DEPARTMENT OF FORENSIC SCIENCE
M.D. UNIVERSITY, ROHTAK
(NAAC Accredited 'A^{+}' University)

Syllabus (NEP-2020) of M.Sc. Forensic Science (W.e.f. Academic Session 2024-2025)
Structure for 2 Years & 1 Year Post Graduate Programme

SEMESTER-I

COURSE			Credits	Credits			Marks				Total
				L	T	P	Theory		Practical		
Type	Code	Title					Internal	External			
DSC	24FSCS201DS01	General Forensic Science	4	3	1	0	30	70		-	100
	24FSCS201DS02	Fundamentals of Fingerprint Examination	4	3	0	1	25	50		25	100
	24FSCS201DS03	Questioned Document Examination	4	3	0	1	25	50		25	100
	24FSCS201DS04	Forensic Psychology	4	3	1	0	30	70		-	100
	24FSCS201DS05	Instrumental Methods in Forensic Analysis -I	4	3	0	1	25	50		25	100
SEC1	24FSC201SE01	Fundamentals of Forensic Testimony	4	3	1	0	30	70		-	100
Total			**24**								**600**

SEMESTER-II

COURSE			Credits	Credits			Marks				Total
				L	T	P	Theory		Practical		
Type	Code	Title					Internal	External			
DSC	24FSCS202DS01	Basics of Forensic Chemical Sciences	4	3	0	1	25	50		25	100
	24FSCS202DS02	Basics of Forensic Biological Sciences	4	3	0	1	25	50		25	100
	24FSCS202DS03	Basics of Forensic Physical Sciences	4	3	0	1	25	50		25	100
	24FSCS202DS04	Criminalistics	4	3	0	1	25	50		25	100
	24FSCS202DS05	Instrumental Methods in Forensic Analysis-II	4	3	1	0	30	70		-	100
SEC2	24FSC202SE01	Forensic Medicine	4	3	1	0	30	70		-	100
Total			**24**								**600**

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1. Options for 2 Years and 1 year M.Sc. Forensic Science Programs:

There are three Options I, II & III in Second Year of M.Sc. Forensic Science. Option will be chosen option as per instructions given below:

a. The students who have passed Bachelor's Degree under non-NEP mode are eligible to take either Option I or Option II in PG 2nd Year under NEP 2020.
b. The students who have been awarded Bachelor's Degree after exit of three year in Four Year UG Program under NEP mode and taking admission in 2-year PG Program are only eligible to take Option III in PG 2nd Year under NEP 2020.
c. The students who have been awarded Bachelor's Degree with Hons. in Four Year UG Program under NEP mode are eligible to take either Option I or Option II in one year PG Program under NEP 2020.

2. Students admitted to the 1-year M.Sc. Forensic Science program must select one option: either I or II.

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OPTION-I
ONLY COURSE WORK

SEMESTER-III

COURSE			Credits	Credits			Marks			Total
				L	T	P	Theory		Practical	
							Internal	External		
Type	**Code**	**Title**								
DSC	25FSCS203DS01	Societal and Forensic Aspects of Drug Abuse	4	3	0	1	25	50	25	100
	25FSCS203DS02	Essentials of Analytical Forensic Toxicology	4	3	0	1	25	50	25	100
	25FSCS203DS03	Advanced DNA Forensics	4	3	0	1	25	50	25	100
	25FSCS203DS04	Forensics of Biological Evidences	4	3	0	1	25	50	25	100
	26FSCS203DS05	Forensic Criminology & Law	4	3	1	0	30	70	-	100
SEC3	25FSC203SE01	Computer Forensics	4	3	1	0	30	70	-	100
Total			**24**							**600**

SEMESTER-IV

COURSE			Credits	Credits			Marks			Total
				L	T	P	Theory		Practical	
							Internal	External		
Type	**Code**	**Title**								
DSC	25FSCS204DS01	Forensic Physical Anthropology	4	3	0	1	25	50	25	100
	25FSCS204DS02	Recent Research Trends in Forensic Biological Sciences	4	3	1	0	30	70	-	100
	25FSCS204DS03	Advanced Forensic Physics, Ballistics & Explosives	4	3	0	1	25	50	25	100
	25FSCS204DS04	Police & Crime Investigative Agencies	4	3	1	0	30	70	-	100
	25FSCS204DS05	Accreditation of Forensic Science Laboratories	4	3	1	0	30	70	-	100
SEC4	25FSC204SE01	Research Elements in Forensic Science	4	2	-	2	15	35	50	100
Total			**24**							**600**

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OPTION-II
COURSE WORK AND RESEARCH

SEMESTER-III										
COURSE			Credits	Credits			Marks			Total
				L	T	P	Theory		Practical	
							Internal	External		
Type	Code	Title								
DSC	25FSCS203DS01	Societal and Forensic Aspects of Drug Abuse	4	3	0	1	25	50	25	100
	25FSCS203DS02	Essentials of Analytical Forensic Toxicology	4	3	0	1	25	50	25	100
	25FSCS203DS03	Advanced DNA Forensics	4	3	0	1	25	50	25	100
	25FSCS203DS04	Forensics of Biological Evidences	4	3	0	1	25	50	25	100
	25FSCS203DS05	Criminology & Law	4	3	1	0	30	70	-	100
SEC3	25FSC203SE01	Computer Forensics	4	3	1	0	30	70	-	100
Total			24							600

SEMESTER-IV										
COURSE			Credits	Credits			Marks			Total
				L	T	P	Theory		Practical	
							Internal	External		
Type	Code	Title								
SEC4	25FSC204SE01	Research Elements in Forensic Science	4	2	0	2	15	35	50	100
Research Thesis/ Project	25FSC203PD01	Dissertation/ Project work	20	-	-	-	150	450	-	600
Total			24							600

OPTION -III

ONLY RESEARCH

SEMESTER-III										
COURSE			Credits	Credits			Marks			Total
				L	T	P	Theory		Practical	
							Internal	External		
Type	Code	Title								
SEC3	25FSC203SE01	Computer Forensics	4	3	1	0	30	70	-	100
Research Thesis/ Project	25FSC203PD01	Dissertation/ Project work	20	-	-	-	150	450	-	600
Total			24							600

SEMESTER-IV										
COURSE			Credits	Credits			Marks			Total
				L	T	P	Theory		Practical	
							Internal	External		
Type	Code	Title								
SEC4	25FSC204SE01	Research Elements in Forensic Science	4	2	0	2	15	35	50	100
Research Thesis/ Project	25FSC203PD01	Dissertation/ Project work	20	-	-	-	150	450	-	600
Total			24							600

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SEMESTER-I **General Forensic Science**				
Course Type: **DSC**	Course Code:24FSCS201DS01	Credits: **L3 + T1**	Max. Marks: **T70**	Time: **3 Hours**

Course Objective

Objective of this paper is to introduce the students to Forensic Science and its role in the criminal investigation system. The students would be appraised about the origin, scopes, functioning, and principles of Forensic Science. This course carries the necessary information to understand the role of Police and Forensic Laboratories in crime scene investigation along with its presentation in the court of law.

Course outcome

CO-1: Students would be able to understand the basics, mandates along with history and development of forensic science.

CO-2: Students would know about the functioning of Forensic Science Laboratories & Academic institutes and job opportunities therein.

CO-3: Students would be able to understand and explain the relationship between police and forensic system.

CO-4: Students would be able to understand about the expert report and testimony for the courtroom.

Instructions

Examiner would set nine questions. Question No. 1 shall be compulsory containing short answer type questions covering all units. The remaining eight questions would include two questions from each unit I-IV. Candidate would be required to attempt one question from each of the four units. Candidate would attempt five questions in all. All the questions (1-9) shall carry equal marks.

Unit-I	**Basics of Forensic Science:** Forensic Science and Criminalistics; Definition, Origin and Mandates of Forensic Science, Cases including Medico-Legal requiring forensic assistance in India; History and Development of Forensic Science in India; **Forensic Evidences:** Nature, Branches and Interdisciplinary nature of forensic science, Laws/Principles. Historical Milestones and Pioneers of Forensic Science; Recent Developments and Technological Trends in Forensic Science investigation.
Unit-II	**Administration of Forensic Science in India:** Jurisdictions and Classification/set-ups of Forensic Science Laboratories in India; Forensic related Central & State Investigative/Academic Institutes in India including CEL, GEQD, CDTIs, FBP, DFSS, NFSU; Important Indian and Foreign Bureaus/Academies/Boards of Forensic Sciences. Significance of accreditation of FSLs by NABL in India.
Unit-III	**Forensic Education & Employment in India:** Forensic Science Teaching Institutes and types of academic courses in India; FACT, FACT-PLUS and other tests in Forensic Science in India; Nature of Private and Government Employment/jobs opportunities in Forensic Science in India along with educational eligibilities and recruitment rules in FSLs.
Unit-IV	**Rapport of Police with Forensic Science:** Case registration (FIR) & Court Trial Procedure in criminal cases; Role of Police/Investigating Officer at Scene of Crime; Relationship between police and forensic expert; Investigative Technological Advancements in Police for crime solving. **Ethics in Forensic Science, Chain of Custody.**

Suggested Readings:

1. Basu, S. The History of Forensic Science in India. 1st ed. Taylor & Francis. (2021).
2. Fisher, B.A.J. & Fisher, D.R. Techniques of Crime Scene Investigation. 9th ed. CRC Press. (2022)
3. James, S.H. and Nordby, J.J. & Bell, S. Forensic Science: An Introduction to Scientific and Investigative Techniques. 4th ed. CRC Press: USA. (2015).
4. Nanda, B.B. and Tiwari, R.K. Forensic Science in India- A Vision for the Twenty First Century. Select Publisher: New Delhi. (2014).
5. Saferstein, R. & Roy, T. Criminalistics -An Introduction to Forensic Science. 13th ed. Pearson: USA. (2021).

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6. Seigel, J.A., Saukko, P.J. &Knupfer, G.C. Encyclopedia of Forensic Science vol. I, II& III. Academic Press: United States; (2000).
7. Sharma, B.R. Forensic Science in Criminal Investigation and Trails. 6th ed. Universal Law Publishing. (2019).
8. James S.H. Nordby, J.J. Forensic Science: An introduction to scientific and investigative techniques CRC Press (2003).

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SEMESTER-I

Fundamentals of Fingerprint Examination

Core Paper: DSC	Paper Code: 24FSCS201DS02	Credits: L3+P1	Max. Marks: T50+ P25	Time: 3 Hours

Course Objective

Objective of this paper is to introduce the students about fingerprints and its role in the criminal investigation system. The students get to know about how fingerprints can be used in criminal investigation & also helps in making students aware about how fingerprints use to establish identity of an individual.

Course Outcomes

CO-1: Students would be able to utilize various terminologies, history and various classification system used in fingerprinting.

CO-2: Students would be able to identify and compare the fingerprints on the basis of Galton's details/ different ridge characteristics

CO-3: Students would get familiarity with Automatic Fingerprint Identification System (AFIS)

CO-4: Students would describe various methods of developing latent fingerprints and essentials of report writing in Fingerprint

Instructions

Examiner would set nine questions. Question No. 1 shall be compulsory containing short answer type questions covering all units. The remaining eight questions would include two questions from each unit I-IV. Candidate would be required to attempt one question from each of the four units. Candidate would attempt five questions in all. All the questions (1-9) shall carry equal marks.

