSP : 308	8	6.4	4
4	BFST : 304	3	2.4	2				
5	BFST : 305	3	2.4	2	BFSP : 309	8	6.4	4
6	BFST : 306	3	2.4	2				
7	BFST : 307	3	2.4	2				
	Total of SEM III	21	16.8	14		24	19.2	12
TOTAL NO OF CREDITS FOR SEMESTER III: 26								

YASHAVANTRAO CHAVAN INSTITUTE OF SCIENCE ,SATARA								
COURSE STRUCTURE UNDER AUTONOMY								
B. Sc. FORENSIC SCIENCE (ENTIRE)								
B. Sc. II SEMESTER– IV (Duration – 6 Months)								
Sr. No.	SUBJECT CODE	TEACHING SCHEME						
		Theory			Practical			
		No. of lectures	Hours	Credits	Subject	No. of lectures	Hours	Credits
1	BFST : 401	3	2.4	2	BFSP : 407	8	6.4	4
2	BFST : 402	3	2.4	2				
3	BFST : 403	3	2.4	2	BFSP : 408	8	6.4	4
4	BFST : 404	3	2.4	2				
5	BFST : 405	3	2.4	2	BFSP : 409	8	6.4	4
6	BFST : 406	3	2.4	2				
7	BFST-AECC 4	3	2.4	2				
	Total of SEM IV	21	16.8	14		24	19.2	12
TOTAL NO OF CREDITS FOR SEMESTER IV: 26								
TOTAL NO OF CREDITS FOR SEMESTER III + IV: 52								

YSHAVANTRAO CHAVAN INSTITUTE OF SCIENCE ,SATARA
COURSE STRUCTURE UNDER CHOICE BASED CREDIT SYSTEM (CBCS)

B. Sc. FORENSIC SCIENCE(ENTIRE)

B. Sc. II SEMESTER– III (Duration – 6 Months)

Subject	Paper	ESE	Internal Exam		Subject	Practical-I		Submission	
			CCE-I	CCE-II (Online Test)		Exam	Journal	Case study/ Educational Tour/ Seminar	Day to day Performance
BFST : 301	Criminalistics I	30	5	5	BFSP : 307	50	10	5	5
BFST : 302	Forensic Chemistry III	30	5	5					
BFST : 303	Forensic Biology III	30	5	5	BFSP : 308	50	10	5	5
BFST : 304	Forensic Physics III	30	5	5					
BFST : 305	Microscopy	30	5	5	BFSP : 309	50	10	5	5
BFST : 306	Computer Forensic and Incident Response	30	5	5					
AECC 3	Environmental Science	30	10	10					
Total of SEM III	TOTAL	210	40	40		150	30	15	15
	GRAND TOTAL	500							

YASHAVANTRAO CHAVAN INSTITUTE OF SCIENCE ,SATARA
COURSE STRUCTURE UNDER CHOICE BASED CREDIT SYSTEM (CBCS)

B. Sc. FORENSIC SCIENCE (ENTIRE)

B. Sc. II SEMESTER– IV (Duration – 6 Months)

Subject	Paper	ESE	Internal Exam		Subject	Practical-I		Submission	
			CCE-I	CCE-II (Online Test)		Exam	Journal	Case study/ Educational Tour/ Seminar	Day to day Performance
BFST : 401	Criminalistics II	30	5	5	BFSP : 307	50	10	5	5
BFST : 402	Forensic Chemistry IV	30	5	5					
BFST : 403	Forensic Biology IV	30	5	5	BFSP : 308	50	10	5	5
BFST : 404	Forensic Physics IV	30	5	5					
BFST : 405	Spectroscopy	30	5	5	BFSP : 309	50	10	5	5
BFST : 406	Computer Forensic Investigation	30	5	5					
AECC 3	Environmental Science	30	10	10					
Total of SEM IV	TOTAL	210	40	40		150	30	15	15
	GRAND TOTAL	500							
TOTAL OF MARKS FOR SEMESTER III+ IV: 1000									

B.Sc. II
(Semester III)
BFST : 301 Criminalistics I

Credit: 2 (45)

Learning Objectives:

After studying this paper the students will know –

- 1) *The basics of crime scene management and its types and methods to access the crime scene.*
- 2) *How to record the crime scene and the duties of different agencies involved in investigation.*
- 3) *The types of evidence, labeling, packaging and chain of custody.*
- 4) *The procedure of investigative report writing and its legal considerations.*

Unit I Crime Scene Management (12)

Types of crime scenes – Macroscopic, Microscopic, Indoor And Outdoor. Securing and isolating the crime scene, Surveying the crime scene, Searching the crime scene, Safety measures at crime scenes, Duties of first responders at crime scenes.

Unit II Crime Scene Documentation (11)

Note taking, Crime scene photography and videography, Sketching and crime scene measurement techniques, Crime scene logs. Legal considerations 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?.

Unit III Crime Scene Evidence (11)

Classification of crime scene evidence – physical and trace evidence. Locard's principle. Collection of evidences. Labeling and sealing of evidence. Hazardous evidence. Preservation and packaging of evidence. Chain of custody

Unit IV Report writing (11)

Preparation of report, Purpose of writing an investigative report ,Legal considerations of report: sec 45 IEA, sec 293 of CrPC

Learning Outcomes-

- 1) Students should be able to introduce several aspects of crime scene management.
- 2) Students should be able to explain procedures of crime scene recording.
- 3) Students should be able to prepare investigative reports with legal considerations.
- 4) Students should be able to evaluate the 5Ws and 1H in investigation process.

