Appendix I: Semester I

Scheme of Teaching and Examination under credit based semester pattern for M. Sc.

Forensic Science Course

S.No.	Paper	Subject	Credits	Teaching Scheme				Examination Scheme							
								Theory						Practical	
				Theory + Tutorial (Periods)	Practical (Periods)	Total Periods	Duration Hours	Max Marks Theory Paper	Max Marks Internal	Total Marks	Minimum Passing Marks	Duration Hours	Max Marks Practical	Total Marks	Minimum Passing Marks
1.	$1T_1$	Criminalistics	4	3	2	5	3	60	15	75	30	4	25	25	10
2.	$1T_2$	Advanced Forensic Science	4	3	2	5	3	60	15	75	30	4	25	25	10
3.	$1T_3$	Forensic Biology and Serology	4	3	2	5	3	60	15	75	30	4	25	25	10
4.	$1T_4$	Forensic Chemistry and Toxicology	4	3	2	5	3	60	15	75	30	4	25	25	10
5.	$1T_5$	Forensic Physics and Ballistics	4	3	2	5	3	60	15	75	30	4	25	25	10
6.	$1T_6$	Digital and Cyber Forensic	4	3	2	5	3	60	15	75	30	4	25	25	10
7.	$1T_7$	Forensic and Correctional Psychology	4	3	2	5	3	60	15	75	30	4	25	25	10
8.	$1T_8$	Communication and scientific report writing	4	3	2	5	3	60	15	75	30	4	25	25	10
9.		Seminar	1			2	2						25	25	10
			33	24	16	42		480	120	600	240		225	225	90
Grand Total of Semester I: 825															

Appendix I: Semester II

Scheme of Teaching and Examination under choice based credit based semester pattern for M. Sc.

Forensic Science Course

S.No.	Paper	Subject	Credits	Teaching Scheme					Examination Scheme						
									Theory		Practical				
				Theory + Tutorial (Periods)	Practical (Periods)	Total Periods	Duration Hours	Max Marks Theory Paper	Max Marks Internal	Total Marks	Minimum Passing Marks	Duration Hours	Max Marks Practical	Total Marks	Minimum Passing Marks
1.	$2T_1$	Criminalistics	4	3	2	5	3	60	15	75	30	4	25	25	10
2.	$2T_2$	Advanced Forensic Science	4	3	2	5	3	60	15	75	30	4	25	25	10
3.	$2T_3$	Forensic Biology and Serology	4	3	2	5	3	60	15	75	30	4	25	25	10
4.	$2T_4$	Forensic Chemistry and Toxicology	4	3	2	5	3	60	15	75	30	4	25	25	10
5.	$2T_5$	Forensic Physics and Ballistics	4	3	2	5	3	60	15	75	30	4	25	25	10
6.	$2T_6$	Digital and Cyber Forensic	4	3	2	5	3	60	15	75	30	4	25	25	10
7.	$2T_7$	Forensic and Correctional Psychology	4	3	2	5	3	60	15	75	30	4	25	25	10
8.	$2T_8$	Communication and scientific report writing	4	3	2	5	3	60	15	75	30	4	25	25	10
9.		Seminar	1			2	2						25	25	10
			33	24	16	42		480	120	600	240		225	225	90
Grand Total of Semester I: 825															

Appendix I: Semester III
Scheme of Teaching and Examination under choice based credit based semester pattern for M.Sc.
Forensic Science Course

S.No.	Paper	Subject	Credits	Teaching Scheme				Examination Scheme							
								Theory				Practical			
				Theory + Tutorial (Periods)	Practical (Periods)	Total Periods	Duration Hours	Max Marks Theory Paper	Max Marks Internal	Total Marks	Minimum Passing Marks	Duration Hours	Max Marks Practical	Total Marks	Minimum Passing Marks
	3T1	*Foundation Course/Swayam module	4	4		4	3	80	20	100	40				
	3T2	Criminology and Forensic Law	4	4		4	3	80	20	100	40				
	3T3-SI	**Special I**													
	3T3-SI-1	Questioned Document Analysis-I	16	4		4	3	80	20	100	40				
	3T3-SI-2	Advanced Fingerprint Development Methods-I		4		4	3	80	20	100	40				
	3T3-SI-3	Forensic Linguistics and Stylistics		4		4	3	80	20	100	40				
	3T3-SI-4	Forensic Photography		4		4	3	80	20	100	40				
	3T4-SII	**Special II**													
	3T4-SII-1	Forensic Biology and Entomology	16	4		4	3	80	20	100	40				
	3T4-SII-2	Forensic Serology		4		4	3	80	20	100	40				
	3T4-SII-3	DNA Fingerprinting		4		4	3	80	20	100	40				
	3T4-SII-4	Forensic pathology and Microbial forensic		4		4	3	80	20	100	40				
	3T5-SIII	**Special III**													
	3T5-SIII-1	Instrumentation	16	4		4	3	80	20	100	40				
	3T5-SIII-2	Advanced Forensic Chemistry		4		4	3	80	20	100	40				
	3T5-SIII-3	Advanced Forensic Toxicology		4		4	3	80	20	100	40				
	3T5-SIII-4	Advanced Chemistry		4		4	3	80	20	100	40				

	3T6-SIV	**Special IV**													
	3T6-SIV-1	File system	16	4		4	3	80	20	100	40				
	3T6-SIV-2	Digital Image Processing		4		4	3	80	20	100	40				
	3T6-SIV-3	Network Forensics		4		4	3	80	20	100	40				
	3T6-SIV-4	Applied Cryptography		4		4	3	80	20	100	40				
	3T7-SV	**Special V**	16												
	3T7-SIV-1	Instrumentation in Forensic Physics		4		4	3	80	20	100	40				
	3T7-SIV-2	Internal Ballistics		4		4	3	80	20	100	40				
	3T7-SIV-3	External Ballistics		4		4	3	80	20	100	40				
	3T7-SIV-4	Terminal Ballistics		4		4	3	80	20	100	40				
	3P3-SI-I	Practical I	4		8							8	100	100	40
	3P3-SI-II	Practical II	4		8							8	100	100	40
	3P4-SII-I	Practical I	4		8							8	100	100	40
	3P4-SII-II	Practical II	4		8							8	100	100	40
	3P5-SIII-I	Practical I	4		8							8	100	100	40
	3P5-SIII-II	Practical II	4		8							8	100	100	40
	3P6-SIV-I	Practical I	4		8							8	100	100	40
	3P6-SIV-II	Practical II	4		8							8	100	100	40
	3P7-SV-I	Practical I	4		8							8	100	100	40
	3P7-SV-II	Practical II	4		8							8	100	100	40
		Seminar	1		2								25	25	10
Total Marks for Each Specialization			33							600				225	
Grand Total of Semester III: 825															

Note: Candidate should select six theory papers and two practicals as per the following scheme:

1) Candidate should choose any Foundation course I (other than his/ her main subject for post graduation) as per Appendix 9 of Direction 10 of 2015 and amended from time to time or one Swayam module prescribed by the University

2) 3T2 is compulsory.

3. There are following five Specializations.

i. **Specialization I: Questioned Documents & Fingerprint**

ii. **Specialization II: Forensic Biology & Serology**

iii. **Specialization III: Forensic Chemistry & Toxicology**

iv. **Specialization-IV: Cyber Security and Cyber Forensic.**

v. Specialization-V: Forensic Physics and ballastics

3. Candidate should select any one group of specializations out of five as above mentioned

4. Candidate should select any two practical related to specializations.

(Annexure-I)

Appendix I: Semester IV

Scheme of Teaching and Examination under credit-based semester pattern for M. Sc. Forensic Science Course

S. No.	Paper	Subject		Teaching Scheme				Examination Scheme							
								Theory					Practical		
				Theory + Tutorial (Periods)	Practical (Periods)	Total Periods	Duration Hours	Max Marks Theory Paper	Max Marks Internal	Total Marks	MinimumPassing Marks	Duration Hours	MaxMarks Practical	Total Marks	Minimum Passing Marks
1	4T1	*FoundationCourse/Swayam module	4	4		4	3	80	20	100	40				
2	4T2	Criminology and Forensic Law	4	4		4	3	80	20	100	40				
3	**4T3-SI**	**Special I**													
	4T3-SI-1	Questioned Document Analysis-II	16	4		4	3	80	20	100	40				
	4T3-SI-2	Advanced Fingerprint Development Methods-II		4		4	3	80	20	100	40				
	4T3-SI-3	Forgery and its Forensic Detection		4		4	3	80	20	100	40				
	4T3-SI-4	Automated Fingerprint Identification System		4		4	3	80	20	100	40				
4	**4T4-SII**	**Special II**	16												
	4T4-SII -1	Forensic Anthropology and Odontology		4		4	3	80	20	100	40				
	4T4-SII -2	Microbial Forensics and Bioinformatics		4		4	3	80	20	100	40				
	4T4-SII -3	DNA Fingerprinting		4		4	3	80	20	100	40				
	4T4-SII -4	Wildlife and Environment Forensics		4		4	3	80	20	100	40				
5	4T5-SIII	**Special III**													
	4T5-SIII-1	Instrumentations	16	4		4	3	80	20	100	40				
	4T5-SIII-2	Advanced Forensic Chemistry		4		4	3	80	20	100	40				
	4T5-SIII-3	Advanced Forensic Toxicology		4		4	3	80	20	100	40				
	4T5-SIII-4	Pharmaceutical and Narcotic Drugs		4		4	3	80	20	100	40				
6	**4T6-SIV**	**Special IV**													
	4T6-SIV-1	Steganography and Watermarking	16	4		4	3	80	20	100	40				
	4T6-SIV-2	Mobile and Smart Phone Forensics		4		4	3	80	20	100	40				
	4T6-SIV-3	Biometrics		4		4	3	80	20	100	40				
	4T6-SIV-4	Malware Forensics		4		4	3	80	20	100	40				
7	**4T7-SV**	**Special V**	16												
	4T7-SV-1	Forensic Physics		4		4	3	80	20	100	40				
	4T7-SV-2	Ballistics Modeling and Analysis		4		4	3	80	20	100	40				
	4T7-SV-3	Weapon Systems and Ballistics Measurements		4		4	3	80	20	100	40				
	4T7-SV-4	Rocket Ballistics		4		4	3	80	20	100	40				
8	4P3-SI-I	Practical I	4		8							8	100	100	40
	4P4-SII-I	Practical I	4		8							8	100	100	40
	4P5-SIII-I	Practical I	4		8							8	100	100	40

	4P6-SIV-I	Practical I	4		8							8	100	100	40
	4P7-SV-I	Practical I	4		8							8	100	100	40
9	**4P8**	**Project work (specialization)**	4										100	100	40
10		Seminar	1		2								25	25	10
Total Marks for Each Specialization										600			225		
Grand Total of Semester IV: 825															

Note: Candidate should select six theory papers, one practical and one project as per the following scheme:
1). Candidate has to select relevant Foundation course II or Swayam module (as opted in Semester III).