Unit-I	**Fingerprints in General:** Dactylography, Dermatoglyphics, and Dactyloscopy, basis for the science of fingerprints, Friction Ridge Skin, Morphogenesis of Friction Ridge Skin, Primary Dermal Ridge Development, Definition of fingerprint, History of Fingerprint Identification, Fingerprint as forensic Evidence, Visible Fingermarks, Latent Fingermarks,
Unit-II	**Classification of Fingerprints for Comparison purposes**: Pattern area, Core, Delta, Type lines, Poroscopy, edgeoscopy, Fingerprint Pattern Types: Essentials and its types of Loop, Arch, whorl, Composites, accidental patters etc, Ten Digit and Single Digit fingerprint classification.
Unit-III	**Methods of Taking Fingerprints**: From living and dead persons, preserving and lifting of fingerprints. **Comparison Protocols:** Class and individual characteristics (Galton's details), different ridge characteristics, Automatic Fingerprint Identification System (AFIS). Contactless fingerprinting.
Unit-IV	**Fingerprint Developing Methods:** Chemistry of latent fingerprint residue, factor contributing to latent fingerprints, Methods of Development of latent fingerprints using conventional methods–Powdering (Black and grey, fluorescent and magnetic), Fuming method, Vacuum Metal Deposition (VMD) Method, Chemical method, Reagent chemistry and formulations, Sequential Treatment and Enhancement., **Report Writing & Court Room Testimony**: Evidence and testimony in court, Information required by the Forensic expert, Components of Forensic Reports, Preparation of Report, Presenting findings in a Report format.
	Practicals 1. To obtain Plain and rolled inked finger prints. 2. To identify the finger Print Patterns. 3. To perform Ridge tracing and Ridge counting. 4. To identify the Ridge characteristics (Minutia). 5. To compare the finger Prints. 6. To develop latent finger Prints with powdering methods. 7. To develop latent finger Prints with fuming methods. 8. To develop latent finger Prints with chemical methods.

Suggested readings

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1) Saferstein, R.(1990) Criminalistics, Prentice Hall, New York.
2) David R. Ashbaugh (1999) Quantitative and Qualitative Friction Ridge Analysis, CRC Press.
3) Roland Menzel (1999) Fingerprint Detection with Lasers, 2nd Ed., Marcel Dekker, Inc. USA.
4) James F. Cowger (1993) Friction Ridge skin, CRC Press London.
5) Mehta, M.K (1980) Identification of Thumb Impression & Cross Examination of Finger Prints, N.M. Tripathi Pub. Bombay.
6) Moenssens (1975) Finger Prints Techniques, Chitton Book Co. Philadelphia, NY.
7) Chatterjee S.K. (1981) Speculation in Finger Print Identification, Jantralekha Printing Works, Kolkata.
8) Cowger, James F (1993) Friction ridge skin- Comparison and Identification of fingerprints, CRC Press, NY.
9) J A Siegel, P.J Saukko (2000) Encyclopedia of Forensic Sciences Vol. I, II and III, Acad. Press.

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SEMESTER-I

Questioned Document Examination

Core Paper: DSC	Paper Code: 24FSCS201DS03	Credits: L3 + P1	Max. Marks: T50+ P25	Time:3Hours

Course Objective

Objective of this paper is to introduce the students to questioned document examination and its role in forensic science. The students would be able to understand the scenarios where such an examination may become necessary since the authenticity of documents is deemed necessary in most educational, employment and other areas.

CourseOutcomes

CO-1: Students would gain knowledge ofdifferenttypesofcrimewerequestioneddocumentexamination may become necessary

CO-2: Students wouldbeable tocomparehandwritingandsignature specimens.

CO-3: Studentswouldbeabletoexplainauthenticityofprinteddocumentsandcurrencynotes.

CO-4: Students wouldbeabletoperformPhotographyofdocumentsandstandanddelivertestimony/cross-examination onquestioned documentsinthecourtoflaw.

Instructions

Examiner would set nine questions. Question No. 1 shall be compulsory containing short answer type questions covering all units. The remaining eight questions would include two questions from each unit I-IV. Candidate would be required to attempt one question from each of the four units. Candidate would attempt five questions in all. All the questions (1-9) shall carry equal marks.

Unit-I	**Questioned Document**: Definition, Importance, Classification and Preliminary Examination ofquestioned documents. Preservationofdocuments**, Handwriting:** Definition, Development, InstrumentsandAppliancesof handwritingexpert.**HandwritingCharacteristics:**GeneralCharacteristics,IndividualCharacteristics,DevelopmentofIndividualityinHandwriting ComparisonofHandwriting:NaturalVariations,FundamentalDivergences.
Unit-II	**Forgeries:** Forgery and its types and characteristics, identification and examination of forgeries.**Deciphermentofsecret,indented, Invisible andcharreddocuments**, Examinationofsealandothermechanicalimpressions,examinationofsequenceofintersectingof strokes.StandardsforComparison andDisguiseetc. Electronic document and its types.
Unit-III	**Age of Document & Alterations:**Determinationof Ageof Document- Absolute/relative Age, Alterations in the document: erasures, additions, overwriting andobliterations. **Comparison of type written/printed matter**: Working of typewriter, Printing andMachine Defects, alterations in typed text, various type of typewriting devices- check writingmachines, electronic typewriterandproportionalspacingtypewriter. ComparisonofPrintedmatter:VariousPrintingProcesses.**CurrencyNoteexamination:**Identifyingfeatures offakeand genuineIndiancurrencynotes.
Unit-IV	**Instrumentation and Photography of Documents**: - Basic Principles & Techniques Visible andFlorescence (UVandIR),Photomicrography&Microphotography,Stereo-zoomMicroscopy,VideoSpectralComparator(VSC)andElectrostaticDetectionApparatus(ESDA), Forensic Information System for Handwriting (FISH).**ReportWriting&CourtRoomTestimony**:Evidenceandtestimonyincourt,Informationrequiredbytheforensic expert,ComponentsofForensicReports,PreparationofReport,PresentingfindingsinaReportformat.
	Practicals 1. IdentificationofHandwritingIndividualCharacteristics. 2. Studyofnaturalvariationsinhandwriting. 3. Comparisonofhandwritings. 4. DetectionofSimulatedforgery. 5. Detectionoftracedforgery. 6. StudyofDisguiseinhandwriting. 7. Currencynotesexamination

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	8. Examinationofsequenceofintersectingof strokes 9. Development of Indented and invisible writing

Suggested readings

1) Huber, A. R. and Headrick, A.M. (1999) Handwriting Identification: Facts and Fundamentals CRC LLC
2) Ellen, D (1997) The scientific examination of Documents, Methods and techniques. 2nd ed., Taylor & Francis Ltd.
3) Morris (2000) Forensic Handwriting Identification (fundamental concepts and Principles)
4) Harrison, W.R. (1966) Suspect Documents & their Scientific Examination, Sweet & Maxwell Ltd., London.
5) Hilton, O (1982) The Scientific Examination of Questioned Document, Elsevier North Holland Inc., New York.
6) Mehta, M. K. (1970) The identification of Handwriting & Cross Examination of Experts, N.M. Tripathi, Allahabad.
7) Saxena's : Saxena's Law & Techniques Relating to Finger Prints, Foot Prints & Detection of Forgery, Central Law Agency, Allahabad (Ed. A.K. Singla).
8) Osborn, A. S. (1929) Questioned Documents, Boyd Printing Co., Chicago.
9) Saferstein, R.(1990) Criminalistics, Prentice Hall, New York.

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SEMESTER-I **Forensic Psychology**				
Core Paper: DSC	**Paper Code:** 24FSCS201DS04	**Credits: L3 + T1**	**Max. Marks: T70**	**Time: 3 Hours**

Course Objective

This paper is an interface between psychology and law. Human mind is a complex matter and psychological approach forms one of the basics of humane approaches to complex criminal and civil investigations. Thus this paper would help the students to understand the basics, necessity and legal aspects of psychology.

Course Outcomes

CO-1: Students would be able to explore their expertise in forensic psychology.
CO-2:Students can make use of psychological assessment in criminal behavior.
CO-3: Students would be able todescribe functioning of Polygraph, BEOS and Narco test.
CO-4: Students could make people aware of the legal aspects and ethics of forensic psychology.

Instructions

Examiner would set nine questions. Question No. 1 shall be compulsory containing short answer type questions covering all units. The remaining eight questions would include two questions from each unit I-IV. Candidate would be required to attempt one question from each of the four units. Candidate would attempt five questions in all. All the questions (1-9) shall carry equal marks.

Unit-I	**Basics:** Forensic Psychology and the Law, Ethical Issues in Forensic Psychology, Civil and criminal case assessment, Eye witness testimony, Criminal profiling- need and types, Forensic Scientific evidence, Crime and Psychopathology, Genetics and Crime, Serial murders, Modus Operandi.
Unit-II	**Psychological Assessment**: Psychological Assessment Tools- Assessing mental competency, Mental disorders and Forensic Psychology, Various methods for detection of deception- Interview, Non-verbal detection, statement assessment, voice stress analyzer, Polygraph, thermal imaging, Brain Electrical Oscillation Signature Profiling, Functional Magnetic Resonance study, Current research in detection of deception/truth finding mechanisms
Unit-III	**Polygraph**: Historical aspects of Polygraph, Principles of polygraph, psycho physiological aspects, operational aspects, Question formulation techniques, Interviewing technique procedure, The Art-Polygraph, Legal and Ethical aspects, Human rights of individual.
Unit-IV	**Narco-Analysis:** Historical aspects, Principle and Theory, General Procedure –Legal and Ethical aspects, Human rights of individual. **Brain Electrical Oscillation Signature (BEOS) Profiling:** Principle and Theory, General Procedure –Legal and Ethical aspects, Human rights of individual.

Suggested readings:

1) Forensic Science in Criminal Investigation & Trials – B.R.Sharma
2) The Hand Book of Forensic Psychology – Weiner Hass
3) Hand Book of Forensic Psychology – O' Donohue Levensky
4) Brain Experience – C.R.Mukundan
5) Criminal Profilling – B.Turvey
6) Investigative Forensic Hypnosis – J. Niehans
7) Art & Science of the Polygraph Techniques – J.A.Matte
8) Hand Book of Polygraph Testing – M.Kloinen
9) Detecting Lies & Deceit – A.Vrij

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SEMESTER-I

Instrumental Methods in Forensic Analysis -I

Course Type: **DSC**	Course Code:24FSCS201DS05	Credits: **L3+P1**	Max. Marks:**T50+ P25**	Time: **3 Hours**

Course Objective

The objective of this course is to make understanding of the analytical instrumental techniques for forensic purposes. The students would be able to learn principles & working and strategic approach of utilizing involving microscopy, chromatography, spectroscopic, etc in forensic investigations.

Course Outcomes

CO-1: Students would be able understand basic terminology about instrumental techniques
CO-2: Students would be able understand basic Centrifugation techniques
CO-3: Students would be able understand about chromatographic techniques
CO-4: Students would be able understand Microscopy and physical instrumental analysis.

Instructions

Examiner would set nine questions. Question No. 1 shall be compulsory containing short answer type questions covering all units. The remaining eight questions would include two questions from each unit I-IV. Candidate would be required to attempt one question from each of the four units. Candidate would attempt five questions in all. All the questions (1-9) shall carry equal marks.

Unit-I	**Terminology:** Need of Instrumentation in Forensic Science, Preliminary & Confirmatory, Qualitative and quantitative, Destructive and Non-Destructive, Separatory and Hyphenated methods of analysis. Understanding terminologies of Accuracy, Precision, Signal to noise ratio, Sensitivity and Detection limit, and Calibration in instrumental analysis. **Centrifugation Techniques**: Basic principles of sedimentation, Various types of centrifuges, Density gradient centrifugation, Preparative centrifugation, Ultra-Centrifuge-Refrigerated Centrifuges.
Unit-II	**Chromatography:** Definition, Principles, and Techniques/classification. Working principle, Basic Setup, and Forensic applications of **TLC, HPTLC, GC (Pyrolysis, HS-GC, & GC-MS), HPLC and LC-MS** along with their forensically useful detectors.
Unit-III	**Spectroscopy:** Fundamentals of Spectroscopy and EMR, Techniques, Basics of Fluorescence, Phosphorescence and Chemiluminescence spectrometry. **UV-vis Spectroscopy, Raman Spectroscopy and FT-IR:** Principle, Theory, Types, Working and Forensic applications Interpretation and Forensic applications.
Unit-IV	**Microscopy**: Working principle, Basic Setup, and Forensic applications of Compound, Comparison, Fluorescence, Polarized, Stereo-zoom microscope, electron microscopy (SEM and TEM).
	Practicals 1. Demonstration of Thin Layer Chromatography 2. Demonstration of GC and HPLC 3. Demonstration of FT-IR 4. Demonstration of UV-Vis Spectrophotometer 5. Demonstration of Light and Electron (SEM) microscopy

Suggested Readings

1. Skoog, D.A., West, D.M. and Holler, F.J. Fundamentals of Analytical Chemistry 6th ed. Saunders College Publishing. (1996).
2. Jickells, S. and Negrusz, A. Clarke's Analytical Forensic Toxicology. Pharmaceutical Press. (2008).
3. Robinson, J.W. Undergraduate Instrumental Analysis. Marcel Dekker: New York. (1987).
4. Settle, F.A. Handbook of Instrumental Techniques for Analytical Chemistry. Prentice Hall. (1997).
5. Stahl, E. Thin Layer Chromatography: A Laboratory Handbook. Springer: Berlin. (1969).
6. Wouldard, H.H., Merritt, L.L., Dean, J.A. and Settle, F.A. Instrumental Methods of Analysis, 7th ed. CBS Pub & Distributors: New Delhi. (1986).
7. James R. et al. (2005) Undergraduate Instrumental Analysis
8. Lee&Gaensslen : Advances in Forensic Science, (Vol. 2) Instrumental Analysis.