Suggested Readings

1. M. Byrd, *Crime Scene Evidence: A Guide to the Recovery and Collection of Physical Evidence*, CRC Press, Boca Raton (2001). (Unit-I)
2. Richard Saferstein: *Forensic science from the crime scene to the crime lab*. (Unit-I,II,III,IV)
3. S.H. James and J.J. Nordby, *Forensic Science: An Introduction to Scientific and Investigative Techniques*, 2nd Edition, CRC Press, Boca Raton (2005). (Unit-II,III)
4. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's, *Techniques of Crime Scene Investigation*, CRC Press, Boca Raton (2013). (Unit-I,II)

Learning Objectives :

1. The student will understand basic of spectroscopic method .The student will understand UV-visible spectroscopy and working of UV-visible spectroscopy and its application.
2. The students will understand the health risk associated with exposure to lead, cadmium, and mercury and approaches health effects.
3. The student will understand chemical nature as well a detection, extraction methods of lead cadmium.
4. The student able to the major classes of pesticides and their environmental and human.

Unit I Spectroscopy**(11)**

Introduction electromagnetic radiations, full range, absorbance, transmittance, Beer-Lambert's laws,- Applications ,U.V. Visible IR-molecular spectroscopy, electronics, vibrational, rotational spectra, Principle, diagram, working and construction, applications .

Unit II Polymers**(12)**

Introduction-General idea of structures, types, tacticity, polymerization processes with examples, radical and ionic mechanism of polymerization, characteristic properties of polymers, Structure, preparation and applications of Polyethylene (types and Ziegler-Natta process), Teflon, PVC, Polystyrene.

Unit III Chemical Toxicology I**(11)**

Toxic chemicals in the environment – physical and chemical properties of lead, mercury, arsenic, cadmium and chlorine, bromine – Metallic and non- metallic toxic chemical and its toxic effect– Extraction and detection methods, Forensic significance .

Unit IV Chemical Toxicology II**(11)**

Introduction of pesticides ,classification of pesticides ,properties ,and its biochemical effects – Extraction and detection methods of pesticides, forensic significance.

Learning outcomes:

1. Students will able to know basics of spectroscopy & Introduction of UV-visible of spectroscopy.
2. Students will know the principle, working and application of Uv-visible spectroscopy.
3. Students will know the basics on polymer synthesis & how to make a material.
4. Students will know the structure and properties of polymers and polymeric materials & its analysis.

Suggested Readings :

- 1.DFS manual of chemistry (Forensic Toxicology). (Unit-III,IV)
2. A. Poklis, Forensic toxicology in, Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (Ed.), CRC Press, Boca Raton (1997). (Unit-III,IV)
- 3.Instrumental methods of chemical analysis by Gurdeep R.Chatwal & Sham K. Anand. Himalaya Publication (Unit-I)
- 4.Introduction to spectroscopy by Pavia((Unit-I))
- 5.Instrumental analysis by Skoog Holler Crouch.(Unit-I)
- 6.Principles of forensic medicine by Apurba Nandy, M.D (Unit-III,IV).
7. Fundamental of polymer (Raw material to finishing product) by Niranjana Karak.(Unit-II)

Part I (Crminalistic I)

Learning Objectives:

After studying this paper the students will know:

1. *The Evaluation report of Crime Scene, Crime Scene Reconstruction.*
2. *The Sketching methods for Different types of Crime Scene.*
3. *The Collection & Packaging of Different types of evidences on Crime Scene.*

Practicals :

1. To prepare a report on evaluation of crime scene.
2. To reconstruct a crime scene (outdoor and indoor)
3. To study the Triangulation method of various types of crime scene.
4. To study rectangular polar coordinate method of sketching.
5. Collection, packaging and preservation of evidences at crime scene.
6. To prepare a report on crime scene investigation.
7. To prepare a crime scene sketch by using baseline method.
8. To prepare a crime scene sketch by using triangulation method.
9. To prepare a crime scene sketch by using cross projection method.

Learning outcome:

1. The student will acquire the strength to investigate the crime scene thoroughly.
2. The students will acquire skills to cover each and every details of crime scene through sketching method.
3. Students will able to write a report on crime scene investigation which helps to solve the crime.

Suggested reading:

1. Richard Saferstein: Forensic science from the crime scene to the crime lab. (Unit-I,II,III,IV)
2. S.H. James and J.J. Nordby, *Forensic Science: An Introduction to Scientific and Investigative Techniques*, 2nd Edition, CRC Press, Boca Raton (2005). (Unit-II,III)

Part II (Forensic Chemistry)

Learning Objectives :

After studying this paper the students will know :

1. *The Preliminary and confirmatory detection methods for Pesticides.*
2. *The detrection of Poision by Preliminary test.*
3. *The Detection of metal poison by Preliminary test.*
4. *The Instrumentation analysis.*

Practicals :

1. Preliminary and confirmatory test for detection of pesticides (2)
i) Organophosphate ii) Organochlorine
2. To detect the metal & Non metal poison by Preliminary test (2)
i) zinc(Zn) ii) Lead (Pb) iii)Mercury(Hg)iv) Chlorine (Cl) V) Iodine(I)
3. To detect the metal poison by chemical method (2)
i) zinc(Zn) ii) Lead (Pb) iii)Mercury(Hg)iv) Chlorine (Cl) V) Iodine(I)
4. Introduction Uv-visible spectrophotometer.
5. pH-Metry
i)To determine the dissociation constant of monobasic acid(acetic acid)
ii)To determine dissociation of dibasic acid (malonic acid)

6. Commercial analysis (double titration) .

- i) Determination of percentage of magnesium in the given sample of talcum powder.
- ii) Determination of titrable acidity in the given sample of milk or lassi using sodium hydroxide.

Learning outcome:

1. The students will be able to detect the pesticide in poisoning cases by using preliminary and confirmatory test.
2. They will detect the metallic poison easily.
3. They will acquire skills regarding instrumentation.

Suggested reading:

1. Textbook of qualitative and quantitative analysis by A.I Vogel.
2. DFS manual.
3. A course in practical chemistry for B.Sc.I (Shivaji university)
4. A course in practical chemistry for B.Sc.II (Shivaji university)
5. Laboratory Procedure Manual: Petroleum Products, Directorate of Forensic Science, MHA, Govt. of India, 2005.
6. Working Procedure Manual on Chemistry; Directorate of Forensic Science MHA Govt. of India.