2. **4T2 is compulsory.**
3) Selected specialization in SEM III by the candidate will be continued in SEM IV
1. In each semester student will have to give seminar on any topic relevant to the syllabus encompassing the recent trends and development in that field. The topic of the seminar will be decided at the beginning of each semester in consultation with the supervising teachers. The student has to deliver the seminar which will be followed by discussion. The seminar will be open to all the teachers of the department, invitees, and students.

2. The student will have to carry out the research based project work in lieu of practical in the fourth semester in the department or depending on the availability of placement; he/she will be attached to any of the national/regional/private research institute/organization. The student in consultation with supervisor will finalize the topic of the project work at the beginning of the third semester.

3. Each theory paper is supposed to cover minimum 45 clock hours (15 clock hours per unit) of teaching and 360 clock hours in semesters I and II for all the eight papers. Whereas 60 clock hours (15 clock hours per unit) of teaching and 360 clock hours in semesters III and IV for all the Specialization papers

4. One credit course of theory will be of 25 marks.

5. One credit course of practical will consist of laboratory exercise of 25 marks.

6. One credit course of seminar will consist of exercise of 25 marks

Appendix-II

Project Work Scheme

Guidelines for the Students, Supervisors and Examiners

Every student is required to carry out Experimental / Field Based Project Work (this is in lieu of practical II of semester III & IV) on a related research topic of the subject /course. It must be an original work and must indicate some degree of experimental work. On the basis of this work, student must submit the Project Report (typed and properly bound) in two copies at least one month prior to commencement of the final Practical/lab Examination of Semester IV. The project report shall comprise of Introduction, Material and Methods, Results, Discussion, Summary, Conclusions and, References along with the declaration by the candidate that the work is original and not submitted to any University or Organization for award of the degree and certified by the supervisor and forwarded through Head/Course-coordinator/Director of the Department/Centre or the Principal of the College

The supervisors for the Experimental Project Work shall be expert from the relevant subject.

OR

A person selected by duly constituted Selection Committee of R.T.M. Nagpur University, approved by the University and appointed as full time regular teacher at UG level having M.

Appendix I: Semester IV
Scheme of Teaching and Examination under credit based semester pattern for M. Sc. Forensic Science Course

S.No.	Paper	Subject		Teaching Scheme			Examination Scheme								
							Theory						Practical		
				Theory + Tutorial (Periods)	Practical (Periods)	Total Periods	Duration Hours	Max Marks Theory Paper	Max Marks Internal	Total Marks	Minimum Passing Marks	Duration Hours	Max Marks Practical	Total Marks	Minimum Passing Marks
1	4T1	*Foundation Course/Swayam module	4	4		4	3	80	20	100	40				
2	4T2	Criminology and Forensic Law	4	4		4	3	80	20	100	40				
3	**4T3-SI**	**Special I**													
	4T3-SI-1	Questioned Document Analysis-II	16	4		4	3	80	20	100	40				
	4T3-SI-2	Advanced Fingerprint Development Methods-II		4		4	3	80	20	100	40				
	4T3-SI-3	Forgery and its Forensic Detection		4		4	3	80	20	100	40				
	4T3-SI-4	Automated Fingerprint Identification System		4		4	3	80	20	100	40				
4	**4T4-SII**	**Special II**	16												
	4T4-SII -1	Forensic Biology		4		4	3	80	20	100	40				
	4T4-SII -2	Forensic Serology		4		4	3	80	20	100	40				
	4T4-SII -3	DNA Fingerprinting		4		4	3	80	20	100	40				
	4T4-SII -4	Wildlife Forensics		4		4	3	80	20	100	40				
5	4T5-SIII	**Special III**													
	4T5-SIII-1	Forensic Chemistry	16	4		4	3	80	20	100	40				
	4T5-SIII-2	Toxicology		4		4	3	80	20	100	40				
	4T5-SIII-3	Forensic Analysis of Drugs		4		4	3	80	20	100	40				
	4T5-SIII-4	Pharmacology		4		4	3	80	20	100	40				
6	**4T6-SIV**	**Special IV**													
	4T6-SIV-1	Mobile and cyber	16	4		4	3	80	20	100	40				

		forensic														
	4T6-SIV-2	Ethical hacking and recovery Forensic		4		4	3	80	20	100	40					
	4T6-SIV-3	Data Security		4		4	3	80	20	100	40					
	4T6-SIV-4	Biometrics		4		4	3	80	20	100	40					
7	**4T7-SV**	**Special V**	16													
	4T7-SV-1	Forensic Physics		4		4	3	80	20	100	40					
	4T7-SV-2	Ballistics Modeling and Analysis		4		4	3	80	20	100	40					
	4T7-SV-3	Weapon Systems and Ballistics Measurements		4		4	3	80	20	100	40					
	4T7-SV-4	Rocket Ballistics		4		4	3	80	20	100	40					
8	4P3-SI-I	Practical I	4		8							8	100	100	40	
	4P4-SII-I	Practical I	4		8							8	100	100	40	
	4P5-SIII-I	Practical I	4		8							8	100	100	40	
	4P6-SIV-I	Practical I	4		8							8	100	100	40	
	4P7-SV-I	Practical I	4		8							8	100	100	40	
9	4P8	Project work(specialization)	4										100			
10		Seminar	1		2								25	25	10	
Total Marks for Each Specialization										600			225			
Grand Total of Semester IV: 825																

Note: Candidate should select six theory papers, one practical and one project as per the following scheme:

1). Candidate has to select relevant Foundation course II or Swayam module (as opted in Semester III).

2. **4T2 is compulsory.**

3) Selected specialization in SEM III by the candidate will be continued in SEM IV

1. In each semester student will have to give seminar on any topic relevant to the syllabus encompassing the recent trends and development in that field. The topic of the seminar will be decided at the beginning of each semester in consultation with the supervising teachers. The student has to deliver the seminar which will be followed by discussion. The seminar will be open to all the teachers of the department, invitees, and students.

2. The student will have to carry out the research based project work in lieu of practical in the fourth semester in the department or depending on the availability of placement; he/she will be attached to any of the national/regional/private research institute/organization. The student in consultation with supervisor will finalize the topic of the project work at the beginning of the third semester.

3. Each theory paper is supposed to cover minimum 45 clock hours (15 clock hours per unit) of teaching and 360 clock hours in semesters I and II for all the eight papers. Whereas 60 clock hours (15 clock hours per unit) of teaching and 360 clock hours in semesters III and IV for all the Specialization papers

4. One credit course of theory will be of 25 marks.

5. One credit course of practical will consist of laboratory exercise of 25 marks.

6. One credit course of seminar will consist of exercise of 25 marks.

Appendix-II

Project Work Scheme

Guidelines for the Students, Supervisors and Examiners

Every student is required to carry out Experimental / Field Based Project Work (this is in lieu of practical II of semester III & IV) on a related research topic of the subject /course. It must be an original work and must indicate some degree of experimental work. On the basis of this work, student must submit the Project Report (typed and properly bound) in two copies at least one month prior to commencement of the final Practical/lab Examination of Semester IV. The project report shall comprise of Introduction, Material and Methods, Results, Discussion, Summary, Conclusions and, References along with the declaration by the candidate that the work is original and not submitted to any University or Organization for award of the degree and certified by the supervisor and forwarded through Head/Course-coordinator/Director of the Department/Centre or the Principal of the College

The supervisors for the Experimental Project Work shall be expert from the relevant subject.

OR

A person selected by duly constituted Selection Committee of R.T.M. Nagpur University, approved by the University and appointed as full time regular teacher at UG level having M. Phil degree with 10 years teaching experience at UG level, or a person who has Ph.D. Degree, with 5 years teaching experience in relevant subject.

OR

Scientists of National Laboratories/ Regional Research Laboratories who are approved by Dean of their appointments in such facilities by the Union Government / the State Government / Nagpur University / Other Universities recognized by UGC with at least in the Grade Pay of Rs.8000/-.

The topic for the project work will be assigned to the student by supervisor at the beginning of third semester. The topic will be forwarded to the controller of examination by the head of the department. The Project Work will carry total 100 marks out of which weightage of 80 marks will be evaluated by both external and internal examiner in the respective Department / Center / Affiliated College. The examiners will evaluate the Experimental Project Work taking into account the 1) Coverage of subject matter, 2) Arrangement and presentation, 3) References and 4) Critical application and original experimental contribution of the candidate.

For written Project work : 80 Marks

For Viva-Voce : 20 Marks

Total : 100 Marks

M.Sc. Forensic Science I Year

1T1: Criminalistics

Marks: 75 **Lecture: 3 hrs/week**

Unit I:

Basics of Criminalistics: Definition of Criminalistics, Role of Criminalistics in Forensic investigation. Different types of evidences at the crime scene and their Forensic significance. Identification and Importance of Corpus Delicti, Modus operandi, Signature, trophy on the crime scene, admissibility of evidences.

Unit II:

Crime Scene Investigation and Reconstruction: Crime Scene Search methods. Locating, Collection & Preservation of various evidences. Crime Scene Documentation (Sketching, Photography, Videography and Notes-taking). Crime Scene Management: Securing the crime scene, Avoiding contamination & cross contamination, Duties of various officers/experts on the crime scene, Evidence recovery log, Chain of Custody, Forwarding & Authorization letters and documentation. Report writing and Evidence Evaluation, Mobile FSL- Role & Functioning.

Crime Scene Reconstruction: Steps (Recognition of evidence, Documentation of evidence, Collection of evidence, Evaluation of evidence, Hypothesis, Testing, Reconstruction), various crime scenes and scenarios (like Hit and Run, Accidents, Hanging (Suicidal/Homicidal), Ante-Mortem and Post-Mortem drowning, Strangulation, Chocking, Shooting, Burglary, etc.). Digital Aids in Reconstruction (3-D Photography/Videography, Computer aided Reconstruction),

Blood Spatter Analysis: Historical perspective, Introduction, terminologies, biological and physical properties of human blood, droplet dynamics- in-flight and on-impact, directionality, point of convergence and point of origin, Spatter Types, altered bloodstain patterns, Artefactual bloodstain patterns, Documentation, Evaluation & importance of Bloodstain evidences. Precautions to be taken.