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SEMESTER-I **Fundamentals of Forensic Testimony**				
Course Type: **SEC1**	Course Code:24FSC201SE01	Credits:**L3-T1-P0**	Max. Marks:**70**	Time: **3 Hours**

Course Objective

The objective of this course is to make the students familiar about the significance of forensic expertise's and opinion in scientific investigation of crime and evidences. The students would understand about the chain of custody, role of Police, courts, medic-legal areas and related law, report preparation and court testimony from forensic point of view.

Course Outcomes

CO-1: Students would be able to understand and explain Forensic Science in India
CO-2: Students would be able to understand the function of Courts, Police stations and Medico-legal Institutes
CO-3: Students would be able to describe the essentials of forensic/expert testimony in courts

Instructions

Examiner would set nine questions. Question No. 1 shall be compulsory containing short answer type questions covering all units. The remaining eight questions would include two questions from each unit I-IV. Candidate would be required to attempt one question from each of the four units. Candidate would attempt five questions in all. All the questions (1-9) shall carry equal marks.

Unit-I	Introduction to Criminal Justice System, Administration of Forensic Science Laboratories in India, Judicial/Forensic rhetoric, Burden of proof. Hierarchy of Indian Courts, Administrative units of Police, Types of Inquests in India and related laws, Laws and procedure of case registration, Court Trial Procedure in criminal cases. Definition of FIR, Bail/s, Summon, warrant and Arrest in Indian law.
Unit-II	Chain of Custody: Collecting case information/facts, Legal Procedure and requirements of case forwarding by police and its receipt of evidences at FSLs for scientific analysis. Medical jurisprudence, Medico-legal investigation and post-mortem report in rape, poisoning, etc.
Unit-III	Definition of Expert, Reporting officer and Elements and Legal significance of Forensic reports in India, understanding and interpretations of Forensic reports by the professionals. Important rulings and comments by the Indian Court on cases associating forensic investigation involving biological, chemical, physical, psychological, digital evidences.
Unit-IV	Indian laws including BharatiyaNagrikSurakshaSanhita/CrPC Section 293 and BharatiyaSakshya Bill/Indian Evidence Act, Section -45 with reference to forensic science, Background of Expert/forensic testimony with reference to Briefs of Frye and Daubert standards, Private and Government experts and significance of their testimony in Indian courts. Essentials of Report Writing, Court room testimony, Pre-court preparation, Examination in chief, Cross Examination and Re-examination, Do's and don'ts of testimony, Ethics in Forensic testimony.

Suggested readings

1) Saferstein, R.(Latest Edition) Criminalistics, Prentice Hall, New York.
2) J A Siegel, P.JSaukko (2000) Encyclopedia of Forensic Sciences Vol. I, II and III, Acad. Press.
3) Mathew E. Johll (2009) Investigating Chemistry: A Forensic Science Perspective
4) Suzanne Bell (2009) Drugs, Poisons, and Chemistry
5) DFSS Working Manuals of Forensic Chemistry, Narcotics, Explosives MHA GoI (Latest Edictions).
6) S.N. Tiwari, Manual of Forensic Toxicology MHA, GoI.
7) Modi, Text Book of Medical Jurisprudence Forensic Medicines and Toxicology (1999) CBS Pub. New Delhi

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SEMESTER II

SEMESTER-II **Basics of Forensic Chemical Sciences**				
Course Type: **DSC**	Course Code:24FSCS202DS01	Credits: **L3+P1**	Max. Marks: **T50+P25**	Time: **3 Hours**

Course Objective

This paper carries objective to make the students fully conversant with the origin, history, scopes, evidences, analysis in forensic chemical sciences. The students would also learn about the legal aspects of chemical evidences involving arson, petroleum products, bribe tarp case and analysis of poisons etc.

Course Outcomes

CO-1: Students would be able to understand the inceptions and developments in forensic chemical sciences.
CO-2: Students would be able to understand forensic chemistry and involved analysis.
CO-3: Students would be able to understand legal toxicology and involved cases.
CO-4: Students would be able to describe report formatting, laws and R&D developments in forensic toxicology.

Instructions

Examiner would set nine questions. Question No. 1 shall be compulsory containing short answer type questions covering all units. The remaining eight questions would include two questions from each unit I-IV. Candidate would be required to attempt one question from each of the four units. Candidate would attempt five questions in all. All the questions (1-9) shall carry equal marks.

Unit-I	**Introduction:** Concepts and broad areas of Forensic chemical sciences, Convectional and modern Set-up/Nomenclature of divisions/sections involving chemical analysis in FSLs, Pioneers in Forensic Chemical sciences, Introduction to IICT, IMTE and MSME testing centre. **Forensic Chemistry**: Introduction, Cases, and Chemistry of evidences involving Fire & Arson, Petroleum adulteration, Explosives, Illicit Liquors, Bribe-trap, Traces of Cosmetics, Vitriolage, etc.
Unit-II	**Scheme ofAnalysis for unknown sample/s:**Presumptive and confirmatory testing of Unknown and known samples with special reference to Color/spot tests, and instrumental analysis. Forensic Report writing in forensic chemistry. **Drugs of abuse:** Definition, Drugs as forensic Evidence, Classification of Drugs of abuse based on origin and CNS effects restricted to NPDS Act.
Unit-III	**Forensic Toxicology**: Definition, brief chorology, specified areas/branches and scopes of legal/forensic toxicology, overview of Orfila's maxim and Guiding principles, Duties of the legal Toxicologist, Significance of toxicological findings. **Poisons & Poisoning-**Definition and forensic classifications of Toxic Agents/poisons, Brief about Fate of Poisons in body, Elements of Poisoning, Mechanism of action, signs & symptoms, lethal doses of suicidal, homicidal and accidental involving alcohol, pesticides, toxic plants, metal, snake venoms, gaseous, drugs, etc; Brief introduction of **Cattle poisoning,Forensic Entomotoxicology, Veterinary toxicology** from Indian perspective.
Unit-IV	**Samples required in toxicological analysis:** Medico-legal toxicology and its aspects, Classification of matrices, Selection of Post-mortem samples, preservatives, containers and storage conditions as per standard references, Exhumation of bodies for toxicological analysis in India. **Toxicological Analysis:** Classical and Modern extraction methods of poisons, Chemical and instrumental analysis of poisons (alkaloidal/drugs, alcohol, pesticides, metallic, gaseous, snake envenom, etc) in forensic toxicological cases. Forensic Report writing in forensic toxicology as per standard references. **Laws and Acts: -**Laws related to forensic, medico-legal toxicology, Drugs and Poisons in India, Brief about Drugs and Cosmetics Act 1940, NDPS Act 1985, The Poisons Act 1919, BharatiyaNagrik Suraksha Sanhita/CrPC Section 293, Report writing in forensic chemical sciences, R&D developments and ethical including Human and Animal permission and concerns in Forensic chemical sciences.
	Practicals 1) Practical demonstration of TLC, UV-vis, FT-IR, GC, and HPLC 2) Forensic analysis of evidences in Arson, Petroleum, Explosive, Alcohols and Liquors, cosmetics, Bribe-trap case (Chemical, TLC and instrumental analysis) 3) Chemical tests for Acids and Base 4) Forensic analysis of Plant poisons (Morphological and chemical tests) 5) Forensic analysis of Metallic poisons (Reinsch test)

NFSU

	6) Forensic analysis of Pesticide poisons (TLC) 7) Quantification of alcohol in blood sample (HS-GC &Kozela-Hine method in FSL)

Suggested readings

8) Saferstein, R.(Latest Edition) Criminalistics, Prentice Hall, New York.
9) J A Siegel, P.JSaukko (2000) Encyclopedia of Forensic Sciences Vol. I, II and III, Acad. Press.
10) Mathew E. Johll (2009) Investigating Chemistry: A Forensic Science Perspective
11) Suzanne Bell (2009) Drugs, Poisons, and Chemistry
12) DFSS Working Manuals of Forensic Chemistry, Narcotics, Explosives MHA GoI (Latest Edictions).
13) Yinon Jitrin (1993) Modern Methods & Application in Analysis of Explosives, John Wiley & Sons, England
14) Casarett& Doll Toxicology (2003) The Basic Science of poisons.
15) JJ Fenton (2002) Toxicology A Case-Oriented Approach
16) S.N. Tiwari, Manual of Forensic Toxicology MHA, GoI.
17) Clarke's Analysis of Drugs and Poisons, (Formerly Isolation & Identification of Drugs) 3rd Ed. 2 Vol. Set.
18) Clark, E.G.C. : Isolation and identification of Drugs, VI and Vol. II, 1966, 1975-1986.
19) Modi, Text Book of Medical Jurisprudence Forensic Medicines and Toxicology (1999) CBS Pub. New Delhi

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SEMESTER-II

Basics of ForensicBiological Sciences

Course Type: **DSC**	Course Code:24FSCS202DS02	Credits: **L3+P1**	Max. Marks: **T50+P25**	Time: **3 Hours**

Course Objective

Forensic biology encompasses a plethora of sciences that become necessary during crime investigations relevant to the biological evidences. This paper would introduce the students to various branches of forensic biology that form the back bone of investigations leading to answers regarding postmortem intervals, bioterrorism, identity etc.

Course Outcomes

CO-1: The forensic significance of botanical evidence to pinpoint a place of crime, clandestine graves and probable time of crime.

CO-2: The difference between ante and post-mortem drowning along with the bearing the diatoms have in the investigation of probable place and time of drowning.

CO-3: The methods used to arrive at post-mortem interval, manner of death and sometimes the cause of death by using entomological evidence.

CO-4: Understand the significance of wildlife and the crucial role Students can play in providing justice to wildlife.

CO-5: Students would be able to differentiation between a natural outbreak of certain diseases and the deliberate attack in the form of bioterrorism.

Instructions

Examiner would set nine questions. Question No. 1 shall be compulsory containing short answer type questions covering all units. The remaining eight questions would include two questions from each unit I-IV. Candidate would be required to attempt one question from each of the four units. Candidate would attempt five questions in all. All the questions (1-9) shall carry equal marks.

Unit-I	**Forensic Biology**: Introduction, sub-disciplines, Important Cases involving Forensic Biology. **Forensic Botany:** Introduction, types, location, collection evaluation and forensic significance of botanical evidences. **Wood**: Type of wood and their identification and comparison. **Pollens**: Structure, function, methods of identification and comparison.
Unit-II	**Forensic Diatomology:** Nature, location, Structure and life cycle of diatoms, methods of identification and comparison, Diatom Monitoring and D-Mapping of water bodies, Extraction from water samples, Slide preparation and identifying features. Diatom Test: Ante-mortem and Post-mortem drowning, Diatom as a forensic evidence, Forensic significance of Diatom Test, Fate of Diatom inside the body, Extraction methods of diatoms from body, Criterion of Concordance, Validity of Diatom test and its Limitations.
Unit-III	**Forensic Entomology**: Introduction, general entomology and arthropod biology, insects of forensic importance, collection of entomological evidence during death investigations, the role of aquatic insects in forensic investigations, Insect succession on carrion and its relationship to determine time since death, its application to Forensic Entomology
Unit-IV	**Wild Life Forensics:** Introduction, importance, protected and endangered species of Animals and Plants. Identification of wild life materials such as skin, fur, bones, nails, horn, teeth, flowers and plants, by conventional and modern methods, Identification of Pug marks of various animals. **Microbial Forensics**: Microbes and forensics, Microbial profiles as identification tools, use of microorganisms in bioterrorism, transmission of HIV as a criminal act, role of microbes in food poisoning.
	Practicals 1. To study of life cycle of blowfly *Chrysomyarufifacies*. 2. To study and compare pollen of two seasonal plants 3. To study and compare water samples on the basis of Diatoms. 4. To examine slides of scale patterns of different animal hair samples. 5. To examine the medullary pattern of different animal hair samples.