BFST : 303 Forensic Biology III

Learning Objectives :

Credit: 2 (45)

To studying this paper student will know :

1. *The Basic structure of DNA.*
2. *The basic knowledge of genetics.*
3. *The study of various Extraction methods for DNA analysis.*
4. *The metabolic pathway of human body.*

Unit I History of Genetics and Nucleic Acids (11)

Introduction, DNA: as a genetic material, Modern concept of gene, DNA: Structure of eukaryotic DNA, RNA: General structure, types and function. DNA Replication-Initiation, Elongation, Termination Transcription- Initiation, Elongation, Termination protein synthesis- Initiation, Elongation, Termination

Unit II Methods of DNA extraction (12)

Enzymatic DNA extraction method Phenol-Chloroform method-Cell lysis and Protein digestion.Silica –column based method- Cell lysis and Protein digestion, DNA adsorption onto silica, washing, elution of DNA. Magnetic bead method, Differential Extraction.

Unit III Metabolism (11)

Tricarboxylic acid cycle-Introduction, Pathway, Function. Electron Transport Chain- Introduction, Pathway, Function.Glycolysis/ EMP pathway- Introduction, Pathway, Function.

Unit IV Bioinstrumentation and Biochemical techniques (11)

Electrophoresis :Basic principle, types of electrophoresis – moving boundary, zonal, paper, gel.

1)Agarose 2)PAGE 3)SDS-PAGE 4) Pulse Field Gel **Centrifugation**:Principle, types and applications of centrifuge. Ultracentrifuge : differential and density gradient centrifugation. Care and maintenance of centrifuge.

Learning Outcomes:

1. Students will able to know the process of replication, transcription, translation.
2. Students will understand the modern concept of gene.
3. Students will able to know various types of extraction method.
4. Students will understand the detection of DNA sample to solving crimes.

Suggested Readings-

- 1) Protein Purification – Harris and Angel.(Unit-III)
- 2) Principle of Biochemistry by Lehninger.(Unit-I)
- 3) Practical Biochemistry – Keith Wilson and Walker
- 4)Forensic Biology by Richard Li.(Unit-II,IV)
- 5) i-genetics-Russel.(Unit-I)
- 6) U-Satynarayan. (Unit-I)
- 7) Biochemistry by Stryer (Unit-I)
- 8) Biochemistry by Voet. (Unit-I)
- 9) Biochemistry by Chatwal. (Unit-I)

BFST : 304 Forensic Physics III

Learning Objectives :

Credit: 2 (45)

To studying this paper student will know:

1. *The Basic knowledge of Diffraction and its types.*
2. *The knowledge of Polarization of light, production of polarized light.*
3. *The knowledge of Resolving power of optical instruments.*
4. *The Basic knowledge of Newton's law and its different applications.*

Unit I Diffraction (12)

Introduction, Huygen's-Fresnel's theory, Fresnel's assumptions, Distinction between interference and diffraction, Fresnel and Fraunhofer types of diffraction, Diffraction due to single edge, Diffraction due to a narrow slit.

Unit II Polarization (11)

Introduction, Types of Polarization, Production of Plane polarized light, Polarizer and Analyzer, Malus law, Anisotropic crystal: Calcite crystal, Nicol prism, Production and detection of linearly, elliptically and circularly polarized light.

Unit III Resolving Power (11)

Raleigh's criterion, Resolving power of optical instruments, Criterion for resolution according to Lord Rayleigh's, Resolving power of telescope, Resolving power of a prism, Resolving power of a plane transmission grating.

Unit IV Interaction Of Radiation With Matter And Newton's Law Of Motion (11)

Interaction of radiation with matter: Reflection, Absorption, Transmission, Fluorescence, Phosphorescence. Newton's all law, its forensic application; Elasticity, elastic properties of matter, elastic constants and their interrelation.

Learning Outcomes:

1. Students will learn about difference between Interference and Diffraction.
2. Students will understand the Resolving power of optical instruments.
3. Students will learn Newton's all law and its forensic application.
4. Students will able to know the elastic constants and their interrelation.

Suggested Readings-

1. Molecular diffraction of light By- C. V. Raman.(Unit-I,II)
2. Basic Optics: Principle and concepts by – Avijit Lahiri.(Unit-II,III)
3. Polarized light in optics and spectroscopy-David S. klinger, James W. Lewis,Cora E. Randall.(Unit-II)
4. System for ophthalmic Dispensing – Third edition, chapter 2.2.(Unit-I)
5. Introduction to optics Third Edition – Frank L. Pedrotti,S.J. , Leno S. Pedrotti, Leno S. Pedrotti.(Unit-II,III)
6. Newton and three law motion –Nicholas Croce, Chapter 5(Law Explained).(Unit-IV)
7. Engineering Physics- Dattu R. Joshi
 - Diffraction –(Unit-I)
 - Resolving Power of Optical Instruments.(Unit-III)
 - Polarization.(Unit-II)

Practicals: Part I (Forensic Biology III)

Learning Objectives :

After studying this paper the students will know :

1. *The analysis & handling of Centrifugation Instrumentation.*
2. *The Isolation technique of DNA.*
3. *The handling & analysis of body fluids by using the HPLC instrumentation.*
4. *The Separation of polymorphic Enzymes by using Electrophoresis method.*

Practicals :

- 1) To study the centrifugation of milk.
- 2) To Demonstrate the gel electrophoresis.
- 3) Study and working of Ion exchange chromatography.
- 4) To Study the Isolation of chromosomal DNA.
- 5) Study of DNA Extraction and Quantification.
- 6) To study HPLC.
- 7) To perform electrophoresis for separation of various polymorphic enzymes.
- 8) DNA extraction by Phenol-Chloroform method.
- 9) DNA extraction by Silica –column based method.