Unit III:

Fingerprint: Nature, Location, Classification, Patterns of Fingerprints, Classification of Fingerprints: Henry's Classification, Single Digit Classification, Extended Henry's System, Types of Fingerprints (Latent, Patent and Plastic), Invisible Finger-mark development methods (Powder methods, Fuming methods, Chemical Methods, etc.) Recent techniques (Digital Imaging & Enhancement, Laser & other radiation based

techniques, Preservation and photography of fingerprints on various surfaces. Ridge counting, Ridge tracing, Minutiae Identification & Matching (Manual and Automated: AFIS).

Palm Prints: Nature, Location, Types, Development, Lifting, Evaluation, Analysis, Forensic Significance.

Practical I- Criminalistics

Marks: 25 **Lectures: 2 hrs/week/Batch**

Candidate should complete minimum 80% of the total no. of practical.

1. To do the investigation of a given scene of crime (indoor/outdoor/mobile).
2. To make sketch of a crime scene using baseline method/triangulation method.
3. To reconstruct a given Crime scene (hit and run/burglary/murder, etc.)
4. To collect, preserve, package and forward different evidences recovered from the scene of crime (biological/ physical/chemical).
5. To develop latent fingerprints using powder methods.
6. To develop latent fingerprints using chemical methods.
7. To examine and match the given fingerprints.
8. To develop/lift/collect/evaluate ear prints.
9. To develop/lift/collect/evaluate bite marks on given surface(s).
10. To determine the height of fall/angle of impact/point of origin/area of convergence from the given blood spatter.

M.Sc. Forensic Science I Year

1T2: Advanced Forensic Science

Marks: 75 **Lecture: 3 hrs/week**

Unit I:

Identification of Person: Identity of a person, Methods of personal identification, Post mortem examination, Type of autopsy, objectives and procedure, Virtual autopsy, examination of personal artefacts, examination of tattoos. portrait parley. Exhumation: Forensic perspective and related aspects of exhumation, reasons of exhumation, techniques for detection of buried bodies underground (in mass graves/war crimes, etc.).

Unit II:

Challenges in Fingerprint Examination: Levels of Fingerprint examination, Impression on Blank Paper, Impression taken after death, Drowned person fingerprint, Presentation of fingerprint, Fingerprint jurisprudence. Life of Fingerprints, Fingerprint Expert, Qualification of Fingerprint Expert.

Forensic Auditing: Forensic Accounting, Basics of Forensic accounting, Corporate Fraud, Insurance fraud, Forensic audit and Forensic accounting, skills of a Forensic expert dealing fraud investigation, Steps of fraud investigation. Type of insurance fraud (cheque fraud, insurance claim fraud, bank transaction fraud, fraud in documents, etc.) Investigation of bank insurance fraud, securities fraud, hidden income or assets, insurance fraud and bankruptcy fraud, evaluating frauds, fraud deterrence, money laundering, types of money laundering. Review on famous case studies on corporate fraud, bank frauds, insurance claim fraud, Property dispute fraud.

Unit III:

Research in Forensic Science: Identification and criteria of selecting a research problem on Forensic Science (Hypothesis), Formulation of objectives, research plan, and its components. literature search/review, Sampling- Principles, methods, types of sampling, rationale for using a particular sampling method. Population and sample size, sampling procedures (random and non-random) with terms of research in Forensic Science.

Methods of Research- Survey, experimental, Ex-post facto, case study methods, and content analysis, etc. Tools of Data Collection - Observation, interview schedule, questionnaire, experimental. Review of research paper(s) related to Forensic Science.

Practical II- Advanced Forensic Science

Marks: 25 **Lectures: 2 hrs/week/Batch**

Candidate should complete minimum 80% of the total no. of practical.

1. To study the various methods of Autopsy examination.
2. To develop and examination the fingerprints on various challenging surfaces.
3. To study the level one details of fingerprints.
4. To study the level two details of fingerprints.
5. To study the level three details of fingerprints.
6. To study the alterations in cheque.
7. To review two case studies involving corporate frauds.
8. To examine forged documents.
9. Visit to mortuary.
10. Visit to police station.

M.Sc. Forensic Science I Year

1T3: Forensic Biology & Serology

Marks: 75 **Lecture: 3 hrs/week**

Unit I: Body Fluids: Composition, formation and function. Collection and preservation of biological fluids. Types and distribution of body fluids (semen, synovial fluid, gastrointestinal secretions tears, milk, faeces, saliva, aqueous humour, Vaginal fluid, epithelial cells, etc.)

Unit II: Blood and its variants: Blood composition , Blood group antigens the classification of blood cell antigens, Blood transfusions and the immune, disease diagnosis based on blood examination, Transfusion reactions: Immune-mediated, Transfusion reactions: Non-immune, Haemolytic disease of the new-born(HDN), significance of maternal antibodies, Coombs test, Background information, Basic biochemistry, Molecular information, Forensic significance of ABO blood group , Hh blood group, Rh blood group, Kell blood group, Duffy blood group, Kidd blood group, Diego blood group, MNS blood group, etc.

Unit III: Biological & Serological Evidences

Nature & Type of Biological evidences (Both animal & plant origin), Hairs. Differences between animal and human hair, Forensic examination of different types of hair.

Histopathology of various tissues. Various body fluids (Blood, Semen, Saliva, Urine, milk, etc.) their composition & Forensic Importance, origin, grouping, etc.

Different botanical evidences of forensic significance; Leaves, seeds, pollens, Paper and Paper Pulp identification, Microscopic and biochemical examination of pulp material etc. Diatoms: Isolation of diatoms from various body organs, long bones and their forensic significance in drowning cases.

Introduction to DNA profiling, extraction/isolation of DNA from stains, tissues, hair, nails, buccal swabs, blood, semen and other samples. FTA cards for isolation of DNA. DNA typing systems length polymorphisms, short tandem repeats and single nucleotide polymorphisms.

Practicals-III

Serology & Forensic Biology

Marks: 25 **Lectures: 2 hrs/week/Batch**

Candidate should complete minimum 80% of the total no. of practical.

1. Preliminary Examination of saliva, sweat, tear, milk.
2. SAP/VAP electrophoresis.
3. Preliminary and confirmative test of vaginal fluid.
4. Coombs test.
5. Determination of ABO blood group by absorption elution method.
6. Determination of medullary index of hair samples.
7. Microscopic examination of paper pulp.
8. Isolation of diatoms.
9. RFLP.
10. Isolation of DNA from Hairs.
11. Histopathology of tissue.
12. Visit to autopsy center at mortuary, Forensic Science Laboratory, Pathology Laboratory, Veterinary Center, Biodiversity and wildlife Center.

M.Sc. Forensic Science I Year

1T4: Forensic Chemistry and Toxicology

Marks: 75 **Lecture: 3 hrs/week**

Unit I: Methods of Analysis

Introduction, types of cases/ exhibits, preliminary screening, presumptive test (colour and spot test), inorganic analysis, micro-chemical methods of analysis, Examination procedures involving standard methods and instrumental techniques, analysis of beverages: alcoholic and non-alcoholic, country made liquor, illicit liquor and medicinal preparations containing alcohol and drugs as constituents, drugs of abuse: introduction, classification of drugs of abuse, drugs of abuse in sports, narcotics drugs and psychotropic substances, designer drugs and their forensic examination.

Unit II: Forensic Toxicology

Definition, dosage, administration of poisons, Classification of poisons, action of poisons and factors modifying its action. Collection and preservation of toxicological exhibits in fatal and survival cases, signs and symptoms of poisoning, mode of action and its effect on vital functions, medico-legal and post mortem examination report/finding studies, specific analysis plan/ approach to toxicological examination of poisoning samples. The role of drug recognition expert, Drugs of Abuse, Signs and symptoms of addiction, Interpretation of toxicological findings, Functions and roles of toxicologists in a forensic science laboratory

Unit III: Methods of Extraction

Techniques used in toxicology. Extraction, Isolation and clean-up procedures from biological samples: using conventional as well as modern techniques such as solid phase extraction, solid phase micro-extraction techniques, separation of poisons and drugs using chromatographic and electrophoretic techniques, identification and estimation of poisons and drugs using chromatographic and spectrophotometric and other instrumental methods, significance of analytical studies with respect to Forensic examination

Practical-IV Forensic Chemistry and Toxicology

Marks: 25 **Lectures: 2hrs/week/Batch**

Candidate should complete minimum 12 of the total number of practicals.

1. Identification of adulteration in alcoholic liquor.
2. Determination of methanol and ethanol in alcoholic liquors.(Wettest, GC,TLC)
3. Estimation of ethyl alcohol in blood sample by wet test, colour test.
4. Analysis of viscera (simulated sample) for pesticides by TLC. (2)
5. Identification of adulteration of vegetable oils by colour test, GC and HPLC.
6. Systematic analysis of pharmaceutical drugs by using HPLC. (2)
7. Extraction and identification of organic poisons from food sample by colour test, HPLC, IR-spectroscopy. (2)
8. Extraction and identification of inorganic poisons from food sample by colour test, UV-visible spectrophotometry. (2)
9. Extraction and analysis of plant poisons by chromatographic methods. (2)
10. Extraction of poison from biological and non-biological sample by solvent extraction method. (2)
11. Extraction, Isolation and clean-up procedures for poisons from biological samples. (2)
12. Report submission on industrial or laboratory visit.

M.Sc. Forensic Science I Year

1T5: Forensic Physics and Ballistics

Marks: 75 **Lecture: 3 hrs/week**

Unit I:

Fibers: Types of fibres (Natural, Artificial), forensic aspects of fibre examination fluorescent, optical properties, refractive index, birefringence, dye analysis etc. Identification and comparison of man-made and natural fibre.

Paints: Types of paints- (Household, Automotive, etc.), Binders and their composition, layers, macroscopic and microscopic examination, pigment distribution, micro-chemical analysis- solubility test, pyrolysis chromatographic techniques, TLC, colorimetry, IR spectroscopy and X- ray diffraction, elemental analysis, interpretation of paint evidence. Matching of layers, obtaining physical fit, Side-by-side comparison, Evaluation of uniqueness. Case Studies (Burglary, Hit and Run, Accidents, etc.)