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Suggested Readings

1) Jason H. Byrd and James L. Castner (2001) Forensic entomology, CRC Press LLC.
2) Forensic Science Hand book by Richard saferstein Vol (II); Prentice Hall, Publications.
3) Robertson (1999) : Forensic examination of Hair. Francis & Taylor, USA.
4) Safersstein, R. (1982) Science Handbook; Vol. III, Prentice Hall, New Jersey.
5) Curry, A. S. (1965) Methods of Forensic Science, Vol. IV, Interscience, New Youk.
6) Chowdhuri, S. (1971) : Forensic Biology, B P R & D Govt. of India.
7) Forensic Diatomology by M.S. Pollanen Encyclopedia of Forensic Science, Wiley (2010)

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SEMESTER-II

Basics of Forensic Physical Sciences

Course Type: **DSC**	Course Code:24FSCS202DS03	Credits: **L3+P1**	Max. Marks: **T50+P25**	Time: **3 Hours**

Course Objective

This paper would cover introduction of evidences in Forensic Physics, Ballistics, and Computer/cyber etc. The students would learn about Resuscitation of Obliterated Numbers, and identification and comparison of firearms and ammunition along with GSR testing. Students would also learn about digital data and its forensic aspects, etc. Forensic Report writing for all these evidences would also be covered in this paper.

Course Outcomes

CO-1: Students would gain knowledge of different types of forensic physical evidences
CO-2: Students would be able to analyze glass, soil, paint toolmarks, and skid marks.
CO-3: Students would be able to understand and analysis crime scene ballistics evidences.
CO-4: Students would be able to retrieve digital data, compare voice samples and perform forensic photography.

Instructions

Examiner would set nine questions. Question No. 1 shall be compulsory containing short answer type questions covering all units. The remaining eight questions would include two questions from each unit I-IV. Candidate would be required to attempt one question from each of the four units. Candidate would attempt five questions in all. All the questions (1-9) shall carry equal marks.

Unit-I	**Introduction:** Need and scopes of Forensic Physical Sciences from Indian perspective; Set-ups of fields in forensic physical sciences and associated divisions/sections in Indian FSLs, Pioneers of the fields; Introduction, cases, composition, and determination of adulterants in evidences including Glass, Soil, Paint, Cement, Wires/cables, Seals, Counterfeit coins, Gem Stones; **Resuscitation** of Obliterated Numbers on Metal surfaces; **Basics of Biometrics :** Introduction to Biometrics, Future of Biometrics.
Unit-II	**Forensic Ballistics/Firearm Analysis-** Overview to Arms Act (Indian), Forensic firearm examination/forensic ballistics and associated cases; History & Development of Forensic ballistics in Indian; Standard vsCountry Made/ Improvised Firearms; Introduction to Muzzleloaders (Match lock, Wheel lock, Flint lock firearms), Briefs of Pinfire, Rimfire and Centrefire systems of firearms. Classification and identification of commonly encountered firearms (Revolver, Pistol, Rifle and Shotgun) including country-made/improvised, Projectiles/Bullets, and Cartridges; Proof Marks of Weapons and Head-stamp markings on Ammunition.
Unit-III	Comparison for matching the Crime/Questioned and Test fire ballistics evidences (bullets and cartridge cases); Examination of Bullet /Exit bullet hole and other parameters in Accident, Suicide, Homicide firearm injuries; Fundamentals of estimation of Range of Firing, and testing Gunshot residues; Forensic Report writing in Firearm/ballistics cases.
Unit-IV	**Computer/Cyber forensics and Voice Analysis:** Fundaments of Computer Forensics; Types of Computer and cyber crimes; Forensics methods of retrieval and analysis of extracted digital evidence. Investigation of Cyber Crimes; Investigation of Malicious Applications, Search and Seizure of Volatile and Non-volatile Digital Evidence. **Voice/speaker identification:**Fundamentals of forensic Voice comparison in forensic science using different software. Forensic Report writing in Computer and Voice cases.**Artificial Intelligence** AI in Civil and Police investigation, Future of AI.
	Practicals 1) Forensic analysis Wires/Cables, and Seals, etc. 2) Resuscitation of Obliterated Numbers on Metal surfaces 3) Identification of firearms and ammunition of forensic interest 4) Comparison of ballistic evidences (Bullets and cartridge cases) 5) Chemical Tests for GSR 6) Estimation of Range of firing 7) Retrieval of digital information using forensic tool 8) Comparison of voice samples (Optional)

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Suggested readings

1) Dejey& Murugan. Cyber Forensics. 1st ed. Oxford University Press. (2018).
2) Jain, A.K., Flynn, P. & Ross, A.A. Handbook of Biometrics, Springer Publications, Springer. (2008).
3) Kävrestad, J. Guide to Digital Forensics: A Concise and Practical Introduction, Springer. (2017).
4) Maras, M.H. Computer Forensics- Cybercriminals, Laws, and Evidence. 2nd ed., Jones & Bartlett Learning. (2015).
5) Moore, R. Cybercrime- Investigating High-Technology Computer Crime, 2nd ed., Routledge. (2015).
6) Reiber, L. Mobile Forensic Investigations- A Guide to Evidence Collection, Analysis, and Presentation. 1st ed., McGraw-Hill. (2016).
7) Tistarelli, M. &Champod, C. Handbook of Biometrics for Forensic Science (Advances in Computer Vision and Pattern Recognition). 1st ed. Springer. (2017).
8) Ewens, W.J. and Grant, G.R. Statistical Methods in Bioinformatics: An Introduction, Springer. (2006).
9) Goyal, R.M. and Pawar, M.S. Computer Crimes- concept, control and prevention. Sysman Computer Pvt. Ltd. (1994).
10) Tiwari, R.K., Sastry, P.K. and Ravikumar, K.V. Computer Crime & Computer Forensics, Select Publisher, New Delhi. (2003).
11) DFSS Manuals of Forensic Sciences (Physics, Ballistics, Computer) MHA Govt. of India (Latest version)
12) Renata Holubova et al., Forensics and Physics, Cambridge Scholars Publishing (2024).
13) Carla Miller Nozigliaand Jay Siegel, Solving Crimes with Physics (Forensics: the Science of Crime Solving S.) 2005
14) Sharma, B.R. (1990) Firearms in Criminal Investigation and Trails.
15) DiMado (1987) Gunshot Wounds.
16) Kumar (1987) Forensic Ballistics in Criminal Justice.
17) Brian J. (2008) Handbook of Firearm and Ballistics Examination and Interpretation Forensic Evidence.
18) James Smyth Wallace (2008) Chemical Analysis of Firearms, Ammunition, and Gunshot Residue.

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SEMESTER-II

Criminalistics

Course Type: **DSC**	Course Code:24FSCS202DS04	Credits: **L3+P1**	Max. Marks: **T50+P25**	Time: **3 Hours**

Course Objective

Objective of this paper is to make the students aware of procedure of crime scene investigation system. The students would be appraised about the various methods of crime scene investigation, reconstruction of crime scene &Students would be able to know Chain of custody in forensic science.

Course Outcomes

CO-1: Students would be able to reconstruct a scene of crime.
CO-2:Students would be able to utilized Forensic Podiatry, Chieloscopy in personal identification of suspect.
CO-3: Students would be able to describe Chain of custody in forensic science.
CO-4: Students would be able to perform Crime scene photography.

Instructions

Examiner would set nine questions. Question No. 1 shall be compulsory containing short answer type questions covering all units. The remaining eight questions would include two questions from each unit I-IV. Candidate would be required to attempt one question from each of the four units. Candidate would attempt five questions in all. All the questions (1-9) shall carry equal marks.

Unit-I	**Criminalistics:** Definition, Meaning of Recognition, collection, identification, individualization and interpretation of physical evidences. **Pursuit to crime scene**: Securing the scene, Documentation crime scene (including photography and sketching)
Unit-II	**Basic Principles & Stages Involved:** Data Collection, Conjecture, Hypothesis formulation, Testing & Theory formation; Pattern evidence; Writing a reconstruction report of cases of Special Importance pertaining to forensics. **Forensic Podiatry**: Foot prints and shoeprints, Importance, Gait pattern, Casting of footprints in different medium, electrostatic lifting of latent footprints. **Chieloscopy:** Significance, Nature, location, collection and evaluation. **Ear prints**: Significance, Nature, location, collection and evaluation.
Unit-III	**Tool Marks examination**: Types of tool marks, Class characteristics and individual characteristics, Lifting of tool marks, Examination. **Basics ofBloodstain Pattern Analysis (BPA), Investigation of Road Accident crime scene**: Examination of scene, Victim and the vehicle, Collection of the evidence, **Crime Scene Reconstruction (CSR):** Nature & Importance of CSR.
Unit-IV	**Chain of custody & Legal aspects of forensic science**: Difference between a civil case & a criminal case, Case acceptance, case opening, and case examination, production of evidence, Expert Witness. **Crime scene photography**: Crime scene and laboratory photography, Basic use of forensic photography, including selection and use of equipment, photographs as evidence, close-up work, Digital Photography of crime scene.
	Practicals 1. Miscellaneous evidences (Cloth, Bangles, fibres) 2. Evaluation of Crime scene. 3. Sole prints comparison and their lifting from the scene of crime. 4. Lifting of prints and impressions by caste and replicas. 5. Study of Lip prints and ear prints. 6. Tool Marks examination

Suggested readings:

1) Kirk (2000) Vehicular Accident investigation and reconstruction.
2) H. James, Wouldiam G. Eckert (1999) Interpretation of Blood stain evidence at Crime Scene, 2nd edition, CRC Press.
3) Sharma, B.R. (1974) Forensic Science in Criminal Investigation and Trials, Central Law Agency, Allahabad.
4) Lundquest& Curry (1963) Forensic Science, Vol I to IV, Charles C. Thomas, Illinois, USA.
5) Saferstein : Forensic Science Handbook, Vol I, II & III, Prentice Hall Inc. USA.
6) Saferstein (1976) Criminalistics, Prentice Hall Inc. USA.
7) Kirk (1953) Criminal Investigation Interscience Publisher Inc. New York.
8) Sharma B. R. (1980) Footprints, Tracks and Trials. Central Law Agency. Allahabad.

SEMESTER-II

Instrumental Methods in Forensic Analysis -II

Course Type: **DSC**	Course Code:24FSCS202DS05	Credits: **L3+T1**	Max. Marks: **T70**	Time: **3 Hours**

Course Objective

The objective of this course is to make understanding of the analytical instrumental techniques for forensic purposes. The students would be able to learn principles & working and strategic approach of utilizing involving microscopy, chromatography, spectroscopic, electrophoresis, mass spectrometry, etc in forensic investigations.

Course Outcomes

CO-1: Students would be able to understand electrophoretic techniques
CO-2: Students would be able to understand Immunoassay techniques
CO-3: Students would be familiar with Mass Spectrometry
CO-4: Students would be able to understand about physical techniques in instrumental analysis

Instructions

Examiner would set nine questions. Question No. 1 shall be compulsory containing short answer type questions covering all units. The remaining eight questions would include two questions from each unit I-IV. Candidate would be required to attempt one question from each of the four units. Candidate would attempt five questions in all. All the questions (1-9) shall carry equal marks.