Practical outcome-

1. Students will understand the Various techniques for DNA extraction.
2. Students will be able to know the separation of sample by using centrifugation method.
3. Student will be able to know the electrophoresis technique for the detection of macromolecules.

Suggested readings-

1. Forensic Biology by Richard Li.
2. Forensic Analysis pre laboratory and laboratory student manual Dr. E. Hywel Evans

Part II (Forensic Physics III)

Learning Objectives:

After studying this paper the students will know :

1. *The student will be able to understand the how to determine the resolving power of telescope*
2. *The student will be able to understand the how to determine the resolving power of prism*
3. *The student will be able to understand the how to determine the resolving power of plane diffraction grating.*

Practicals :

1. To determine the Resolving power of telescope.
2. To determine the Resolving power of given prism.
3. To determine the Resolving power of plane diffraction grating.
4. To determine the wavelength of sodium light using Fresnel's biprism
5. To determine the specific rotation of sugar solution (Polarimeter)
6. To determine the refractive index of material of prism using Spectrometer
7. To determine the radius of capillary using Travelling microscope

8. Spectrometer: Schuster's Method Adjustment of Collimator and Telescope for Parallel rays.
9. Measurement of divergence of laser
10. Interference with single slit
11. Diffraction due to Plane grating .
12. Fraunhofer diffraction at a circular aperture
13. Verification of Malus Law
14. Determination of wavelength of light using Plane grating.
15. Determination of Refractive Index of given liquid using Laser
16. Determination of wavelength of spectral lines using Plane diffraction grating

Practical outcome-

1. The student will be able to understand the Schuster's Method.
2. The student will be able to understand the refractive index of material of prism using Spectrometer.

Suggested reading:

1. Practical handbook of B.Sc. II (Shivaji university)
2. Practical handbook of B.Sc. III (Shivaji university)

BFST : 305 Microscopy

Credits: 2 (45)

Learning Objectives :

1. *The Basic knowledge of compound microscope and its forensic applications.*
2. *The knowledge of different types of microscope and their principle, construction and working.*
3. *The knowledge of difference between compound microscope and light microscope.*
4. *The Students will know the difference between SEM and TEM.*

Unit I Microscopy I (11)

Compound microscope-Principle, construction, working, well labeled diagram, Application in Forensic science. **Binocular microscope**-Principle, construction, working, well labeled diagram, Application in Forensic science. **Light microscope**-Principle, construction, working, well labeled diagram, Application in Forensic science.

Unit II Microscopy II (12)

Comparison Microscope -Principle, construction, working, well labeled diagram, Application in Forensic science. **Dark field microscope** -Principle, construction, working, well labeled diagram, Application in Forensic science. **Fluorescence microscope** -Principle, construction, working, well labeled diagram, Application in Forensic science

Unit III Microscopy III (11)

Polarizing microscope -Principle, construction, working, well labeled diagram, Application in Forensic science. **Phase contrast microscope** -Principle, construction, working, well labeled diagram, Application in Forensic science. **Stereomicroscope** -Principle, construction, working, well labeled diagram, Application in Forensic science.

Unit IV Microscopy IV (11)

Electron microscope -Principle, construction, working, well labeled diagram, Application in Forensic science. **Types of Electron Microscopy:** 1) Scanning electron microscopy 2) Transmission electron microscopy

Learning Outcomes:

1. Students will learn about different types of microscope and its principle, construction and working.
2. Students will learn about Comparison Microscope and its forensic applications
3. Students will learn about difference between Scanning Electron Microscope and Transmission Electron Microscope.

Suggested reading:

1. Bioinstrumentation : L. Veera kumari
2. Bradbury, S. (1968) The Microscope, past and present. Pergamon Press.
3. Exploring With the Microscope 1995. Werner Nachtigall. Sterling Publishing.

BFST : 306 Cyber Forensic & Incident Response

Learning objectives :

Credit: 2 (45)

To studying this paper student will know :

1. *Basic Investigation techniques related to computer forensic.*
2. *The methods to investigate the Cyber Crime.*
3. *How to collect & handle the evidence in mobile phone investigation.*
4. *The preventive measures should be taken before occurring Incident, minimize risk factor.*

Unit I Introduction to Cyber Forensic (12)

Introduction to Cyber Forensic, Cyber Forensic Steps (Identification, Seizure, Acquisition, Authentication, Presentation, Preservation) Computer Forensic Expert, Cyber Forensic Investigation Process. The Goal of the Forensic Investigation, Why Investigate (Internet usage exceeds norm, Using e-mail inappropriately, Use of Internet, e-mail, or PC in a non-work-related manner, Theft of information, Violation of security policies or procedures, Intellectual property infractions, Electronic tampering) Establishing a Basis or Justification to Investigate, Determine the Impact of Incident, Auditing V/s Cyber Forensic Investigations.

Unit II Identification of Computer Peripherals (11)

Components of Computer, composition of computer, CMOS, BIOS. Input Devices ,Storage Devices, Secondary storage Devices, Other Components of Computer-Processor, Motherboard, Input/output Ports-USB, Infra-Red, Bluetooth. Network Connections- RAID, SMPS, How computer memory measured.

Unit III Basics of Mobile Phone Investigation (11)

Cell Phone work, mobile system network, mobile technologies, mobile number tracing. Modes of Data Transfer, latest cell phone crimes, types of mobile crimes, mobile crime investigation. Investigating- mobile handset theft, Flash SMS, SMS tampering, back/post dated SMS, SMS spoofing, and MMS Scandals.

Unit IV Incident Response (11)

Introduction to Incident Response Process (What is Computer Security Incident, Goals of Incident Response Involved in Incident Response Process, Incident Response Methodology, Formulate a Response Strategy, Investigate the Incident.) Preparing For Incident Response, Overview of Pre-incident Preparation, Identifying Risk, After Detection of an Incident.

Learning Outcomes-

1. Students should be able to understand cyber investigation process.
2. Students should be able to know required qualification and skill for cyber expert.
3. Students should be able to explain the goal of Forensic investigation.
4. Students should be able to understand the role of computer peripherals.