Unit II:

Soil: Formation and types of soil, composition and colour of soil, particle size distribution, turbidity test, microscopic examination, density gradient analysis, ignition loss, elemental analysis, interpretation of soil evidence, Discussion on important case studies of glass & soil. Geo-forensics as an important tool in Forensic Investigations.

Glass: Types of glass and their composition, Forensic examination of glass fractures under

different conditions, determination of direction of impact: cone fracture, rib marks, hackle marks, backward fragmentation, colour and fluorescence, physical matching, density comparison, physical measurements, refractive index by refractometer, elemental analysis, interpretation of glass evidence. 3-R rule, Sequence of shot determination.

Unit III:

Other Physical Evidences- Forensic Examination of cables, cut wires, locks, keys, real and imitation, jewellery, Ropes, ligature, tungsten filaments, seals (postal, metallic), fuse, fuse wire, stone, brick, debris, construction materials, iron rods, cloth pieces, knot examination, duplicate labels-container identification. Principles & Techniques: specific gravity, density, refractive index, microscopic examination, physical matching, mechanical fit, elemental analysis, etc.

Practical-V Forensic Physics and Ballistics

Marks: 25 **Lectures: 2hrs/week/Batch**

Candidate should complete minimum 12 of the total number of practicals

Candidate should complete minimum 80% of the total no. of practical.

1. Examination and analysis of paint chips collected from hit and run cases.
2. Examination and analysis of glass pieces collected from hit and run cases.
3. Comparison of head light glass and automobile window glass.
4. Examination of vehicle identification numbers.
5. Examination of soil sample.(chemical and microscopic)
6. Analysis of dyes.
7. To determine particle size of Evidence
8. To determine density and density gradient of Soil

M.Sc. Forensic Science I Year

1T6: Digital & Cyber Forensics

Marks: 75 **Lecture: 3 hrs/week**

Unit I:

Recent amendments in IT Act, internet & web technologies, web hosting and development, attributes in cyberspace and legal framework of cyberspace, hacking, virus, obscenity, pornography, programme manipulation, Copyright, Patent, software piracy, intellectual property rights, trademark, domain disputes, and computer security, etc., Encryption and Decryption methods. Search and seizures of evidence. Investigation of cyber crimes and tools for analysis.

Unit II: Information security: Domains, Common Attacks, Impact of Security Breaches. Protecting Critical Systems (Information Risk Management, Risk Analysis etc) Information Security in Depth Physical security (Data security Systems and network security)

Program Security: Secure programs, Non-malicious program errors, Viruses and other malicious code, Targeted malicious code, Controls against program threats File protection mechanism, Authentication: Authentication basics, Password, Challenge-response, Biometrics.

Unit III:

Database Security: Introduction to Database, Basics of SQL, Security requirements, Reliability and integrity, Sensitive data, Interface, Multilevel database, Proposals for multilevel security **Network Security:** Threats in networks, Network security control, Firewalls, Intrusion detection systems, Secure e-mail, Networks and cryptography, Example protocols: PEM, SSL, IPsec. Principles of network forensics, Attack Traceback and attributes, Critical Needs Analysis. **IDS:** Network based Intrusion Detection and Prevention Systems, Host based Intrusion Previnsion System. Cloud Computing-Its Forensic and Security Aspects.

Practical-VI Digital & Cyber Forensics

Marks: 25 **Lectures: 2hrs/week/Batch**

Candidate should complete minimum 80% of the total number of practicals

1. C Program about data input and output.
2. C Program about conditional statements.
3. Understanding looping statements of C Program.
4. Understanding of Array of C Program.
5. Understanding function of C Program.
6. Structure of HTML: Creating webpage using Structure of HTML.
7. Understanding dynamic and static pages, Viewing HTML Source and HTTP Headers, Understanding Header Information.

M.Sc. Forensic Science I Year

1T7: Forensic & Correctional Psychology

Marks: 75 **Lecture: 3 hrs/week**

Unit I:

Forensic Psychology: Historical perspective, scenario in India, functions and role of forensic psychologist. Assesment ans Evaluation in Forensic Psychology: Forensic Assessment, Tests used in Forensic Psychology Assessment: Intelligence Tests, Achievement and Aptitude Tests, Personality Tests, MMPI Test, Rorschach Test, Thematic Apperception Test, Neuropsychological tests, Mens rea, diminished capacity, competency evaluation, Forensic Behavioral Analysis, Forensic Psychologists as an Expert.

Unit II:

Psychopathology & Abnormal Behaviour, Theories of Offending, Gender & Crime, Ethnicity & Crime. Effect of Media. Terrorism & the related psychological aspects. Psychometric Assessment tools used in Forensic Psychology, Nature of Crime (Organized, Disorganized, Planned, Spontaneous), Crime Scene Analysis, Psychological Autopsy, Stages and Types of Offender Profiling. Behavioural Analysis, Serial Killers, Signature, Modus Operandi. Portrait Parley. Psycholoical profiling of juvenile offenders.

Unit III:

Elements of Forensic Psychiatry**:** Forensic Psychiatry: Introduction to different mental illnesses; neurosis (depression, mood disorder, Insanity, Psychosis, Delusion, delirium, schizophrenia), Impulsive control stress disorder, Anti-social personality disorder, psychopathy, Post traumatic stress disorder and post partum stress disorder. Substance Abuse. Association between mental disorder and crime. Mc Naughten rule, diminshed responsibility, testamentary capacity.

Practical-VII Forensic Psychology

Marks: 25 **Lectures: 2hrs/week/Batch**

Candidate should complete minimum 80% of the total no. of practical.

1. Mental Status Examination. (2)
2. Criminal Behavior Analysis (2)
3. Demonstration/Working of Polygraph: Testing of Individuals.(2)
4. BEOSP: Formulating the Probes.
5. WAIS/WAPIS
6. Assessment of Antisocial Personality Disorder
7. Narco analysis- Demo/working/principle/framing questionnaire

M.Sc. Forensic Science I Year

1T8: Communication Skills & Scientific Report Writing

Marks: 75 **Lecture: 3 hrs/week**

Unit I:

Fundamentals of Communication: Role and purpose of communication: *7 C's of communication*, Barriers to effective communication, Enhancing listening, Forms of Communication: one-to-one, informal and formal. **Verbal Communication (Written):** Business Letter, Social correspondence, Writing resume and Job applications

Unit II:

Listening skills: Effective Listening: Principles and Barriers, Listening Comprehension on International Standards

Speaking Skills: Pronunciation and Accent, Reading excerpts from news dailies & magazines, Extempore, Conversational English, Effective presentation: Planning, design and layout of presentation, Information Packaging, Audience analysis, Audio visual aids, Speaking with confidence, Case Studies. Business Conversation, Effective Public Speaking, Art of Persuasion

Unit III:

Reading & Writing Skills: Vocabulary: Synonyms, antonyms, diminutives, homonyms, homophones, Idioms & phrases, Foreign words in English

Writing Skills: Mechanics and Semantics of Sentences, Writing effective sentences, Style and Structure, Writing Paragraphs, Précis Writing, Letter writing, Coherence and structure, Essay writing, Inter - office communication: Business Letter; E mails; Netiquette, Intra office communication: Memos, Notices, Circulars, Minutes.

Practical VIII- Communication Skills and Scientific Report Writing

Marks: 25 **Lectures: 2hrs/week/Batch**

Candidate should complete minimum 80% of the total no. of practical.

1. To study the format of Forwarding letter with the help of a case example.
2. To write forwarding letter in case of Murder/Rape/Assault/HBT/Asphyxial death.
3. To write scientific report in case of Murder.
4. To write scientific report in case of Rape.
5. To write scientific report in case of death due to drowning.
6. To write scientific report in case of hit and run.
7. To write scientific report in case of HBT.
8. To study the barriers to effective communication with the help of activities.
9. To speak in Public speaking on topic of relevance.
10. To make an effective Presentation using the various aids.

M.Sc. Forensic Science I Year
2T1: Criminalistics

Marks: 75 **Lecture: 3 hrs/week**

Unit I: Footprints: Casting, Lifting, Evaluation, Analysis and comparison with reference/control sample(s), Gait Pattern Analysis, Forensic Significance Footwear Impressions: Casting, Lifting, Evaluation, Analysis and comparison with reference/control sample(s), Forensic Significance. **Tyre marks & Skid marks:** Casting, Lifting, Evaluation, Speed of the vehicle, Analysis and comparison with reference/control sample(s), Forensic Significance.

Unit II:

Tool marks: Nature, Location, Types of tool marks: compression marks, striated marks, combination of compression and striated marks, repeated marks, class characteristics and individual characteristics, tracing and lifting of marks, Photographic examination of tool marks and cut marks on clothes and walls etc. Development, Lifting, Evaluation, Analysis and comparison (mechanical fit, chemical and stereomicroscopic) with reference/control sample(s), Forensic Significance. **Erased Marks & Serial Number Restoration:** Method of making- cast, punch, engrave; methods of obliteration, method of restoration- etching (different chemicals for different surfaces), magnetic, electrolytic etc., restoration of marks on wood, leather, polymer etc. recording of restored marks.

Lip Prints: Nature, Location, Types, Classification, Development, Lifting, Evaluation, Analysis, Minutiae Identification and comparison with reference/control sample(s), Forensic Significance. **Ear Prints:** Nature, Location, Types, Classification, Development, Lifting, Evaluation, Analysis and comparison with reference/control sample(s), Forensic Significance. **Bite Marks:** Nature, Location, Types, Classification, Development, Lifting, Evaluation, Analysis and comparison with reference/control sample(s), Forensic Significance. Ante mortem and post-mortem bite mark. **Rugoscopy:** Location, Nature, classifications, development of rugae, significance of rugoscopy.

Unit III:

Examination of (questioned) documents: Alterations in document: Addition, deletion, substitution, obliteration in documents, techniques of decipherment of alterations.

Examination of typewritten documents: Types of typewriters, typeface, parts of typewriter, and examination of typewritten document, determination of the author, ageing of document. **Examination of photocopied document:** Type of photocopy machines, parts of photocopy machine, examination of photocopied document.

Practical I: Criminalistics

Marks: 25 **Lectures: 2 hrs/week/Batch**

Candidate should complete minimum 80% of the total no. of practical.