Unit-I	**Electrophoresis:** Theory, General Principles, Instrumentation, and forensic applications of techniques– Sodium dodecyl sulphate (SDS) polyacrylamide gel electrophoresis, Iso-electric focusing (IEF), Capillary Electrophoresis (CE) with reference to DNA Profiling and other forensic areas.
Unit-II	**Immunoassays**: Principles of Enzymology, Competitive, homogeneous immunoassays, Radioactive isotopes, & Fluorescence immunoassay, and their application in Forensic science including clinical tests
Unit-III	**Mass Spectrometry:** Basic Principle, Overview of Techniques: Ionization types (CI-MS, EI-MS, ECNI, FI, APCI), and Mass analyzers (Transmission Quadrupole, Quadrupole Ion trap, Time of Flight & Double Focusing), Scanning modes (SIM and SCAN), Tandem Mass Spectrometry and MALDI-TOF. Fundaments of **Stable Isotope Ratio** and **Ion Mobility Spectrometry**. Forensic Applications of Mass spectrometry in details.
Unit-IV	**Atomic Absorption Spectrometry and ICP-MS:** Basic Principle, working and applications.**Coulometry, Polarography and Thermogravimetry**: Basics and their Forensic applications. **NMR and XRD:** Basics and Forensic applications.

Suggested Readings

1) Skoog, D.A., West, D.M. and Holler, F.J. Fundamentals of Analytical Chemistry 6th ed. Saunders College Publishing. (1996).
2) Jickells, S. and Negrusz, A. Clarke's Analytical Forensic Toxicology. Pharmaceutical Press. (2008).
3) Robinson, J.W. Undergraduate Instrumental Analysis. Marcel Dekker: New York. (1987).
4) Settle, F.A. Handbook of Instrumental Techniques for Analytical Chemistry. Prentice Hall. (1997).
5) Stahl, E. Thin Layer Chromatography: A Laboratory Handbook. Springer: Berlin. (1969).
6) Wouldard, H.H., Merritt, L.L., Dean, J.A. and Settle, F.A. Instrumental Methods of Analysis, 7th ed. CBS Pub & Distributors: New Delhi. (1986).
7) James R. et al. (2005) Undergraduate Instrumental Analysis
8) Lee&Gaensslen : Advances in Forensic Science, (Vol. 2) Instrumental Analysis.

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SEMESTER-II **Forensic Medicine**			
Course Type: **SEC2**	Course Code:**24FSC202SE01**	Credits:**L3+T1+P0**	Max. Marks:**70**

Course Objective

Forensic medicine is one of the most important aspects of forensic biology. Death when in dispute-whether natural or unnatural calls for investigation and this paper would help the students to appreciate the reality surrounding death investigations on the part of physicians.

Course Outcomes

CO-1 Students would be able to understand the concept of death and legal issues pertaining to it.

CO-2: Students would be able to form opinions on Time Since Death and Injuries,

CO-3: Students would understand the types of Sexual Offences, Asphyxial deaths, Infanticide etc. and the jurisprudence related to it.

Unit-I	**Forensic Medicine**: Definition of Forensic Medicine and Medical Jurisprudence, Dying declaration, Death: Definition, types; somatic, cellular and brain-death, Sudden natural and unnatural deaths.
Unit-II	**Identification**: Definition, Identification of unknown person, dead bodies and remains of a person by age, sex, stature, dental examination, scars, moles, tattoos, dactylography, DNA typing and personal belonging including photographs. **Medicolegal Death Investigation:** Aspects of death scene analysis by a medical examiner, including autopsyprocedures, unidentified remains, child death investigations and mass disaster investigations.
Unit-III	**Determination of Time Since Death:** Immediate changes, Livor, Rigor and Algor mortis, cadaveric spasm, cold stiffening and heat stiffening. Putrefaction, mummification, adipocere and maceration Postmortem artifacts.**Sexual Offences**: Medico-legal investigation of Sexual offences, including examination of victim and suspect.
Unit-IV	**Infanticide**: Definition and related issues.**Forensic Pathology:** Terminology and scientific techniques used in medico-legal investigations, sudden or unexpected deaths, homicides, suicides, accidental deaths, and trauma.

Suggested readings:

1) Forensic Dentistry (1999) Paul G. Stimson, Curtis A. Mertz; CRC Press, LLC.
2) Craniofacial Identification in forensic Medicine, edited by John. G Clement and David. L. Ranso; Oxford University, Press; 1998.
3) Beals, R.L. and Hozier, H. (1985): An Introduction to Anthropology, Macmillan, New Delhi.
4) Krogman, W.M. And Iscan, M. (1987): Human Skeleton in Forensic Medicine, Charles & Thomas, U.S.A.
5) Gray's Anatomy (1987): Churchill Livingston, Edinburgh.
6) Modi, J.K. (1988): Medical Jurisprudence & Toxicology, N.M. Tripathi Pvt. Ltd.
7) Taylor (2000) : Forensic Art and Illustrations CRC Press.
8) Singh, I.P. and Bhasin M. K. (1968): Anthropometery, Kamla-Raj Publications, Delhi.
9) Beals, R.L. and Hoizer, H. (1985): An introduction to Anthropology, Macmillan, New Delhi.
10) Alan Gunn (2009) Essential Forensic Biology, 2nd Edition
11) Text book of Forensic Medicine by Krishan Vij; B.I. Churchill Livingstone Pvt. Ltd. 2001.
12) Craniofacial Identification in forensic Medicine, edited by John. G Clement and David. L. Ranso; Oxiford University, Press; 1998.
13) Forensic Taphonomy, edited by Wouldiam D. Haglernd, Marculla H. Sorg; CRC Press, LLC, 1997.
14) Glaister (Ed)-Rentoul& Smith (1973) : Forensic Medicine & Toxicology, Churchill Livingston, Edinburgh.
15) Modi, J.K. (1988): Medical Jurisprudence & Toxicology, N.M. Tripathi Pvt. Ltd.
16) Glaister Anatomy (Ed)—Rentoul& Smith (1973): Forensic Medicine & Toxicology, Churchill Livingston, Edinburgh.

SEMESTER-III
(Option 1: Course work)

SEMESTER-III **Societal and Forensic Aspects of Drug Abuse**				
Course Type: **DSC**	Course Code:25FSCS203DS01	Credits: **L3+P1**	Max. Marks: **T50+P25**	Time: **3 Hours**

Course Objective

This paper would cover all forensic and social aspects of drug abuse with reference to India. Students would learn about the reasons, problems, counter measures, and implications related to drug abuse. This paper would also cover clandestine dugs, drug profiling and R&D work on drugs of abuse.

Course Outcomes

CO-1: Students would be able to understand the status and measure of problem of dug abuse in India.
CO-2: Students would understand about the types of drugs abused in India and abroad, and related laws.
CO-3: Students would be able to understand Clandestine drug laboratories and their functioning.
CO-4: Students would be able to understand protocols and implications in drugs analysis.

Instructions

Examiner would set nine questions. Question No. 1 shall be compulsory containing short answer type questions covering all units. The remaining eight questions would include two questions from each unit I-IV. Candidate would be required to attempt one question from each of the four units. Candidate would attempt five questions in all. All the questions (1-9) shall carry equal marks.

Unit-I	**Drug abuse in India:** Current status, Social implications/impacts, Legal and illegal cultivation of Narcotic plants, Drug trafficking with reference to Golden crescent, Golden triangle and other international channels, National statistics on drug abuse, trafficking and seizures; Indian Sates effected with problem of drug abuse an reasons; Central and State level policies and strategic measures to irradiate problem of drug abuse in India, Introduction to India's Narcotic Control Bureau and UNODC coping with problem of Narco-terrorism. Role and functioning of rehabilitation centers in coping problem of drug abuse in people.
Unit-II	**Drugs of abuse:** Understanding ofDrug Dependence and Chemistry of drug addiction; Terminology &Classification as per Schedules/law (Indian, UK and USA systems); Types and Chemistry of analogues/variants of abused drugs in India involving Forensically important Opioids, Stimulants, Hallucinogens, Depress ants, Club drugs/DFSA, Prescription, OTCs, Inhalants/Volatile drugs/substances, and Drug abused in sports (doping). Reasons of deaths in Drug abuse.
Unit-III	**Clandestine Drug Laboratory:** Terminologies, Elements, Types, Problems, Contributing factors, Basic Equipments and methods of preparation adopted in Clandestine drug laboratories. Status of clandestine drug labs in India. Introduction to New Psychoactive Substances, Designer drugs with reference to drug analogs of synthetic Opioids (Fentanyl), Stimulants (Bath salts, Amphetamine) and Hallucinogenic (MDMA, DOM).
Unit-IV	**Drug profiling:** Fundamental of Chemical Drug profiling to find source of origin; Use and role of precursors, diluents, adulterants and other impurities in profiling drugs of abuse. Current implications in forensic drug profiling/testing. **R&D Analytical trends in Forensic Drug Analysis:** Analytical techniques including Microextraction- Solid Phase, Dispersive; Dispersive Liquid-Liquid, Headspace Solid Phase, &High resolution mass spectrometry in biological sample preparation and chromatographic techniques in Drugs of abuse analysis involving Heroin, Cocaine, Ganja, Charas, Barbiturates, Sleeping pills, Rohypnol, Ketamine, MDMA, and Prescription (pain killer) drugs.
	Practicals 1) Physical Identification of drugs of abuse (to be performed in FSLs) 2) Chemical analysis of drugs of abuse (to be performed in FSLs) including prescription and OTCs 3) Instrumental analysis of drugs of abuse (to be performed in FSLs) including prescription and OTCs 4) Method/s of Drug profiling for tracing source of origin (to be performed in FSLs). 5) Attachment at FSL(Attachment Report would also remain a part of assessment)

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Suggested readings

1) Ministry of Social Justice and Empowerment, Government of India and NDDTC, AIIMS, New Delhi, February 2019
2) Punjab Opioid Dependence Survey. Available at http://pbhealth.gov.in/scan0003%20(2).pdf
3) The Bulletin on Narcotics Volume LIX, Nos.1 and 2, 2007 A century of international drug control UNITED NATIONS New York, 2009 is available at www.unodc.org/unodc/en/data-and-analysis/bulletin/index.html
4) Fenton, John Toxicology : a case-oriented approach / John Fenton, 2002 by CRC Press LLC.
5) Saferstein, R.(Latest Edition) Criminalistics, Prentice Hall, New York.
6) J A Siegel, P.JSaukko (2000) Encyclopedia of Forensic Sciences Vol. I, II and III, Acad. Press.
7) Mathew E. Johll (2009) Investigating Chemistry: A Forensic Science Perspective
8) Suzanne Bell (2009) Drugs, Poisons, and Chemistry
9) JJ Fenton (2002) Toxicology A Case-Oriented Approach
10) Clarke's Analysis of Drugs and Poisons, (Formerly Isolation & Identification of Drugs) 3rd Ed. 2 Vol. Set.
11) Clark, E.G.C. : Isolation and identification of Drugs, VI and Vol. II, 1966, 1975-1986.
12) Modi, Text Book of Medical Jurisprudence Forensic Medicines and Toxicology (1999) CBS Pub. New Delhi

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SEMESTER-III

Essentials of Analytical Forensic Toxicology

Course Type: **DSC**	Course Code:**25FSCS203DS02**	Credits: **L3+P1**	Max. Marks: **T50+P25**	Time: **3 Hours**

Course Objective

This paper would cover important aspects analytical forensic toxicology, fate of drug/poisons in body, their metabolites, and interpretations. Focus would also be on drug toxicity snakebite, pesticide poisoning and related implication in forensic science. Dope test, R&D work & role of associated national and international bodies in forensic toxicology would also be made clear to the students.

Course Outcomes

CO-1: Students would be able to discuss History and Pioneers of Forensic Toxicology, Elements of Forensic Toxicology, Role of the Forensic Toxicologist and Laws related.

CO-2: Students would be able to define ADME of drugs of abuse.

CO-3: Students would be able to utilize applications of Veterinary Toxicology, Entomotoxicology, Environmental Toxicology and Ptomaine in Forensic context.

CO-4: Students would be able to measure Toxicity using LD50 and ED50

CO-5: Students would be able to extract and analyze poison from biological material.