Suggested reading:

1. Incident Response & Computer Forensics by Kavin Mandia, Chris Prosis, Matt Pepe (Second Edition). (Unit-IV)
2. Mobile Forensic Investigations: A Guide to Evidence Collection, Analysis, and Presentation 1st Edition. (Unit-III)
3. Cybercrime and Digital Forensics: An Introduction 2nd Edition. (Unit-I, II)
4. Digital Forensics: Digital Evidence in Criminal Investigations by Angus McKenzie Marshall. (Unit-I, II, III, IV)

Part I: (Microscopy)

Learning Objectives:

After studying this paper the students will know:

1. *The types of Microscope used for Analysis of evidence.*
2. *The fluorescence effect of microscope.*
3. *The Polarizing effect of Microscope*

Practicals :

1. To study the compound microscope.
2. To study the light microscope.
3. To study the comparison microscope.
4. To study the stereo microscope.
5. To study the dark field microscope.
6. To study the polarizing microscope.
7. To study the Fluorescence microscope.

Learning Outcomes:

1. Student will able to operate the microscope effectively to solve the various crime cases such as sexual assault and rape cases.
2. They will able to analysis various physical evidences such as glass fragments, soil sample, cloth sample to determine the origin.

Suggested reading:

3. Practical handbook of B.Sc. II year (Shivaji university)
4. Practical handbook of B.Sc. III year (Shivaji university)
5. Bioinstrumentation L.Veerakumari.

Part II(Cyber Forensic & Incident Response Part II)

Learning Objectives:

After studying this paper the students will know :

1. *The Investigation techniques of Digital Evidence.*
2. *The tracing routes tools used for analysing the digital evidence.*
3. *The Encryption tools used for encrypt data.*
4. *The Handling of Encase software for analysis purpose of digital evidence*

Practicals :

1. To identify, seize and preserve digital evidence computer from crime scenes.
2. To detect deletions, obliterations and modifications of files using encase software.
3. To trace routes followed by e-mails and chats.
4. To identify the IP address of the sender of e-mails.
5. To identify encrypted files.
6. To identify hidden files.

Learning outcomes:

1. Students practically retrieves the deleted data from various pen drives, flash drives etc.
2. Students will practically collect the digital evidences and preserve the evidences by doing demo practical.
3. Students will acquire thorough knowledge regarding collection of digital evidences their analysis.

Suggested reading:

5. Incident Response & Computer Forensics by KavinMandia,ChrisProsis,MattPepe(Second Edition).(Unit-IV)
6. Forensic Computer Crime Investigation by Thomas.A.Johnson.(Unit-I)
7. Mobile Forensic Investigations: A Guide to Evidence Collection, Analysis, and Presentation 1st Edition.(Unit-III)
8. Cybercrime and Digital Forensics: An Introduction 2nd Edition.(Unit-I,II)
9. Digital Forensics: Digital Evidence in Criminal Investigations by Angus McKenzie Marshall.(Unit-I,II,III,IV)

SEMESTER IV

SEMESTER IV
FORENSIC SCIENCE IV
BFST : 401 Criminalistics II

Learning Objectives:

Credit : 2 (45)

After studying this paper the students will know –

1. *The art of collecting, packaging and preserving different types of physical and trace evidence at crime scenes.*
2. *The tools and techniques for analysis of different types of crime scene evidence.*

Unit I Physical Evidences I (11)

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 man-made fibres. Collection of fibre evidence. Identification and comparison of fibres.

Unit II Physical Evidences II (11)

Soil evidence – importance, location, collection and comparison of soil samples. Cloth evidence – importance, collection, analysis of adhering material. Matching of pieces. **Tool mark evidence.** Classification of tool marks. Forensic importance of tool marks. Collection, preservation and matching of tool marks. Restoration of erased serial numbers and engraved marks **Forensic gemology.**

Unit III Impression evidences: I (12)

Lip print analysis (Development, collection, packaging , preservation, analysis)**Gate pattern analysis** (Development, collection, packaging , preservation, analysis)**Ear print** (Development, collection, packaging , preservation, analysis)**Palm print**(Development, collection, packaging , preservation, analysis)

Unit IV Impression evidences: II (11)

Tire marks (Development, collection, packaging , preservation, analysis) Fingerprint(Development, collection, packaging , preservation, analysis) Footprints and Shoe prints (Development, collection, packaging , preservation, analysis)

Learning Outcomes-

1. Explain the difference between the identification and comparison of physical evidence.
2. Appreciate the value of class evidence as it relates to a criminal investigation.
3. Students should be able to explain the types of trace evidence.
4. Students should be able to list and explain the functions of analysis of evidence.

Suggested Readings

1. DFS manual.
2. Richard Saferstein: Forensic science from the crime scene to the crime lab. (Unit-II)
3. S.H. James and J.J. Nordby, *Forensic Science: An Introduction to Scientific and Investigative Techniques*, 2nd Edition, CRC Press, Boca Raton (2005).(Unit-I,II,III,IV)
4. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher’s, *Techniques of Crime Scene Investigation*, CRC Press, Boca Raton (2013). (Unit-I,II,III,IV)

BFST : 402 Forensic Chemistry IV

Learning objective:

Credits:2 (45)

After the learning of this subject, the student will be able to do the following:

1. Specify the quality control criteria for petroleum products and motor fuels
2. Analyze the Petroleum product adulteration
3. Perform the collection and analysis of fire scene data.
4. Determining the origin and cause of a fire.

Unit I Petroleum Products I (11)

Distillation and fractionation of petroleum. Commercial uses of different petroleum fractions. Analysis of petrol and diesel, Analysis of traces of petrol and diesel in forensic exhibits. Comparison of petrol and diesel. Adulteration of petrol and diesel.