1. To cast/trace/lift/evaluate/analyse tyre marks/skid marks.
2. To study the tools marks on/by different objects under microscope.
3. Serial number restoration on various surfaces using chemical etching method(s).
4. To cast/trace/lift/evaluate/analyse footprints/footwear impressions.
5. To perform the gait pattern analysis on given sample.
6. To lift/classify/evaluate/analyse the given lip print sample.
7. To examine/compare the bite mark on different surfaces.
8. To examine alterations in the given documents.
9. To examine the typewritten documents.
10. To examine the photocopied documents

M.Sc. Forensic Science I Year
2T2: Advanced Forensic Science

Marks: 75 **Lecture: 3 hrs/week**

Unit I:

Advancement in Forensic Science: Smuggling at airport: Various types of smuggling, methods of concealment and their detection, Forensic Radiology, identification of counterfeit goods, crypto currency, block chain.

Lights in Forensic Science: Gamma rays, UV, X-Ray, Visible Rays, IR Rays, Microwaves, Radio waves in Forensic Science, Types of X-Rays, difference between hard and soft x-ray, Forensic application of X-rays, light sources for detection of various evidences (such as latent fingerprint, body fluids, secret writing, hair, fibre, injury, etc

Unit II:

Forensic Journalism: Introduction, History, Need and Scope of Forensic Journalism, Fundamentals of crime reporting, editing, and writing, Forensic journalism in criminal cases, photography in crime investigation. Role of journalism in Police investigation. Case studies for importance of role of Forensic journalism. Role of Media on the outcome of cases. Media trial, branding/labelling of the suspects/victims/accused, effect on the society.

Statistics in the field of Forensic Science: Introduction to Statistics in the Field of Forensic Science, Descriptive Statistics; Measures of Central Tendency; measures of dispersion, Mean and standard deviation: Distribution of random errors, reliability of results, tests of significance, confidence interval, the value of statistics in forensic science. Correlation- Methods, Types; Tests of Significance. Parametric and non-parametric statistics; level of significance (Chi-square, t-test), the various non-parametric tests, ANOVA. Regression Analysis. Introduction to probability theory and distributions with reference to studies in the field of Forensic Science

Unit III:

Forensic Security: Preventive Forensics and their aids, safety gadgets, alarm systems, surveillance systems, Fire precautions, Fire audit, safety of buildings. Need and Scope of internal security of India, Defence against internal and external threats. Surveillance and counter surveillance, honey traps, Ports security.

Practical II- Advanced Forensic Science Practical

Marks: 25 **Lectures: 2 hrs/week/Batch**

Candidate should complete minimum 80% of the total no. of practical.

1. To identify/examine counterfeit goods.
2. To identify/examine counterfeit currency notes.
3. To examine various forensic evidences under UV lights.
4. To examine various forensic evidences under Visible lights/Transmitted light.
5. To write a ‘crime report’/‘incidence report’ of a given case.
6. To study the application of statistics in forensic science case work/research work.
7. To perform the descriptive analysis on the given data.
8. To perform chi- square test on the given data.
9. To perform the ANOVA test on the given data.
10. To study the surveillance system/alarm system/fire safety measures in a building.

M.Sc. Forensic Science I Year
2T3: Paper XI- Forensic Biology & Serology

Marks: 75 **Lecture: 3 hrs/week**

Unit I: Concepts of Metabolism:

Concept of catabolism and anabolism: metabolic strategies, organization, clustering of enzymes.Regulation of Metabolic Pathways: energy charge, phosphorylation potential, etc. **Carbohydrate metabolism:** Glycolysis, glycogenolysis, gluconeogenesis, pentose phosphate pathway, glucoronic acid pathway. Dark reactions of Photosynthesis: CO2 fixation: C3, C4 and CAM pathways. Cyclic overview and reactions. Metabolic sources of acetyl CoA. Regulation and amphibolic nature of the cycle. Glyoxylate cycle.

Lipid metabolism:

significance of ketone bodies, Biosynthesis of palmitate and its regulation. Mitochondrial and microsomal pathways of chain elongation, long term dietary changes and enzyme level. Metabolism of chloesterol: Biosynthesis of cholesterol and its regulation, lipoproteinmetabolism, chylomicrons, LDL, HDL, VLDHL. Transamination, deamination, Fate of amino acid skeleton, urea cycle, precursors for compounds other than proteins.

Unit II: Eukaryotic Genome: Structure of chromatin, chromosome, centromere, telomere, nucleosome, genome organization, chromatin remodeling; types of histones, histone modifications-methylation, acetylation, phosphorylation and its effect on structure and function of chromatin, DNA methylation, repetitive and non-repetitive DNA sequence, Law of DNA constancy, C value paradox and genome size, Karyotype and ideogram, chromosome banding pattern.

Chromosomal Basis of Inheritance: sex chromosomes, sex linkage, Chromosomal

Variations/Aberrations, non-disjunction of X chromosomes, genotypic sex determination, and genetic sex determination, X linked recessive inheritance, X-linked Dominant inheritance, Y- linked inheritance, and chromosomal disorders associated with crime. Human Genome Project (HGP)- Scope, Forensic Significance & ethical issues.

Unit III: Antigen-Antibody interactions: Antigen-antibody interactions; Major Histo- compatibility complex and MHC restriction, structure and functions; B-cell receptor and T-cell receptor, generation of diversity; Complement system; Transplantation, graft vs host reaction, mixed lymphocyte reaction; Cytokines ,

Hypersensitivity, immunity to microbes (protozoa, bacteria, fungi, intracellular parasites, helminthes & viruses); AIDS and other immune- deficiencies. Hybridoma technology and monoclonal antibodies; Vaccine: natural, synthetic & genetic, problem and prospect associated with development of vaccine for diseases like AIDS, Cancer and Malaria. Immunodiagnostics and immunotherapy in virology, immunoelectrophoresis.

Practicals-III

Forensic Biology &Immunology

Marks: 25 **Lectures: 2 hrs/week/Batch**

Candidate should complete minimum 80% of the total no. of practical.

1. Thin layer Chromatography of lipids
2. Determination of acid value of fats
3. Estimation of blood cholesterol
4. Determination of Iodine number of fat
5. Determination of melting curve of DNA
6. Isolation of genomic DNA from eukaryotic tissue
7. Immuno-electrophoresis
8. Detection AIDS by ELISA
9. Immunodiffusion
10. Precipitation reaction of antigen and antibodies
11. Determination of Barr body from saliva and blood.

M.Sc. Forensic Science I Year
2T4: Paper XI- Forensic Chemistry and Toxicology

Marks: 75 **Lecture: 3 hrs/ week**

Unit I: Arson

Fire, chemistry and physics of fire, fire behaviour, fire triangle, types of fire, modes of production of fire, Room fire sequence, direction of fire, incendiary devices, fire extinguishers, Analysis of fire/arson crime scene, establishing the origin of fire, patterns and surface effects of char, Accidental fire causes, management of evidences on a fire/ arson crime scene.

Unit II: Explosives

Nature, Classification, Composition and characteristics of Explosive, pyrotechnics, IEDs, Commonly used Explosive devices, Explosion process and effects, types of hazard, effect of blast-wave on structures, humans, etc. Crime scene management in explosive cases, post-blast residue collection, Reconstruction of sequence of events, Evaluation and assessment of scene of explosion, systematic examination of explosives and explosion residues in the laboratory using chemical and instrumental techniques in the laboratory and interpretation of results.

Unit III: Other Chemical Evidences

Food and food products, cement, petroleum products, pharmaceutical drugs, beverages, dyes, paints, fibres and ink as chemical evidences found at crime scene, their collection, preservation and analysis, interpretation of findings.

Practicals-IV

Forensic Chemistry and Toxicology

Marks: 25 **Lectures: 2 hrs/week/Batch**

Candidate should complete minimum 80% of the total no. of practical.

1. Identification of adulteration in non-alcoholic beverages.
2. Identification of adulteration in petroleum product. (2)
3. Identification of adulteration of food products by colour test, GC and HPLC.
4. Systematic analysis of pharmaceutical drugs by using HPLC. (2)
5. Collection and analysis of explosion residues by chemical methods. (2)
6. Analysis of explosion residues by HPLC, TLC, GC, FT-IR. (2)
7. Collection and analysis of fire/ arson residues by chemical methods. (2)

8. Analysis of fire/ arson samples by GC, TLC.
9. Analysis of pesticides by colour test and instrumental technique. (2)
10. Analysis of chemicals involved in trap cases by TLC, HPLC. (2)
11. Identification of adulteration in cement samples.
12. Report submission on industrial or laboratory visit.

M.Sc. Forensic Science I Year
2T5: Paper XI- Forensic Physics and Ballistics

Marks: 75 **Lecture: 3 hrs/ week**

Unit I:

Forensic Ballistics-I : Ballistics- Definition, Types, Internal, External & Terminal Ballistics. History, background and Introduction of firearms; their classification, characteristics and their parts. Ammunition, types of ammunition, various components of ammunitions. Firing mechanism, smooth bore and rifling characteristics, identification of origin, improvised / country- made / imitative firearm and their constructional features.

Unit II:

Forensic Ballistics-II: Principles and practice of identification of firearms, ammunition and their components, different types of marks produced during firing process on cartridge-firing pin marks, breech face marks, chamber marks, extractor and ejector marks and on bullet- number/direction of lands and grooves, striation marks on lands and grooves, identification of various parts of firearms, techniques for obtaining test material from various types of weapons and their linkage with fired ammunition, class and individual characteristics, and GSR distribution. IBIS.

Unit III:

Wound Ballistics- understanding the nature, types and formation of wounds/injuries due to projectiles in shooting and bomb blast cases, determination of range of fire- burning, scorching, blackening, tattooing and metal fouling, shots dispersion, Injuries by shotgun, revlolver, pistol, rifles, etc., Wounding power of bullets, Interpretation of medicolegal report. Ricochet, yawing, cavity formation inside the body (temporary & permanent). Differences in Entry and Exit Wounds, etc. Contact wounds, Near contact wound, close range, abrasion collar.

Practicals-V

Forensic Physics and Ballistics

Marks: 25 **Lectures: 2 hrs/week/Batch**

Candidate should complete minimum 80% of the total no. of practical

1. Characteristics of Firearms Calibre, Choke, Trigger pull, Proof marks etc.

2. Examination and Comparison of fired bullets Calibre, rifling characteristics, probable type of firearms

3. Examination and Comparison of fired Cartridges/cases (Calibre, firing pin, breech face, Extractor /Ejector marks etc.)