Instructions

Examiner would set nine questions. Question No. 1 shall be compulsory containing short answer type questions covering all units. The remaining eight questions would include two questions from each unit I-IV. Candidate would be required to attempt one question from each of the four units. Candidate would attempt five questions in all. All the questions (1-9) shall carry equal marks.

Unit-I	**Forensic Pharmacology:** Basics ofADME, Phase-I and Phase-II reactions for Heroin, Cocaine, Charas, Diazepam, Opioids, and poisons including Alcohol, Gaseous, Cyanide, Toxic plants, Toxicological findings and interpretations based on study of metabolites. **Clinical Toxicology:** Toxidromes, Management of poisoning cases, Types of Antidotes in poisoning cases, Basics of Therapeutic Drug Monitoring.
Unit-II	**Analytical implications:** Fundamental issue of Dose–Response, Laboratory Accuracy and Error, Merits and demerits of Screening and Confirmatory Tests in forensic Toxicology, Problems of limited samples and preparation, Present status use using Modern Microextraction and Convectional methods including Stas-Otto Extraction techniques/methods in poisoning cases.
Unit-III	**Forensic Analysis in Drug Toxicity/Overdose death:** Overview and implications involved in forensic cases, especially Drug Spike methods and validations implications. **Drug Doping:**Introductionto Doping and Performance enhancing substances including drugs and steroids, etc; Sampling techniques and analytical strategies in dope test.
Unit-IV	**Snakebite:** Overview to Snakes, Snakebite, Snake venoms, and related Research in India. Analytical implications involved in forensic cases. **Pesticides of forensic interest:** Classification of pesticides and instrumental methods of their analysis from the biological samples. **Recent R&D developments**: In forensic toxicology, Scopes and Working of Chemical Examiner's laboratories, Poison Information Centre/National Poison Information Centre, CDRI, India Institutes of Toxicology Research, National Toxicology Centre, International bodies/boards of forensic toxicology including SOT&TIAFT.
	Practicals 1) Methods of identifying venomous and non-venomous snakes and assessment of snakebite 2) Performing Stas-Otto method of extracting alkaloidal poisons 3) Attachment at FSL (Attachment Report would also remain a part of assessment)

Suggested readings

1) Fenton, John Toxicology : A case-oriented approach / John Fenton, 2002 by CRC Press LLC.
2) J A Siegel, P.JSaukko (2000) Encyclopedia of Forensic Sciences Vol. I, II and III, Acad. Press.
3) Mathew E. Johll (2009) Investigating Chemistry: A Forensic Science Perspective
4) Suzanne Bell (2009) Drugs, Poisons, and Chemistry
5) Clarke's Analysis of Drugs and Poisons, (Formerly Isolation & Identification of Drugs) 3rd Ed. 2 Vol. Set.
6) Clark, E.G.C. : Isolation and identification of Drugs, VI and Vol. II, 1966, 1975-1986.

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SEMESTER-III **Advanced DNA Forensics**				
Course Type: **DSC**	Course Code:25FSCS203DS03	Credits: **L3+P1**	Max. Marks: **T50+P25**	Time: **3 Hours**

Course Objective

Students would be able to understand the basic concepts of human genetics & molecular biology of DNA. & also get to know about usefulness of genetic markers in forensic investigation along with the interpretation of a DNA profile & to understand the potential Benefits of DNA Data banking

Course Outcomes

CO-1: Students would be able to understand the basic concepts of human genetics.

CO-2: Students would be able to understand the usefulness of genetic markers in forensic investigation along with the interpretation of a DNA profile.

CO-3: Students would be able to understand the need, progress, forensic significance and the legal importance of DNA profiling in various scenarios in India and abroad.

CO-4: Students would be able to understand the potential Benefits of DNA Data banking

CO-5: Students would be able to Use DNA statistics for calculations in different types of cases encountered in Forensic Science.

Instructions

Examiner would set nine questions. Question No. 1 shall be compulsory containing short answer type questions covering all units. The remaining eight questions would include two questions from each unit I-IV. Candidate would be required to attempt one question from each of the four units. Candidate would attempt five questions in all. All the questions (1-9) shall carry equal marks.

Unit –I	Human Genetics, Heredity, variations, Alleles, The concept of Genetics & Mendelian Genetics.Mutations, Population Genetics, Hardy-Weinberg Law, polymorphism, molecular biology of DNA, DNA replication, transcription & translation. Blotting Techniques
Unit –II	DNA Profiling: Introduction, History of DNA Typing, Polymorphism,DNA Extraction-Organic and Inorganic extraction, Comparison of Extraction methods, Commercial kits. DNA Quantitation, DNA amplifications, Gel Electrophoresis & DNA detection methods.DNA typing systems- RFLP, VNTR, STR. DNA sequencing. Y-STR, Mitochondrial DNA
Unit –III	DNA Statistics: STR Analysis &interpretations, allelefrequency determination,Paternity/Maternity index, Sibling index, Probability of match. Human Genome Project: Introduction, History, Goals, Benefits, Social, Ethical and Legal Issues,Forensic DNA Databases, Ethical, Legal, and Social Issues Associated with DNA Data database, Potential. Benefits of DNA Data banking.
Unit –IV	Forensic Significance of DNA profiling: Applications in disputed paternity cases, child swapping,missing person's identity- civil immigration, veterinary, wildlife and agriculture cases, legalperspectives- legal standards for admissibility of DNA profiling, procedural and ethical concerns, New and future technologies:DNA chips, SNPs, NGS & RNA & its applications in forensics.
	Practicals To prepare gel plates for electrophoresis. 2. Organic extraction of DNA from blood. 3. Extraction of DNA from other body fluids. 4. Quantification of DNA 5. PCR for DNA samples 6. Accessing of DNA databases.

Suggested readings:

1) Kirby : DNA Fingerprinting Technology.
2) DNA structure and functions by Richard R. Sinden; Academic Press, Inc. 1994.
3) DNA Profiling and DNA fingerprinting (1999) Edited by Jorg T. Epplen and Thomas Lubjuhn; Birkhauser Verlag, Switzerland.
4) Forensic DNA Profiling Protocols (1998) Patrick J. Lincoln and Jim Thomson; Humana Press, Inc.
5) DNA and other Polymorphism in Forensic Science (1990) Henry C. Lee and R.E. Gaensslen; Year book nMedical Publishers, Inc.
7. Keith In man and Norah Rudin (1997) An Introduction to Forensic DNA Analysis, CRC Press; Ny.
6) Koblinsky et al. (2005) DNA -Forensic and Legal Implications.
7) John M. Butler (2005) Forensic DNA Typing: Biology, Technology, and Genetics of STR Markers Academic Press.

SEMESTER-III

Forensics of Biological Evidences

Course Type: **DSC**	Course Code:25FSCS203DS04	Credits: **L3+P1**	Max. Marks: **T50+P25**	Time: **3 Hours**

Course Objective

This paper would help the students to understand and carry out basic investigations relevant to biological evidences. Studentswould understand forensic serology and immunology and assays used to achieve identification and confirmation of the presence of various biological evidences.

Course Outcomes

CO-1: Students would be able to Understand the importance of biological fluids (blood, semen, saliva and other body fluids) in crime investigations.

CO-2: Students would be able to define biology and chemistry of the identification tests used for examination of different body fluids.

CO-3: Students would be able to understand the basic principles of the serological techniques used in Forensic biology for different body fluids.

CO-4: Students would be able to understand the conventional and modern methods of individualization on the basis of different biological evidences.

Instructions

Examiner would set nine questions. Question No. 1 shall be compulsory containing short answer type questions covering all units. The remaining eight questions would include two questions from each unit I-IV. Candidate would be required to attempt one question from each of the four units. Candidate would attempt five questions in all. All the questions (1-9) shall carry equal marks.

Unit –I	**Forensic Hair characterization**: Morphology and types, their importance, nature, location, collection, evaluation and tests for their identification: Species of origin, variation in different major population groups, somatic origin. Methods of Individualization: Blood grouping, enzyme typing and DNA typing.
Unit -II	**Forensic Characterization of Blood:** Biochemistry of ABO blood Groups, Chemistry and properties of Presumptive and Confirmatory tests, Individualization. **Forensic Characterization of Semen:** Formation, Composition, Morphology of spermatozoa, forensic significance, Presumptive and Confirmatory tests (including Azoospermic semen stains). Individualization (Blood Grouping, seminal fluid isozymes typing, forensic significance, Collection and analysis of evidences in Rape cases. Forensic significance of other body fluids as Saliva, Sweat and faecal matters, their collection and identification.
Unit –III	**Blood grouping** from stains of blood, semen, saliva and other body fluids by Absorption-inhibition, Absorption-elution and mixed agglutination techniques, determination of secretor/non-secretor status.
Unit –IV	Immunology: Immune system, immune response, innate and acquired immunity and antigens, raising of antisera, Antigen-Antibody Reactions: primary, secondary and tertiary. **Assays of forensic importance:** Primary binding assays (ELISA**,** Immunochromatographic assays**),** Secondary binding assays (Precipitation based assays- Immunodiffusion and electrophoretic methods for species. Identification, Agglutination based assays-Direct agglutination assay, Passive agglutination assay)
	Practicals 1. To prepare slides of scale patterns of human hair. 2. To examine human hair for cortex and medulla. 3. To determine blood group from fresh blood. 4. To identify blood stains. 5. To identify semen stains. 6. To identify saliva stains. 7. To determine titre of antisera. 8. To perform precipitin test for species of origin determination.

Suggested readings:

1) Race, R.R, and Sanger, R. (1975) : Blood Groups in Man. Blackwell Scientific, Oxford.
2) Saferstein, R. (1982): Science Handbook, Vol. I, II, & III, Prentice Hall New Jersey.
3) Curry, A. S. (1965): Methods of Forensic Science, Vol IV, Interscience, New York.

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4) Barris, H. and Hopkinson, D.A. (1976) : Handbook of Enzyme, Electrophoresis Eleavier, North, Holland, New York.
5) Robertson (1999) : Forensic examination of Hair. Francis & Taylor, USA.
6) Gilblet, E. (1969) : Markers in Human Blood, Davis, Pensylvania
7) Culliford, B.E. (1971) The Examination and Typing of Blood Stains, US Deptt. of Justice, Washingron
8) Dunsford, I and Bowley, C. (1967) : Blood Grouping Techniques, Oliver & Boyd, London
9) Boorman KE, Dodd BE, Lincoln PJ. (1988) Blood group serology, 6th ed. Edinburgh : Churchill Livingstone.
10) Basin Et al. A laboratory Manual for Human Blood analysis. Kamla Raj Enterprises.
11) Li R. (2008) Forensic Biology, Taylor & Francis Group LLC.

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SEMESTER-III				
Forensic Criminology & Law				
Course Type: **DSC**	Course Code:26FSCS203DS05	Credits: **L3+T1**	Max. Marks: **T70**	Time: **3 Hours**

Course Objective

Students would be able to know about concept and types of crime.
Students would be aware of Constitution of India and various BNS, BNSS, BSA sections & of Hierarchy of Courts in forensic provision & get to know about to Dowry Prohibition Act & POCSO Act.

Course Outcomes

CO-1: Students would be able to describe the concept of crime.
CO-2:Students would be able to conduct Criminal Profiling.
CO-3: Students would make use of various IPC sections & of Hierarchy of Courts in forensic provision.
CO-4: Students can apply knowledge in solving crimes related to Dowry Prohibition Act, POCSO Act.

Instructions

Examiner would set nine questions. Question No. 1 shall be compulsory containing short answer type questions covering all units. The remaining eight questions would include two questions from each unit I-IV. Candidate would be required to attempt one question from each of the four units. Candidate would attempt five questions in all. All the questions (1-9) shall carry equal marks.