Unit II Petroleum Products II (11)

Analysis of kerosene and ATF, Analysis of traces of kerosene and ATF, in forensic exhibits. Comparison of kerosene and ATF, Adulteration of kerosene and ATF.

Unit III Cases Involving Arson (12)

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. Analysis of fire debris. Analysis of ignitable liquid residue. Post-flashover burning. Scientific investigation and evaluation of clue materials. Information from smoke staining.

Unit IV Explosive (11)

Classification of explosives – low explosives and high explosives. Homemade explosives. Military explosives. Blasting agents. Synthesis and characteristics of TNT, PETN and RDX. Explosion process. Blast waves. Bomb scene management. Searching the scene of explosion. Mechanism of explosion. Post blast residue collection and analysis. Blast injuries. Detection of hidden explosives.

Learning outcomes:

After the learning of this subject, the student will be able to do the following:

1. Students will able to Specify the quality control criteria for petroleum products and motor fuels
2. Students will able to analyzing the petrol and diesel adulteration
3. Students will able to Specify the quality control criteria for petroleum products and motor fuels
4. Students will able to analyzing the kerosene and ATF, adulteration

Suggested Readings

1. J.D. DeHaan, *Kirk's Fire Investigation*, 3rd Edition, Prentice Hall, New Jersey .(Unit III)
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). (Unit-III,IV)
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).(Unit-III,IV)
6. Instrumental Method of Chemical Analysis. Chatwal & Anand, Himalya Publication.(Unit-I,II,III)
8. Serope Kalpakjian, Steven R Schmid. "Manufacturing Engineering and Technology". International edition. 4th Ed. Prentice Hall, Inc. 2001. ISBN 0-13-017440-8. (Unit-I,II)
9. Hans-J. Koslowski. "Dictionary of Man-made fibers". Second edition. Deutscher Fachverlag.(Unit-III)

Part I (Crriminalistic II)

Learning objectives:

1. Students will able to know the Evidences in details such as fiber, soil, paint, glass etc.
2. Students will able to analyze the various physical evidences found on crime scene.

Practical:

1. To identify and compare tool marks.
2. Examination fiber by using microscope.
3. To compare soil samples by density gradient method.
4. To compare paint samples by physical matching method.
5. To compare paint samples by thin layer chromatography method.
6. To compare glass samples by refractive index method.

Learning outcome:

1. Students had acquired the skill regarding soil analysis, paint analysis etc.
2. Students will able to operate the microscope effectively
3. Students will able perform TLC

Suggested reading:

1. Richard Saferstein: Forensic science from the crime scene to the crime lab.(Unit-IV)
2. Forensic examination of glass, paint by brain caddy.

Part II (Forensic Chemistry IV)

Learning Objectives:

After studying this paper the students will know :

1. *The student will able to understands how to carry out analysis of gasoline's, diesels, and kerosene.*
2. *The student will able to prepare a case report on case involving arson.*
3. *The student will able to carry out analysis of explosives substance.*

Practicals :

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. (no.2)
5. To prepare a case report on a case involving arson.
6. To carry out analysis of explosive substances. (no.2)
7. To separate explosive substances using thin layer chromatography. (no.2)
8. To prepare a case report on bomb scene management.
9. Polymer Testing (no.2)
10. Chemical analysis of explosive materials.(Gun powder)- Colour test, Microscopic examination.(no.2)
11. Examination of fire arson cases by GC, TLC. (no.2)

Learning outcome:

1. The student will be able to prepare a case report on bomb scene management.
2. The student will be able to understand how to carry out chemical analysis of explosives materials.
3. The student will be able to understand how to carry out examination of fire arson cases by GC,TLC

Suggested Reading:

1. DFS manual
2. Forensic Analysis pre laboratory and laboratory student manual Dr. E. Hywel Evans

BFST : 403 Biology IV

Credits: 2 (45)

Learning Objectives :

To studying this paper student will know-

1. To study the protein extraction and purification method.
2. To study the analysis of biological fluid.
3. To analysis the macromolecules by using blotting techniques.
4. To study the human skeleton system..

Unit I Enzymology, Protein purification and Metabolism (12)

Enzymes: Introduction, IUB classification, active site, energy of activation, transition state hypothesis, lock and key hypothesis, induced fit hypothesis. Allosteric enzymes, enzyme inhibition (reversible and irreversible, MM equation). **Protein Extraction and Purification:** Methods of cell disruption (blenders, grinding with abrasives, presses, enzymatic method, sonication) ; salt participation – salting in, salting out, organic solvent precipitation.

Unit II Analysis of Biological Fluid and Other evidences (11)

Saliva, Semen, Vaginal Fluid, Urine, Sweat, Blood, Vomit, Other Evidence-Hair, Nails and tissue samples.

Unit III Human Skeleton and Locomotion (11)

Human Skeleton – Axial Skeleton, Appendicular Skeleton **Locomotion**-Types of joints.

Unit IV Blotting techniques (11)

Southern Blotting (Principle ,Procedure and Application) ,Northern Blotting (Principle ,Procedure and Application) ,Western Blotting (Principle ,Procedure and Application) Quantitative Method PCR(Polymerase Chain Reaction)

Learning Outcomes:

1. Students will able to know the basic of enzymes. .
2. Students will understand the protein extraction and purification.
3. Students will able to know the various biological fluid.
4. Students will understand the analysis of the fluid sample.

Suggested Reading

- 1) Principle of Biochemistry by Lehninger.
- 2) Harper's Biochemistry by Murray.
- 3) Biological spectroscopy by LaKowicz.
- 4) Analytical Biochemistry by Holme.
- 5) Enzyme Kinetics by Plownan.
- 6) Biophysical chemistry by Upadhyay.
- 7) Protein Purification – Harris and Angel.
- 8) Practical Biochemistry – Keith Wilson and Walker.

BFST: 404 Forensic Physics IV

Credits: 2 (45)

Learning Objectives-

To studying this paper student will know-

1. The knowledge of glass, composition of glass.
2. The knowledge of Ballistics and types of Ballistics.
3. The Basic knowledge of fiber optics.
4. The knowledge of Magnetic, Electric Measurements and G.M. Counter.