4. Determination of shot number from size and weight of shots.

5. Examination of air guns / rifles as per Arms Act 1959.

6. Accident reconstruction sample calculations.

7. Velocity estimation from skid marks.

8. Restoration of erased / obliterated marks

M.Sc. Forensic Science I Year

2T6: Digital & Cyber Forensics

Marks: 75 **Lecture: 3 hrs/ week**

UNIT I: Investigating Windows Systems

1. Where Evidence Resides on Windows Systems
2. Conducting a Windows Investigation
1. Reviewing All Pertinent Logs
2. Performing Keyword Searches
3. Reviewing Relevant Files
4. Identifying Unauthorized User Accounts or Groups
5. Identifying Rogue Processes
6. Looking for Unusual or Hidden Files
7. Checking for Unauthorized Access Points
8. Examining Jobs Run by the Scheduler Service
9. Analyzing Trust Relationships
10. Reviewing Security Identifiers (SIDs)
3. File Auditing and Theft of Information
4. Handling the Departing Employee
1. Reviewing Searches and Files Used
2. Conducting String Searches on Hard Drives

UNIT II: Investigating Unix Systems

1. An Overview of the Steps in a Unix Investigation
2. Reviewing Pertinent Logs
1. Network Logging
2. Host Logging
3. User Activity Logging
3. Performing Keyword Searches
1. String Searches with grep
2. File Searches with find
4. Reviewing Relevant Files
1. Incident Time and Time/Date Stamps
2. Special Files
5. Identifying Unauthorized User Accounts or Groups
1. User Account Investigation
2. Group Account Investigation
6. Identifying Rogue Processes
7. Checking for Unauthorized Access Points
8. Analyzing Trust Relationships
9. Detecting Trojan Loadable Kernel Modules
1. LKMs on Live Systems
2. LKM Elements

3. LKM Detection Utilities

UNIT III:Open source tools for digital forensics and Registry Forensic

Open source, Open source examination platform, preparing the examination system, using LINUX and Windows as host, Study of Sleuth Kit: Installing Sleuth Kit, Sleuth Kit tools (Volume layer tools, File system Layer tools, Data unit Layer tools, Metadata Layer Tools) Registry Analysis, Understanding Windows Registry and Registry Structure.

Practicals-VI

Digital & Cyber Forensics

Marks: 25 **Lectures: 2 hrs/week/Batch**

Candidate should complete minimum 80% of the total no. of practical.

1. Speaker identification and verification using speaker verification tool.
2. Study of wireless devices.
3. Study of wireless networks and wireless network analysis.
4. Working with wireshark for Network analysis.
5. Studying of packets and packet formats.
6. Log Collections and analysis.
7. Network evidence collection offline and online.
8. Advance firewall auditing
9. Auditing with and without network traffic
10. Auditing Authentication, Authorization, accounting and logging configuration
11. Intrusion detection and prevention configuration
12. Implementing Web Data Extractor and Web site watcher

M.Sc. Forensic Science I Year
2T7: Forensic & Correctional Psychology

Marks: 75 **Lecture: 3 hrs/ week**

Unit I:

Interviewing and Interrogation Techniques: Importance of Investigative Interviewing, Influence of Psychology, P.E.A.C.E Model of Interviewing, Cognitive Interviewing, Ethical Interviewing, Other Interview Techniques. Interrogation and the related Techniques, Brain Electrical Oscillation Signature Profiling (BEOS), Voice-Stress Analysis/ Layered Voice Analysis, reliability, Limitations, NHRC Guidelines, Admissibility on the Court, Case Studies.

Unit II:

Polygraph/Lie Detector Test: Objectives, theoretical basis, stages of examination (Pre-test, In- test, post-test), Questioning techniques, Stim test, Limitations, Admissibility in the court of law, NHRC guidelines, case studies, etc.

Brain Fingerprinting/Brain-Mapping: Principle**,** Importance**,** History, process, brain waves (P300, delta, theta, gamma, alpha), reliability, case studies, admissibility, etc..

Narco-analysis: Principle, History, drugs used, procedure, reliability, admissibility, limitations, Indian scenario, case studies, etc.

Unit III

Legal & Correctional Aspects: The mentally ill in court, Competency to stand trial Mental Health Act, 1987: (Object, Relevant Definitions, Central & State authority, Reception Orders, Human Rights of Mentally ill persons, Penalties & Case-Studies), Indian Penal Code, 1860 : Relevant general exceptions. Rehabilitation & Correctional Treatment of Offender(s) / Victim(s), Techniques, Strategies and Types of Treatments.

Practicals-VII

Forensic Psychology

Marks: 25 **Lectures: 2 hrs/week/Batch**

Candidate should complete minimum 80% of the total no. of practical

1. Brain mapping- Demo/working/principle/Interpretation of results
2. NEO-PI
3. Minnesota Multiphasic Personality Inventory-2/A (MMPI-2/A)
4. Rorschach Test
5. Bhatia's Battery for Intelligence
6. Thematic Apperception Test
7. Social intelligence Test
8. Free association test

M.Sc. Forensic Science I Year

2T7: Communication Skills & Scientific Report Writing

Marks: 75 **Lecture: 3 hrs/ week**

Unit I:

Writing Skills: Mechanics and Semantics of Sentences, writing effective sentences, Style and Structure, Writing Paragraphs, Précis Writing, Letter writing, Coherence and structure, Essay writing, Inter - office communication: Business Letter; E mails; Netiquette, Intra – office communication: Memos, Notices, Circulars, Minutes. Social correspondence, Writing resume, CV and Job applications. Writing official letters, Leave Applications.

Research Report Writing: Format of research paper, review paper and report writing, Procedure of Reference Citation; Significance of writing research papers and review articles; Major Scientific publishers; Impact factor and citation index.

Unit II:

Documentary Evidences: Medical certificate, Medical report, Medicolegal certificate, Medicolegal report, Dying declaration, Dying deposition, Birth certificate, Death certificate, etc. Format of documentary evidences. Inquest reports, Risk assessment report.

Accreditation of Forensic Science Laboratory, Effluent treatment, Waste management, environment safety issues and standards.

Unit III:

Report Interpretation Challenges in Forensic Science Investigation: Interpretation of Audit report, Types of fraud in competitive examinations, Examination of documents of identification and other relevant documents (admit card, marksheet, application form for competitive examination, OMR sheet, age verification), Case Discussion on important and widespread cases like VYAPAM scam, Telgi Scam, City Bank Scam, Teacher recruitment scam Haryana, etc.

Unit IV:

Workplace Speaking: Types of Interview, Styles of Interview, Facing Interviews- Fundamentals and Practice Session, Conducting Interviews- Fundamentals and Practice Session, Question Answer on Various Dimensions Work Place Speaking: Team Briefing, Conflict Management, Negotiations, Participation in Meetings, Keynote Speeches.

Ethics and scientific conduct: Ethics in human and animal studies, governing agencies and bodies; Intellectual Property right and Plagiarism; Patents, Filing of patent-procedure and documentation, etc.

Practicals-VII

Communication Skills and Scientific Report Writing

Marks: 25 **Lectures: 2 hrs/week/Batch**

Candidate should complete minimum 80% of the total no. of practical

1. To write an application for the given post/designation in an organisation.
2. To summarise the given essay/forensic report.
3. To make the Curriculum Vitae/Resume/Bio-data in the given format.
4. To study the Post-mortem examination report.
5. To examine the given documents in case of fraud. (OMR sheet/Attendance sheet/admit card)
6. To study the various methods of forensic age estimation/age verification in the living.
7. To study the different styles of Interview.
8. To use the various tools/plagiarism checking software.
9. To study the process of 'Patent Filing' in India.
10. To study the forensic aspects of relevant popular cases (Telgi Scam/Citi Bank Fraud) involving fraud.

M.Sc. Forensic Science II Year

4T2: Criminology and Forensic Law

Marks: 100 **Lecture: 4 hrs/week**

Unit I: Criminal Law- II

Offences Relating to Coin and Government Stamps (Section 230-263A)
Offences affecting public health and safety(section 268-279)
Offences Relating to Forgery (Section 463- 477A)
Changes introduced in Indian Penal Code, 1860, Code of criminal procedure and Indian Evidence Act,1872 by Information Technology Act, 2000;

Unit II: Environmental Legislation

Constitutional Provisions for Environment protection in India;
Indian Forest Act, 1927
Environmental Protection Act, 1986;
Water (Prevention and Control of Pollution) Act, 1974;
Air (Prevention and Control of Pollution) Act,1981;
Wildlife Protection Act, 1972;
Hazardous Waste Management and Handling Rules,2008;
Biomedical Waste Management and Handling Rules, 2016;
Environmental Impact Assessment;
Supreme Court on Environmental protection.

Unit III: Special law- II

Provisions under Constitution of India (Articles 14, 15, 20, 21, 22, 51A);
Small Coins (Offences) Act, 1971;
Explosive substances Act, 1908;
The Arms Act, 1959;
The Food Safety and Standards Act, 2006 (Preliminary, Food safety and Standard Authority of India, General principles of Food safety, General provisions as to articles of food, Analysis of Food, Enforcement provisions, Offences and Penalties)
Intellectual property rights in cyberspace- (Copyright issues in cyberspace, Trademark issues in cyberspace, Computer software and related IPR Issues)

Unit IV: Rules of Admissibility of Forensic Evidence-II

Scientific evidence and Principles of General Acceptance;
Federal Rules of Evidence;
Admissibility of Fingerprint Evidence, Handwriting Evidence, Digital evidence etc.;
Ethical expectations from Expert witness;
Constitutional Validity of DNA fingerprinting, Narco-analysis test and Polygraph test;
Supreme Court on Admissibility of Expert Evidence.

M.Sc. Forensic Science II Year

4T3 SI-1: Questioned Document Analysis– I

Marks: 80 **Lecture: 4 hrs/week**

Unit I Forensic Accounting: What is Forensic Accounting, Mindset of the Forensic Accountant, Forensic Accounting Services, Investigative Services, Fraud Detection, Fraud examination, Fraud deterrence, Litigation Services, Expert Witness Service, Consulting Services, Forensic accountant vs Transactional accountant and auditors, Forensic Accounting Skills- Critical Thinking, Reasoning, Communication.
Fraud and White-Collar Crime, Types of white-collar crime, victim of white-collar crime, Fraud theory: Fraud Triangle, Fraud Diamond, conducting a fraud investigation, Gathering evidence- Interviews and Observations. Calculus of Fraud, Organizational Misconduct,Risk assessment.