Unit –I	**Crime Scenario in India:** Concept and Definition of Crime, Introduction to crime, Sociological aspects of crime and criminals in society. **Types of crime and its causes:** Property crimes, public order crimes, violent crimes**,** cyber crimes, juvenile delinquency, Society-Criminal interaction and various types of crimes in India.
Unit-II	**Forensic Criminology**: Introduction of Forensic Criminology, Control and Prevention of Crime in context with Organization, Industrialization, Family-set up, Psychology. **Procedures involved in detection of crime:** Latest evidence-based research in detection and prevention of crime.
Unit-III	**Indian Courts:** Constitution of Courts-Hierarchy of Courts and their Powers. Lok Adalats, Lok Ayuktsand Juvenile Courts. **Constitution of India**-Preamble, Fundamental Rights Article 20, 21, 22.
Unit-IV	**Bharatiya Nyaya Sanhita (BNS) : Offences against the person-Sections**: 101, 103, 80, 109, 114, 116, 118, 119, 130, 74, 137, 138, 63 .**Offences against property**- Sections: - 303, 308, 309, 310, 318, 318 (4), 329, 336, 178, 356, 351 and 62. **Briefs of Information:** Dowry Prohibition Act, POCSO Act. **Bharatiya Sakshya Adhiniyam, 2023 (BSA)- Sections:** 39 **Bharatiya Nagarik Suraksha Sanhita, 2023 (BNSS)- Sections: 326, 328, 329**

Suggested readings:

1. Constitution of India
2. Bharatiya Nyaya Sanhita
3. Bharatiya Nagarik Suraksha Sanhita
4. Bharatiya Sakshya Adhiniyam
5. Barak, Gregg : Integrative Criminology.
6. Johnson : Crime, Correction and Society.
7. Riderman : The Manipulation of Human Behaviour.

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SEMESTER-III **Computer Forensics**			
Course Type: **SEC3**	Course Code:25FSC203SE01	Credits: **L3+T1+P0**	Max. Marks:**70**

Course Objective

This paper would cover fundamentals of computer forensics. It would cover working of computers, computer crimes, imaging, extraction of digital data using available tools, and forensic analysis. IT Act, and Forensic Report writing in computer forensic would also be covered in this paper.

Course Outcomes

CO-1: Students would be able to define cybercrime.
CO-2: Students would be able describe functioning of Computer Software, Hardware and Internet.
CO-3: Students would have knowledge of computer virus, worms, Trojan Horse, trap door.
CO-4: Students would be able to make use of tools of retrieving digital data.

Unit-I	**Digital Databases:** Introduction to Disk forensic, mobile forensic, network forensic, cloud forensic, database forensicetc.
Unit-II	**Computer Crime**: Types including virus, worms, Trojan Horse, trap door, super zapping, logic bomb, salami logic, and others. Modus Operandi of computer/cyber criminals.
Unit-III	**Digital evidence:** Definition, types, associated accessories. **Extraction:** Forensic methods/tools/Imaging of digital data extraction/retrieval from different sources including mobile, laptops, computers, pen drive, and hard disk, etc.
Unit-IV	Fundamentals of report writing in computer forensic. Brief introduction to cyber-Laws, IT Act, & implications associated with court testimony.

Suggested Readings:-

1) Nathan Clarke (2010) Computer Forensics
2) Eoghan Casey BS MA (2001) Handbook of Computer Crime Investigation: Forensic Tools and Technology
3) Marjie T. Britz (2003) Computer Forensics and Cyber Crime: An Introduction
4) Eoghan Casey (2009)Handbook of Digital Forensics and Investigation
5) Warren G. Kruse II and Jay G. Heiser (2001) Computer Forensics: Incident Response Essentials
6) Robert C. Newman (2007) Computer Forensics: Evidence, Collection and Management
7) Michael A. Caloyannides (2001) Computer Forensics and Privacy (Artech House computer security series)
8) Eoghan Casey BS MA (2001) Handbook of Computer Crime Investigation: Forensic Tools and Technology
9) The Indian IT Act 2000.
10) Steve Bunting (2007) The Official EnCE - EnCase Certified Examiner Study Guide.
11) Robert C. Newman (2007) Computer Forensics: Evidence, Collection and Management
12) Eoghan Casey BS MA (2001) Handbook of Computer Crime Investigation: Forensic Tools and Technology
13) Eoghan Casey (2009) Handbook of Digital Forensics and Investigation
14) Tewari, R.K., Sastry, P.K. and Ravikumar, K.V. (2003) Computer Crime & Computer Forensics select Publisher, New Delhi.

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Semester -IV (Option-1)

SEMESTER-IV Forensic Physical Anthropology				
Course Type: **DSC**	Course Code:25FSCS204DS01	Credits: **L3+P1**	Max. Marks: **T50+P25**	Time: **3 Hours**

Course Objective

Students would be aware of human bones and their forensic significance in determining Age, Sex, Race and Stature of deceased. Students would know about Somatoscopy and Somatometry, Forensic Facial Reconstruction & Forensic Odontology in personal identification of humans.

Course Outcomes

CO-1: Students would be able to identify human bones and their forensic significance in determining Age, Sex, Race and Stature of deceased.

CO-2: Students would make use of Portrait Parle/Bertillon system, Somatoscopy and Somatometry, Forensic Facial Reconstruction in elucidating the personal identification of humans.

CO-3: Students would appreciate the practicability of Forensic Odontology

Instructions

Examiner would set nine questions. Question No. 1 shall be compulsory containing short answer type questions covering all units. The remaining eight questions would include two questions from each unit I-IV. Candidate would be required to attempt one question from each of the four units. Candidate would attempt five questions in all. All the questions (1-9) shall carry equal marks.

Unit-I	**Forensic Physical Anthropology:** Definition and Scope within the medical-legal context of personal identification of human remains as in cases of homicides or mass disasters, Brief introduction to ForensicArcheology and Anthropometry.
Unit-II	**Human skeletal system:** Nature and formation of bones, introduction to Human skeleton, Classification of human bones.Determination of Age and sex from human bones. Determination of Race and estimation of stature from skeletal remains.
Unit-III	**Personal Identification:** Portrait Parle/Bertillon system, Somatoscopy and Somatometry. **Forensic Facial Reconstruction:** Two Dimensional and 3 Dimensional Methods, Importance of tissuedepth to reconstruct various facial features.
Unit-IV	**Forensic Odontology:** Development and scope, role in mass disaster and anthropology, structural variation in teeth (human and non-human), types of teeth and their functions. **Determination of age from teeth**: Eruption sequence, Gustafson's method, their significance in personal identification. **Bites marks**: Forensic significance, collection and preservation of bite marks, photography of bite marks, and evaluation of bite marks, Legal aspects of bite marks.
	Practicals 1. Identification of human bones 2. Determination of age from skeletal remains 3. Determination of sex from skeletal remains 4. Determination of stature from skeletal remains All these practicalswould be performed at PGIMS, Rohtak and an attachment report would be part of the assessment

Suggested readings:

1) Forensic Dentisty (1999) Paul G. Stimson, Curtis A. Mertz; CRC Press, LLC.
2) Craniofacial Identification in forensic Medicine, edited by John. G Clement and David. L. Ranso; Oxiford University, Press; 1998.
3) Beals, R.L. and Hozier, H. (1985): An Introduction to Anthropology, Macmillan, New Delhi.
4) Krogman, W.M. And Iscan, M. (1987): Human Skeleton in Forensic Medicine, Charles & Thomas, U.S.A.
5) Gray's Anatomy (1987): Churchill Livingston, Edinburgh.
6) Singh, I.P. and Bhasin M. K. (1968): Anthropometery, Kamla-Raj Publications, Delhi.
7) Alan Gunn (2009) Essential Forensic Biology, 2nd Edition
8) Text book of Forensic Medicine by Krishan Vij; B.I. Churchill Livingstone Pvt. Ltd. 2001.
9) Modi, J.K. (1988): Medical Jurisprudence & Toxicology, N.M. Tripathi Pvt. Ltd.
10) Glaister Anatomy (Ed)—Rentoul& Smith (1973): Forensic Medicine & Toxicology, Churchill Livingston, Edinburgh.

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SEMESTER-IV **Recent Research Trends in Forensic Biological Sciences**				
Course Type: **DSC**	Course Code:25FSCS204DS02	Credits: **L3+T1**	Max. Marks: **T70**	Time: **3 Hours**

Course Objective

This paper would appraise the students about the recent trends in forensic biological research. This would help them to understand the new and upcoming concepts in forensic biology. This would also fire their research interest and help them to further probe in these sciences and look for better pastures for such research in India and abroad.

Course Outcomes

CO-1: Students would be able to understand the recent trends in research in the field of forensic biology
CO-2: Students would understand the value of genealogy in forensic settings
CO-3: Students would be able to understand the concept of death and evidences surrounding such scenarios.
CO-3: Students would be able to understand the returning to the basics of life for forensic purposes.
CO-4: Students would be able to understand about the value the forensic scientists can add to environment.

Instructions

Examiner would set nine questions. Question No. 1 shall be compulsory containing short answer type questions covering all units. The remaining eight questions would include two questions from each unit I-IV. Candidate would be required to attempt one question from each of the four units. Candidate would attempt five questions in all. All the questions (1-9) shall carry equal marks.

Unit-I	**Forensic Genetic Genealogy:** Structure and inheritance patterns of autosomal, Y-chromosomal and mitochondrial DNA, establishing genetic relatedness through these markers. **Forensic DNA phenotyping**-concept, establishing biogeographic ancestry, establishing identity of mass disaster victims and missing persons, externally visible trait prediction.
Unit-II	**Forensic Taphonomy:** concept, process of cadaveric decomposition- terrestrial, buried and submerged environments, environmental factors affecting rate of decomposition, relative and absolute dating techniques, forensic archaeology, estimation of Postmortem interval and other applications of forensic taphonomy, Chain of custody
Unit-III	**Forensic Proteomics**: Proteome, Identification of body fluids and tissues, proteomic genotyping, human individualization, PMI estimation, Anti-doping in sports, Characterization of pathogens, Mass spectrometry is proteomics, challenges and future developments
Unit-IV	**Environmental Forensics:** concept, categories of environmental Forensic investigations, Specific Evaluative Techniques- non testing techniques, fingerprinting techniques- chemical fingerprinting, isotopic fingerprinting, conceptual site models Basics, applications and implications.

Suggested readings

1) Forensic Geneology by Colleen Fitzpatrick, Identifinders Intl 1st edition (**2013**)
2) Environmental Forensics fundamentals A practical guide by Ioana Gloria Petrisor, CRC Press Taylor and Francis
3) Forensic Taphonomy: The postmortem fate of human remains edited by Wouldiam D Haglund and Marcella H Sorg (1997) CRC press LLC
4) Manual of Forensic TaphonomyEditedBy James T. Pokines, Ericka N. L'Abbe, Steven A. Symes 2nd Edition 2021 by CRC Press

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SEMESTER-IV

Advanced Forensic Physics, Ballistics & Explosives

Course Type: **DSC**	Course Code:25FSCS204DS03	Credits: **L3+P1**	Max. Marks: **T50+P25**	Time: **3 Hours**

Course Objective

Core areas of physics, ballistics and explosives involving important and recent techniques and methods would be made clear to the students. Bloodstain patter, arson, explosives, IEDs, explosive and gunshot injuries, and fundamentals of internal, external and would ballistics would be covered in this paper. Forensic Report writing for all these cases would also be covered in this paper.

Course Outcomes

CO-1: Students would be able to understand the concept of forensic engineering and associated evidences.
CO-2: Students would understand about Blood Pattern Analysis and fiber Identification.
CO-3: Students would be able to understand about Fire and Arson investigation.
CO-3: Students would be able to understand about firearms and their ammunitions analysis.
CO-4: Students would be able to understand about Explosives and their forensic analysis.

Instructions

Examiner would set nine questions. Question No. 1 shall be compulsory containing short answer type questions covering all units. The remaining eight questions would include two questions from each unit I-IV. Candidate would be required to attempt one question from each of the four units. Candidate would attempt five questions in all. All the questions (1-9) shall carry equal marks.