Unit I Forensic Trace Analysis (11)

Review of physical properties of materials: temperature, weight and mass, density, refractive index; methods of comparing refractive indices, Composition of glass, Comparison of glass fragments, Measuring and comparing density and refractive index of glass, Classification of glass samples, Glass fractures.

Unit II Ballistics (11)

Introduction of Ballistics, Types of ballistics: internal, external and terminal ballistics
Theory of recoil, Ballistics coefficient, Trajectory formation, Vacuum trajectories, Range, Classification of range (maximum horizontal / vertical, effective, dangerous, safe and legal sense).

Unit III Fibre Optics (11)

Fibre Geometry Total internal reflection, Light propagation through Fibres, Numerical Aperture, Modes of propagation, Classification of Optical Fibres, Step-Index and Graded-Index Fibres, Applications of Fibres.

Unit IV Magnetic, Electric Measurements and Radiation Detection (12)

Magnetic Measurement; (magnetic susceptibility), Electric Measurements; (Hall voltage, Resistivity measurement & FET Characteristics), Radiation Detection; Geiger Muelier counter, Optical fiber communication system, Piezoelectricity

Learning Outcomes:

1. Students will understand the Classification of glass samples, Glass fractures.
2. Students will understand the Basic concept theory of recoil and trajectory formation.
3. Students will understand the Basic concept of optical fibre.
4. Students will understand the different types of modes of propagation.

Suggested Readings

1. Handbook of Firearms and Ballistics Examination and Interpreting Forensic Evidence by Brian J Heard, 2nd Ed. Publication: Wiley-Blackwell.
2. Firearms in criminal investigation and trials- B.R.Sharma (FIFTH EDITION) Page No- 127,134,143,-145,152,319,
3. Encyclopedia of Forensic Science, Volume one: Jay A Siegel, Pekka J Saukko, Geoffery Knupfer. Academic Press.
4. Forensic Ballistics in Criminal Justice: Kaushalendra Kumar.
5. Firearms in Criminal Investigation and Trials: B. R. Sharma, 4th Edition, Universal Law Publishing Company. New Delhi.

Part I (Forensic Biology IV)

Learning Objectives:

After studying this paper the students will know:

- 1. Students will be able to know how to detect amylase activity of starch by using Starch –Iodine Assay.*
- 2. Students will be able to carry estimation of Vitamins C from biological source and separation of compounds by using TLC methods.*
- 3. Students will be able to know microscopic comparison of human hair and animal hair.*

Practicals :

- 1) Detection of Amylase activity-
 - a) Starch-Iodine Assay.
- 2) Estimation of vitamin C from biological source.
- 3) Separation of compounds using TLC, calculation of R_f values.
- 4) Microscopic Comparison of Hair-
 - a) Human Hair
 - b) Animal Hair
- 5) Presumptive test for Blood
 - a) Phenolphthalein Assay
 - b) Benzidine
 - c) Leucomalachite Green
 - d) Luminol test
- 6) Confirmatory Tests for Blood -Crystallization Assays.

Learning outcomes:

1. Students will be able to carry presumptive test for blood by using Phenolphthalein Assay, Benzidine, Leucomalachite Green, Luminol test.
2. Students will be able to carry Confirmatory Tests for Blood -Crystallization Assays.

Suggested readings-

1. Forensic Biology by Richard Li.
2. Forensic Analysis pre laboratory and laboratory student manual Dr. E. Hywel Evans

Part II (Forensic Physics IV)

Learning Objectives:

After studying this paper the students will know:

- 1. The student will be able to know how to investigate fake documents.*
- 2. The student will be able to understand classification of bullets.*
- 3. The student will be able to know different types of glass fractures.*

Practicals :

1. Investigation of fake documents using UV light
2. Classification and measurement of bullets

3. Measurement of Hall voltage.
4. Working with Geiger Mueller counter.
5. Comparison of glass fragments and Study of fractures in forensic material.
6. Examination of soil sample.
7. Determination of density of a given sample.
8. Determination of refractive index of a transparent material. Examination of tire / other marks.
9. Measurement of recoil (Sample calculations) and Determination of remaining velocity
10. (Sample Calculations).
11. Twist versus muzzle velocity (Sample Calculations) and Muzzle velocity
12. (Sample Calculations).
13. Determination of remaining velocity (Sample Calculations).
14. To study the comparison of glass fragment
15. To Study the different types of glass fractures
16. Piezoelectric measurements.
17. Fiber strength measurements.

Learning outcomes:

1. Students will be able to investigate the accident crime scene by tire mark analysis, glass fracture analysis etc.
2. Students will be able to solve the ballistic crime scene and vehicular crime scene.

Suggested reading:

1. DFS manual

BFST : 405 Spectroscopy

Credit: 2 (45)

Learning Objectives:

1. The students will understand the overall knowledge of the NMR spectroscopy and working of NMR spectroscopy and its application.
2. The students will understand the the Mass spectroscopy and working of Mass spectroscopy and its application.
3. The student will understand AAS and AES spectroscopy and working of AAS and AES and its application
4. The student will understand Nephelometry and Turbidometry

Unit I Introduction to spectroscopy (12)

Introduction to spectroscopy, Types of spectroscopy, Introduction to UV -visible spectroscopy, Principle, instrumentation, working, of UV- visible spectroscopy and forensic application of UV-visible spectroscopy. Introduction to IR spectroscopy, Molecular vibration and types of molecular vibration, Principle, instrumentation, working, of IR spectroscopy and forensic application IR spectroscopy.

Unit II Mass spectroscopy and NMR (11)

Introduction to Mass spectroscopy, Principle, instrumentation, working of Mass spectroscopy and forensic application of Mass spectroscopy. Introduction to NMR, Principle, instrumentation, working of NMR and forensic application NMR.