Unit II: Financial Crimes: Characteristics of Financial Crimes, Spending, Saving, The structure, Conspiracy, categories of theft, Burglary, Larceny, Robbery, Embezzlement, Swindle, Schemes, Paper Liabilities trail, check registers, stocks and Bonds, Real property, Vehicle, other assets, jewelry, Furs and Clothing, Antiques, Philately, Numismatic, Artwork.

Unit III: Collection and Preservation of Evidences: Interviewing, gathering documentary evidences, Materiality, Competency, gathering evidence through observation, surveillance, Moving surveillance, Electronic surveillance and monitoring, Telephonic Intercepts, Undercover operation and boy wires.

Unit IV: Scope and Limitations of Document Examination: Handwriting examination, Imprint examination, Reprographic examination, dating examination etc. Problems faced during examination of questioned document. Implications of Frye and Daubert Standards in case works.
Graphology:Definition, History of Graphology, Characteristics of handwriting, Emotions and feeling, loops, Envelopes, graphomania, Signature, Position on the page, doodles, numbers, etc.

M.Sc. Forensic Science II Year

4T3 SI-2: Advanced Fingerprint Development Method-I

Marks: 80 **Lecture: 4 hrs/week**

Unit- I Metal Deposition Methods: Silver nitrate, Physical developer- Chemistry and mechanism, Sequencing, regent reliability test, bleach toning, potassium iodide toning, other toning process. Single Metal Deposition, Multi-metal deposition- I, II, III, IV, fluorescent and vacuum metal deposition-reaction mechanism, conventional gold zinc process, sequencing. Lipid Reagent: Sudan black, chemistry and mechanism of Oil red O, nile red, Europian chelate, etc.

Unit-II Nanotechnology in Fingerprints: Introduction, Structure and properties of nanoparticles, Role of nanotechnology in Forensics, role of nanotechnology in fingerprint development, stability of nanoparticles in solution: Van der Waals interactions, electrostatic repulsion, Steric Hindrance, Optical properties, Types of nanoparticles,Visualizing Fingermarks using nanoparticles, Future Perspectives.

Unit III:.Advanced Methods: Radioactive technique, Biological technique, reflected ultraviolet Imaging system, X-ray fluorescence, Chemical imaging. Challenging surface: Thermal Surface- Solvent treatment, amino acid/Protein reagent, Fuming method. Metallic reagent- Gun bleaching method, Oxidation reduction method, Electrochemical/corrosion method, Fuming method. Gloves- Deposition and development latent print on gloves. Adhesive tape-Tape separation method, processing the adhesive and non adhesive side of tape. Skin- Iodine silver plate transfer, Electronography, Powder method, Iodine-Napthoflavone, Direct lifting method.

Unit-IV: Enhancement Techniques for Fingerprints in Blood: Introduction, Development of techniques for proof and enhancement of blood, Heme Techniques, Protein staining blood enhancement techniques, Powder suspension techniques, amino acid techniques, Spectrophotometric and spectrofluorimetric methods, Application of enhancement techniques, Aging of bloodstains, Sequencing of techniques to maximize enhancement and number of fingerprints.

M.Sc. Forensic Science II Year

4T3 SI-3: Forgery and Its Forensic Detection

Marks: 80 **Lecture: 4 hrs/week**

Unit I:Forgery: Types of forgery, attributes of assisted hand signatures, disguise, discriminators of device, flag of forgery and characters of genuineness, indicators of illiteracy, sign of senility, symbol of sinistrality, gender discrimination. Physical constraints, Scope of questioned document examination. Anachronistic features and their importance, detection and decipherment of alterations and erasures including additions, over writings, obliterations.

Unit II:Signatures and Handwriting: Examination of signatures – characteristics of genuine & forged signatures, examination of builtup of documents, identification of writer of forged writings/signatures. Importance of tremor in identification of writings and signatures, difference between tremors of fraud and genuine tremors in writings and signatures, hesitations, factors responsible for variations (under threat, while travelling, illness, old age, mental state, etc.)

Unit III:Security Documents: Use of computers in document examination, automated Signature verification system, determination of age of documents- relative and absolute age of documents, case studies. Examination of security documents by VSC including currency notes, Revenue stamps, travel documents - passports, visas, air - tickets, identity cards, lottery tickets, driving license, Bills, educational and financial documents, etc. different types of security features and their examination including watermarks, wire marks, security fibre/threads, Ghost/imitated marks/ security printing, optical variable inks, holograms and all other security features.

Unit IV:Other Documents: Types and working of Photostat machine, fax machine, printers, scanners. Identification & linkage of Photocopies and photocopier, typewriter, fax machine, scanner, Desktop printing including image processing device, their role in counterfeit currency and certificate etc. Holographic mark and their examination, Examination of credit, debit and other plastic cards, examination of photocopies, scanned documents, Fax copies etc., and case studies. Numismatic forgery- Introduction, tool, equipments and other resource, method of forgery- alteration, tooling, embossing, application and plating, Casting: Rubber mold model, wax model from mold, Burn out wax, treatment of casting, Creating dye- Cutting by hand, plating, casting and hubbing. Explosive impact copying preparation of detail report with reasons and illustrative charts, uses of standard terminology.

M.Sc. Forensic Science II Year

4T3 SI-4: Automated Fingerprint Identification System

Marks: 80 **Lecture: 4 hrs/week**

Unit-I :Fingerprints and AFIS: History of automated identification system: Early print, single database, growth and development of AFIS system, Transmission standard, ANSI standard, compression standard. NCIC classification system, Henry and American classification system, working of AFIS- Database, processing ten print, latent print processing, latent search. Types of AFIS searches: Ten print to Ten print search, Latent to ten print search, Latent to latent search. AFIS report: Ten print report and latent print report.

Unit-II: Automated Fingerprint classification systems: History of pattern recognition-development of fingerprint classification system, forensic fingerprint classification system, Forensic Fingerprint Identification, Diffusion of Fingerprint system, Automation fingerprint system. Mathematical model of fingerprint topology, Fingerprint verification system, Fingerprint representation, Fingerprint matching. Transition of configuration.

Unit-III: Identification of Latent Print: Introduction, recognition and examination, Identification and Individualization by Osborn grid method, Seymour method, Photographic strip method, Polygon method, Overlay method, Osterburg method, microscopic triangulation method, conventional method. Identification protocol and reconstruction of latent print. Fingerprint quality assessment: Introduction, assessing fingerprint quality, non uniform contact, Inconsistent contact, enhancing Fingerprint image by Directional fourier filtering. Advances in Fingerprint sensor using RF Imaging Technique- Introduction, taxonomy of Fingerprint sensing method, Intrinsic advances of Electric sensing, Commercial capacitive sensor implementation, RF Imaging, RF electric field model, Circuit model.

Unit-IV: The Expert Fingerprint Witness: Definition of expert, Qualification, Knowledge- History and classification of fingerprint, latent print procedure. Evidence examination, pretrial conference with prosecuting attorney and defense attorney. Courtroom methodology: Direct examination, Swearing In, assuming the witness stand, courtroom communication, credentials, response to the jury, courtroom courtesy. Verbal and non-verbal Court presentation.

M.Sc. Forensic Science II Year

4T4 SII-1: Forensic Anthropology and Odontology

Marks: 80 **Lecture: 4 hrs/week**

Unit I: Theories for Anthropology: The scope of anthropology (Paleoanthropology, skeletal biology and human osteology, Paleopathology and Bio-archeology, Forensic Anthropology); Fossil formation, taphonomy, Relative dating techniques, Chronometric dating techniques; Bio-cultural and evolutionary approaches to disease, Birth, growth and aging; infectious disease and bio-cultural evolution; Role of anthropology in mass disaster, Physical Anthropology and its forensic aspects.

Unit II: Forensic Anthropology:Bio-archeology- Field recovery methods, Laboratory processing, curation and chain of custody, Age at death, sex, ancestry, height and weight, premortem injury and disease, taphonomy, peri-mortem trauma, post-mortem trauma, DNA Kinship and identity; Identification and forensic Anthropology: Time since death, ante-mortem records and positive ids, facial reconstruction, (Biological anthropology: The natural history of human kind: Craig Stanford, John S Allen and Susan C Anton).

Unit III: Personal Identification of Living & Dead- Identification through somatometric and somatoscopic observation, nails, occupation marks, scars, tattoo marks and deformities, handwriting and mannerisms; Genetic traits of forensic significance: ear lobe, brachydactyly, polydactyly, widow's peak, eye and hair-color, face form, frontal eminences, nasal profile, nasal tip, lips, chin form; Skeletal age (Earlier years): Prenatal ossification, Postnatal appearance and union of centers of ossification, Differences due to race; Skeleton age (Later years): Cranial suture closure, pubic symphysis; Sexing skeletal Remains: General consideration and age factors, Sex differences in skull, Pelvis and long bones. Calculation of stature of long bones: Studies on stature reconstruction in various population groups;Uses of fragmentary long bones in stature reconstruction; Racial differences in human skeleton; distinguishing humans from other nonhuman skeletal remains.

Unit IV: Forensic Odontology: Definition and Scope of Forensic Odontology, Types of dentition, Basic structure of human teeth, types of teeth & their morphology, and determination of age from teeth using various methods, dental anomalies and their role in Personal Identification; Bite marks: Types & forensic importance; Collection and preservation of samples, analysis of Bite marks, presentation of bite mark evidences in court of law; Role of Forensic Odontology in mass disaster victim identification; Dental Charting; Comparison of Ante-mortem and postmortem dental records.

M.Sc. Forensic Science II Year

4T4 SII-2: Microbial Forensics and Bioinformatics

Marks: 80 **Lecture: 4 hrs/week**

Unit I:

Microbes of Forensic Importance: *Bacillus anthracis, Yersinia pestis, Francisellatularensis, Brucella spp., Burkholderiapseudomallei, Clostridium botulinum, Listeriamonocytogenes* and their morphological & biochemical studies;DNA of microbes in soil for crime detection; Fungi of forensic importance: Opportunistic mycoses, *Chytridiomycota zygomycota, Aspergillus fumigates, Microsporidum, Pneumocytosisjiroveci, Asp.flavus& Candida sp*, epidemiology; Antifungal agents; Food borne – *Shigella, Salmonella*,etc.; Forensic Aspects of Biological Toxins; Microbial Forensic Analysis of Trace and Unculturable Specimens etc.