Unit-I	**Forensic Engineering:** Industrial accidents; Civil engineering investigation; **Physics of Bloodstain Pattern Analysis (**BPA): Droplet Directionality from bloodstain patterns, Determination of Point of Convergence and Point of Origin; Impact spatter and mechanisms; Importance and Legal aspects. **Fire & Arson:** Understanding Chemistry and stages of Fire; Phenomenon of Backdraft, Combustible and Flammable liquids, Working of Fire extinguishers. Legal Definition, motives, and Degrees of Arson, **Scheme of analysis**: Extraction of samples from debris (Direct and solvent extraction methods, Head Space method, SPME, Distillation), Clean-up (Filtration & Acid stripping), Analysis and interpretations of results with HS-GC-MS.
Unit-II	**Fundamentals of Internal Ballistics:** Ammunition powders;Shapes and manner of Propellant burning; Pressure vs Time Curves to Understanding entire sequence of firing. **External Ballistics:** Shapedynamics of bullet/projectile of firearms;Bullet Trajectory and factors affecting bullet flight with respect to Bullet Drop in the flight, Ballistic Coefficient/ Sectional Density, Base drag; Understanding the use of sight/s to compensate for bullet drop and hitting accuracy along with Brief introduction to Drift, Yaw, Precession, and Nutation. **Wound Ballistics:** Mechanism of cavitation's in body in firearm injuries; Instrumental analytical advancements in estimating Range of Firing and detecting Gunshot Residue. Merits and demerits of using Conventional and Advance (Automated) approaches in Bullet and Cartridges comparison/matching in FSLs.
Unit-III	**Explosives**: Overview to Explosive Act (1884) in India; Types, Chemistry/Compositions, Classification and Properties of forensically important explosives (Characteristics of Low, High, Primary, Secondary & Tertiary Explosives); Understanding Oxygen Balance and Velocity of Detonation in explosives; Introduction and types of IEDs/Explosive Trains (Molotov cocktail, Letter bomb, Pipe bomb, VBIED and CBRN), and Important cases. Detection of Hidden Explosives,
Unit-IV	**Physics of Explosion Hazards:** Explosion Process; Characteristics of Blast Waves; Types of Hazard; Forensic Pathology of Victims of an Explosion or ballistic injuries. **Processing and Analysis:** Processing crime scene of Explosion & Reconstruction of Sequence of Events, Post- blast Residue Collection and analysis in forensic laboratory using Chemical and Instrumental (Chromatography and Spectroscopy) methods and Interpretation of Results; Presentation of Explosive Casework Evidence
	Practicals 1. Forensic analysis of volatile evidences in arson case using GC. 2. Understanding Physics behind Bloodstain Pattern for forensic purpose. 3. Identification of Firearm cartridge based on physical properties 4. Examination of Firearm injuries

	5. Using automated ballistic identification system/s (to be performed at FSL) 6. Instrumental analysis of explosives (to be performed at FSL) 7. Attachment at FSL (Attachment Report a part of assessment)

Suggested readings

1) Forensic Examination of Fibres, Second Edition - Kindle Edition - Kindle eBook (Apr. 16, 2007) by Ichael Grieve
2) Noon (2000) : Forensic Engineering Investigation.
3) Forensic Digital Imaging and Photography – (2001) by Herbert L. Blitzer and Jack Jacobia
4) J A Siegel, P.J Saukko (2000) Encyclopedia of Forensic Sciences Vol. I, II and III, Acad. Press
5) H. James, Wouldiam G. Eckert; (1999) Interpretation of Blood stain evidence at crime scene Second edition, CRC Press.
6) Saferstein (2000) Criminalistics, Prentice Hall Inc. USA
7) Sharma, B.R. (1990) Firearms in Criminal Investigation and Trails.
8) DiMado (1987) Gunshot Wounds.
9) Kumar (1987) Forensic Ballistics in Criminal Justice.
10) Brian J. (2008) Handbook of Firearm and Ballistics Examination and Interpretation Forensic Evidence.
11) James Smyth Wallace (2008) Chemical Analysis of Firearms, Ammunition, and Gunshot Residue.

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SEMESTER-IV

POLICE AND CRIME INVESTIGATIVE AGENCIES

Course Type: **DSC**	Course Code:25FSCS204DS04	**Credits: L3 + T1**	**Max. Marks: T70**	Time: **3 Hours**

Course Outcomes

CO-1: Students would be able to explain functioning of Indian Police system at State and central level.

CO-2: Students would be able to explain the association and importance of BPR&D, CBI, NCRB, NICFS, NPA, CID, MOB in solving crime.

CO-3: Students would be able to describe set-up of Police station & their role in crime management

CO-4: Students would also know about the structure and functioning of various international investigative agencies in combating crime.

Instructions

Examiner would set nine questions. Question No. 1 shall be compulsory containing short answer type questions covering all units. The remaining eight questions would include two questions from each unit I-IV. Candidate would be required to attempt one question from each of the four units. Candidate would attempt five questions in all. All the questions (1-9) shall carry equal marks.

Unit-I	Evolution of Police Administration, Indian Police Service, Nature, Rank of Police, Officers–Badges, Role & Functions of Police. Preventive forensics, National Investigative Agencies: National Investigative Agency, Research and Analysis Wing, Intelligence Bureau, Narcotic Control Bureau.
Unit-II	Central level Police organizations, Commissionerate System of Policing, Bureau of Police Research and Development (BPR&D), Central Bureau of Investigation (CBI), National Crime Records Bureau (NCRB), National Institute of forensic Science (NICFS), Sardar Vallabhbhai Patel National Police Academy (NPA).
Unit-III	State level Police Organization: Criminal Investigation Department (CID), Modus Operandi Bureau (MOB), District level police, Structure of an Indian Police Station.
Unit-IV	International Investigative Agencies: Federal Bureau of Investigation (FBI), Central Investigation Agency (CIA), MI-6, Inter-Services Intelligence (ISI) Mossad, Minister of State Security (MSS) , Federal Security Services of Russian Federation (FSB), Directorate General for External Security (DGSE), Australian Secret Intelligence Service (ASIS) and BND Germany.

Suggested readings:

1) Ghosh S.K. and Rustomji K.F. Encyclopedia of police in India, Ashish Publishing House, (1994).
2) Raghavan R.K. Indian police, Manohar Publications, (1989).
3) Shamim Allem. Women in Indian Police, Sterling Publishers, (1991).
4) Rajinder prasher. Police Administration, Deep & Deep, (1986).

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SEMESTER-IV

Accreditation of Forensic Science Laboratories

Course Type: **DSC**	Course Code:25FSCS204DS05	Credits: **L3+T1**	Max. Marks: **T70**	Time: **3 Hours**

Course Objective

The objective of the course is to make students fully conversant with the process of managing quality and managing services through audit and NABL. Information about other international accreditation bodies for forensic science would also be covered in this course. The principles of Quality, Quality Assurance, and Total Quality Management would provide an insight into the concepts of Excellence and best values and the contribution of quality to strategic management.

Course Outcomes

CO-1: Students would be able to describe functioning of NABL, ILAC, APLAC, ASCLD, ISO-IEC, BIS.
CO-2: Students would be able to conduct internal audit in forensic science labs.
CO-3: Students would be able to describe procedure of external audit by NABL.
CO-4: Students would make people aware of accreditation and its significance in testing labs.

Instructions

Examiner would set nine questions. Question No. 1 shall be compulsory containing short answer type questions covering all units. The remaining eight questions would include two questions from each unit I-IV. Candidate would be required to attempt one question from each of the four units. Candidate would attempt five questions in all. All the questions (1-9) shall carry equal marks.

Unit-I	**Basics:** Definition of Quality, Quality Assurance & Quality Control, Accreditation; Need of maintaining quality of Forensic laboratories**,** Benefits and scopes of Accreditation; **Organizations:** NABL, ILAC, APLAC. ASCLD, ISO, etc.
Unit-II	**Essentials of Quality Management System:** Guidelines for Preparing Quality Manual, Quality Management System (People, Technical and Document), Quality Manual, Quality Manager; **Audits**: Definition, Types, FSL Internal Audits, Objectives, Planning, Processing, and Completion.
Unit-III	**Accreditation Process as per ISO 17025:** Selection and role of Leas assessor, Technical assessors, Observer, etc; Procedure of assessment of new applicant laboratories, Process for preparing a Management System Document/Quality Manual & Structure and format of Management System Document/Quality Manual; Pre-assessment, On-site assessment, Guide of assessors to formulate recommendations for NABL, Opening and Closing meetings.
Unit-IV	**Requirements and procedure for getting accreditation from NABL:** General, Structural, Technical/Resource & Management requirements;DetailsofProficiency Testing in accordance with NABL 163**;** Surveillance and Re-Assessment; grant of accreditation along with terms and conditions; Current status of FSLs/CFSLs NABL Accreditation in India.

Suggested Readings:

1) J A Siegel, P.JSaukko (2000) Encyclopedia of Forensic Sciences Vol. I, II and III, Acad. Press
2) NABL -, Guide for Internal audit and Management Review for Laboratories.
3) NABL-210, Assessor Guide.
4) NABL Guides & Forms –No. 100, 131, 151, 160, 141, 142, 163, 209, 214, 216, 200, 220, 218 etc.
5) DFSS: Manuals of Forensic Sciences

MDUR

SEMESTER-IV

Research Elements in Forensic Science

Course Type: **SEC4**	Course Code:25FSC204SE01	Credits:**L2+T0+P2**	Max. Marks:**50**

Course Objective

This course offers an overview of conducting research in forensic science, good laboratory practices and their management. Studentswould also learn about the various standards, safety measures, research stages and involved implications. It also includes report writing and publications.

Course Outcomes

CO-1: Students would be able understand the meaning & types of research
CO-2: Students would be able to learn research standards and methods of analysis
CO-3: Students would be familiar with good laboratory practices.
CO-4: Students would be able to understand sampling protocols, analysis, and publications procedures.

Unit-I	**Concepts of Research &Publications:**Definition of Research, Types & Methods of Research, Characteristics of Forensic Research, Basics of Hypotheses, Research plan, Research design. Research Funding agencies (DST, DBT, ICMR, CSIR, UGC, and role of DFSS and BPR&D), Research Proposal
Unit-II	**Research Standards in Analysis:** Definition, Types and Need of Standards (Biological/Chemical/Biochemical/Physical) in Analytical forensic Science research, Reference Materials, Certified Reference Materials, Routine Laboratory Work, Record Management, **Laboratory Practices:** Standard Operating Procedure (SOP), Laboratory Accreditation (NABL, ISO BIS)
Unit-III	**Data Collection and Analytical Methods:** Methods of Data analysis using Test of Significance, T-Test and Chi-Square Test, Test of Correlation(R), Correlation and Linear Regression, Correlation Coefficient, &Method Validation.
Unit-IV	**Report Writing&Publication:**Data Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of reports, Oral/poster Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports, Conclusions.Role of Conferences, symposia, workshop in R&D.
	Practicals 1) Practical quality assessment factors for choosing research journals 2) Understanding of proceeding with research proposals for obtaining ethical permissions. 3) Understanding Bio-safety levels in terms of laboratory requirements, protocols, storage and disposal of hazardous materials (Chemical and Biological) in research 4) Practical demonstration for collection & analysis of research data using common statistical tools. 5) Understanding filing of patents and logo

Suggested readings:

1) Kothari CR and GargG.(2019) Research Methodology: Methods and Techniques, New Age Int. New Delhi.
2) Adèr, H. J., &Mellenbergh, G. J. (1999).Research methodology in the social, behavioural and life sciences. London, : SAGE Publications, Ltd doi: 10.4135/9780857029027
3) Baldi, B., & Moore, D. S. (2014). The practice of statistics in the life sciences.
4) Verma, A. K. (2017). Research methodology in Indian music: A step by step guide for beginners.
5) Flick, U. (2015). Introducing research methodology: A beginner's guide to doing a research project. London: Sage Publications.
6) Kapoor, D. R., &Saigal, P. (2013). Research methodology: Methods and techniques. New Delhi: Regal Publications.
7) Llewelyn, D., Aplin, T. F., & Cornish, W. R. (2019). Intellectual property: Patents, copyright, trade marks and allied rights.
8) India., & National Science & Technology Management Information System (India). (1998). Funding pattern of sponsored research by scientific agencies, 1990-91 to 1994-95. New Delhi: Ministry of Science and Technology, Dept. of Science and Technology, Govt. of India.

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