Unit III Atomic absorption and Atomic Emission spectroscopy (11)

AAS(Atomic absorption spectroscopy) Introduction to Atomic absorption spectroscopy, Principle, instrumentation, working of Atomic absorption spectroscopy and forensic application.

AES(Atomic Emission spectroscopy) Introduction to Atomic Emission spectroscopy ,Principle, instrumentation, working of Atomic Emission spectroscopy and forensic application.

UnitIV Nephelometry and turbidometry (11)

Nephelometry and turbidometry ,Introduction to Nephelometry, principle, working, construction of Nephelometry and forensic application. Introduction to turbidometry, principle, working, construction of turbidometry and forensic application.

Learning outcomes:

1. Students will able to know basics of spectroscopy & Introduction of UV-visible of spectroscopy.
2. Students will able to know the principle, working and application of Uv-visible spectroscopy.
3. Students will able to know basics of IR spectroscopy.
4. Students will able to know the principle, working and application of IR spectroscopy.

Suggested Readings :

1. Instrumental methods of chemical analysis by Gurdeep R.Chatwal & Sham K. Anand. Himalaya Publication (Unit-I,II,III,IV)
2. Introduction to spectroscopy by Pavia (Unit-I,II,III,IV)
3. Instrumental analysis by Skoog Holler Crouch. (Unit-I,II,III,IV)
4. Instrumental methods of chemical analysis by Y.R Sharma. (Unit-I,II,III,IV)

BFST : 406 Computer Forensic Investigation IV

Learning objective:

Credit: 2 (45)

To studying this paper student will know-

1. The Basic Computer networking information.
2. The tools used in of Mobile Crime Investigation.
3. The Extraction of data from mobile device, analysis tools.
4. The Registration of FIR of Cyber Crimes.

Unit I Computer Networks (11)

Computer Networks, Client –Server architecture, Network technologies, Network Topologies, Network Devices, Network Commands

Unit II Mobile Crime Investigations (11)

Seizure note for Mobile Handset, care taken for while confiscating Mobile Handset. Toolkit for Investigation of mobile Handset, Software Required for Investigation. Mobile Number Portability, Mobile Number Tracing, Tracing Stolen/Lost Handset.

Unit III Cyber Forensic Tools and Utilities (11)

Introduction, Examining a Breadth of Products Cyber Forensic, Tools Good, Better, Best: What's the Right Incident Response, Tool for Your Organization, Tool Review Forensic Toolkit, EnCase, Mobiledit, F-RAT, FTK, Cyber check suites, etc. Specifications for Forensic tool Tested.

Unit IV Legal Provisions For Digital Evidences (12)

Registration of FIR (ITAA 2008), Panchnama (Seizure Memo), Seizure Proceedings, Legal Procedure After Seizure of Evidence. Expert Opinion from Forensic Examiner, Gathering information from ISP/MSP/other service Providers, Analyzing and Handling external data. Guideline to Prepare Chargesheet, Guideline for IO on what to include in Chargesheet, Tips to preserve seized digital media, Deposition of Evidence in court.

Learning Outcomes :

1. Students should be able to list and able to describe different aspects of networking.
2. Students should be able to understand the difference between client-server architecture.
3. Students should be able to work on networking commands.
4. Students should be able to know how a mobile phone works.

Suggested Readings :

1. Incident Response and Computer Forensic by *Kelvin Mandia*, TMH publication. (Unit-I, II, III, IV)
2. Digital Forensics : Digital Evidence in Criminal Investigation by *Angus McKenzie Marshall*. (Unit-II)
3. Cyber Forensic A field Manual for Collecting Examining and Preserving Evidence of Computer. Crimes by *Albert J Menezes*. Auerba . (Unit-III)
4. Richard Saferstein: Forensic science from the crime scene to the crime lab. (Unit-IV)

Part I (Spectroscopy)

Learning Objectives:

After studying this paper the students will know :

1. *The student will be able to understand instrumentation and working of UV–visible spectrophotometer.*
2. *The student will be able to know analysis of plant poisons by using UV- visible spectrophotometer.*

Practicals :

1. To study UV-Visible spectrophotometer.(Instrumentation)
2. Analysis of plant poisons by UV-Visible spectrometer.(2)
3. Measurement of turbidity in unknown solution(2)
4. Measurement of absorbance in different concentration of solution (2)
5. Introduction to FTIR spectroscopy.(Instrumentation)
6. Introduction to Mass spectrophotometer. .(Instrumentation)

Learning outcomes:

1. The student will know how to measure turbidity and absorbance in different concentration of solution.
2. The student will understand instrumentation and working of Mass spectrophotometer.

Suggested Readings : DFS manual

Part II (Computer Forensic Investigation)

Learning objective:

After studying this paper the students will know:

1. *Students will be able to collect the digital evidences.*
2. *Students will be able to work on networking commands.*
3. *Students will be able to authenticate the online transaction.*

Practicals:

1. To identify, seize and preserve mobile evidence from crime scenes.
2. To study the working of networking commands by using cmd.
3. To study the working of networking tools N-map.
4. To use digital signatures for securing e-mail and online transactions.
5. To acquire data from PCs/laptops/HDDs/USBs, pen drives, memory cards and SIM cards.
6. To use symmetric and asymmetric keys for protection of digital record.
7. To carry out imaging of hard disks.

Learning outcomes:

1. Students retrieve the data effectively.
2. They will do online transactions safely.
3. They will do protect the digital record

Suggested reading:

1. Cyber Forensic A field Manual for Collecting Examining and Preserving Evidence of Computer. Crimes by *Albert J Menendez*.Auerba .
2. Scene of the Cybercrime: Computer Forensics Handbook by Syngress, Elsvire, 2nd edition 2008
3. Cyber Forensic A Field Manual for Collecting, Examining and Preserving Evidence of Computer Crimes by Albert Marcella, Jr., Doug Menendez,CRC Press 2nd Edition 2007