Unit II:

Biological agents in warfare: Collection, transportation and preservation of microbial forensic samples, Categories of biological weapons; study of potential bacteria, fungi, viruses, and their toxins, mode of action, identification, preventive measures during handling; laboratory setup, epidemiologic investigation for public health, investigation of suspicious disease outbreak; Biosafety and biosecurity, Biosurveillance documentation and case studies, Toxin analysis using mass spectrometry, Non-DNA methods for Biological Signatures, Electron beam based methods for bio-forensic investigations, proteomics development and application for bio-forensics, design of genomics, design of nucleic acid signature for pathogen identification and characterization.

Unit III:

Bioinformatics & its Applications: Public domain databases for nucleic acid and protein sequences (EMBL, Gene Bank), database for protein structure (PDB); Bioinformatics methods for microbial detection and forensic diagnostic design: Whole genome analysis, DNA analyses for repeats (Direct and inverted); palindromes, open reading frames, annotations of genes, identification of gene.

Sequence alignment: Concept of local and global sequence alignment, Pairwise sequence alignment, scoring an alignment, substitutional matrices, multiple sequence alignment.

Unit IV:

Bioinformatics & its Applications: Overview of comparative genomics, Computational methods, homology algorithms (BLAST, FASTA) for proteins and nucleic acids,Oligonucleotide probe synthesis, artificial gene synthesis, primer and probe designing, CODIS and NDIS.

Phylogenetic analysis: Basic concept of phylogenetic analysis, rooted/unrooted trees, approaches for phylogenetic tree construction (UPGMA, Neighbor joining, Maximum parsimony, Maximum likelihood).

M.Sc. Forensic Science II Year

4T4 SII-3: DNA Fingerprinting

Marks: 80 **Lecture: 4 hrs/week**

Unit I:

Advanced techniques in DNA profiling: Uni-parentally inherited genetic markers in ethnic and geographical origin detection, DNA Profiling Kits (Easy DNA, Pro-filer, etc.) DNA fingerprinting of degraded samples, next generation sequencing, Drug- DNA interactions, SNP microarray for supplementary paternity testing; mitochondrial DNA analysis, DNA multi-reverse parental analysis, cytochrome b analysis, eDNA Personal Effects and DNA analysis(sources and problems)

Unit II:

DNA Fingerprinting Applications: Case studies in disputed paternity cases, child swapping, missing person's identity, civil immigration, veterinary, wild life and agriculture cases;Legal perspectives– legal standards for admissibility of DNA profiling – procedural & ethical concerns, status of development of DNA profiling in India & abroad; Limitations of DNA profiling; Population databases of DNA markers –STRs, Mini STRs, SNPs, Uses of STR Typing; New & future technologies: Microarrays technology, Synthetic DNA, analysis of Degraded DNA, Low Copy Number DNA, MALDI-ToF, Mass Spectrometry.

Unit III:

Forensic DNA evidence interpretation: Interpretation of DNA typing results-Complicating Factors (Multiple contributors, degradation, and extraneous substances), Systemspecific Interpretational Issues (RFLP, PCR systems); Assessing strength of evidence: Determination of Genetic Concordance, Evaluation of Results, Frequency Estimate Calculations, Population Substructure, Likelihood Ratios, and Uniqueness of DNA Profile; Admissibility standards: Frye, Daubert, and the Federal Rules of Evidence, Landmark cases, The State of Debate; Prosecutor's fallacy, defendant's fallacy; Ethics of DNA analysis and Post-conviction DNA analysis.

Unit IV:

The DNA Databank and Quality Assurance– Premise of a data bank; Elements of a successful databank – legislation, collection of samples, analysis of samples; Transformation of analyzed data into a databaseQuality Assurance– Certification and Accreditation, SWDAM, NRC I and II

M.Sc. Forensic Science II Year

3T4 SII-4: Wildlife and Environmental Forensics

Marks: 80 **Lecture: 4 hrs/week**

Unit I:

Wildlife Forensic: Protected and endangered species of animals and plants; Sanctuaries and their importance; Relevant provision of wild life and environmental act; Types of wildlife crimes, different methods of killing and poaching of wildlife animals; Enforcement of wildlife protection policy, Wild animals as pharmacopeias, Wildlife artifacts(Bones, skin, fur, hair, nails, blood, feather, etc.); Trade in wild animals- elephant, Indian rhino, wild cat, poisonous snakes for venom and skin, crocodiles, salamanders, deer, birds (feathers Macau parakeets, whales, sharks, spectacle bear, Himalayan antelopes.

Unit II:

Wildlife Forensic: Recovering evidence at poaching scenes; Locating the burial: Anomalies on the surface international trade in reptile skins, Challenges to species identification of reptile skin products, species and products represented in the reptile skin trade, reptile scale morphology basics and current limitations, Identifying features of major reptile groups.

Unit III:

Environmental Forensics: Introduction to Environmental Forensics; Mercury- Natural and anthropogenic sources, detecting mercury in indoor environment and forensic aspects; Asbestos-sources and detection in air, water, fibres etc; Sewage, Lead- sources, compounds, analytical methods and lead forensics; Arsenicsources, compounds, analytical methods and forensic aspects; Pesticides- Types, analytical testing and forensic techniques; Polycyclic aromatic hydrocarbons (PAHS)- sources, types and analytical techniques; Crude oil and refined products- oil analysis methods, oil spill analysis protocol.

Unit IV:

Environment and Ecosystems: Ecosystem characteristics structure and function,environmental pollution, xenobiotic and recalcitrance, Introduction to BOD and COD, use of biosensors to determine the quality of environment, Introduction and scope of environmental management, basic concepts of sustainable development, Environmental Impact Assessment (EIA), general guidelines for the preparation of environmental impact statement (EIS), international organization for standardization (ISO), ISO 14000 standards and certification, environmental safety, risk management and emergency preparedness, international summit and treaties, important dates dedicated to environmental management.

M.Sc. Forensic Science II Year

4T4 S III-1: Instrumentation

Marks: 80 **Lecture: 4 hrs/week**

Unit I: Advanced Chromatography – II

Principle, theory, instrumentation and applications of Electrophoresis, Ion-exchange and Size Exclusion (Gel Permeation) Chromatography

Introduction to hyphenated techniques: GC-MS, LC-MS and related hyphenated techniques

Unit II: Atomic Spectroscopy – II

Principle, theory, instrumentation and applications of Inductively Coupled Plasma-Mass Spectrometry, Inductively Coupled Plasma-Optical Emission Spectroscopy, X-ray Fluorescence (XRF) and X-ray diffraction (XRD)

Unit III: Molecular Spectroscopy – II

Mass Spectrometry: Introduction, Review of Mass spectrometry, Basic Principles and Theory, Instrumentations and technique, Ionization methods, Fragmentations in Mass spectrometry, high resolution mass spectrometry

Nuclear Magnetic Resonance Spectroscopy: Introduction, Nuclear Spin States, Resonance, Basic principle, Chemical Shift and Shielding effect, Chemical equivalence, Spin-spin splitting (n+1 Rule), Introduction to ^{13}C NMR, Problem based on ^{1}H and ^{13}C NMR, Use of NMR in Forensic analysis.

Unit IV: Miscellaneous – II

Scanning Electron Microscopy and Transmission Electron Microscopy: Basic theory and principles, instrumentation, forensic applications of SEM, SEM-EDS, TEM and HR-TEM

Isotope dilution analysis: Principle, types of isotope dilution analysis, typical applications of isotope dilution analysis.

M.Sc. Forensic Science II Year

3T4 SIII-2: Advanced Forensic Chemistry

Marks: 80 **Lecture: 4 hrs/week**

Unit I: Dyes andPigments

Dyes: Different types of dyes, role of dyes in crime investigation, food colours (edible and non- edible dyes); dyes used in cosmetic and pharmaceutical products. Chemical and instrumental methods of analysis of dyes; Analysis of trace evidence: cosmetics, dyes, Trap related evidence materials, fibers, oils, fats, grease, chemicals and plant material.

Pigments: Introductions, white pigments, Manufacturing process and properties of blue pigment, red pigment, green pigment, yellow pigment

Unit II: Illicit Drugs

Illicit drug types, search of clandestine laboratory, precursors and their analysis, estimation of morphine in opium and heroin in smack. Analysis of drugs in biological samples and their importance: Urine, blood, viscera, etc. Methods of extraction of drugs, limitations of chemical analysis of drugs, report writing and interpretation of drugs.

Unit III: Fertilizers, Pesticides and Other Chemicals

Introduction to fertilizer, different types of fertilizers and classification, substandard and sub-standard adulterated fertilizers, common adulterants; Chemical and instrumental methods of analysis of fertilizers; forensic analysis of organic and inorganic fertilisers, pesticides, insecticides, metallic and non-metallic products, consumer items such as gold, silver, tobacco, tea, sugars, acids and alkalis etc.

Unit IV: Analysis of Beverages & Prohibited Substances

Introduction of alcohol (ethyl alcohol, methyl alcohol) and illicit liquor, Extraction methods of alcohol (Distillation), Proof spirit, absorption, metabolism, de-toxification and excretion of alcohol, Analysis of alcohol by colour tests, GC,GC-MS, Consequences of drunken driving, breath analysis by Breath Analyzer, Detection of alcohol in blood and urine, Alcohol and prohibition.

Analysis of Beverages: Analysis of alcoholic beverages, Detection and Determination of ethanol, furfural, organic acids, aldehydes, chloral hydrate, methanol and ethylene glycol in liquors by colour tests, GC and GC-MS methods and Case Studies.

M.Sc. Forensic Science II Year

3T4 SIII-3: Advanced Forensic Toxicology

Marks: 80 **Lecture: 4 hrs/week**

Unit I: Food Poisons, Pesticides and Insecticides

Food Poisons: Introduction, Food poisoning due to chemical, bacterial and fungal, Sign and symptoms of food poisoning, collection and preservation of evidence material, extraction and isolation, from food material, Biological material, detection and identification by colour test and instrumental techniques.

Pesticides and insecticides: Classification, nature, fatal dose, fatal period, symptoms, post-mortem findings, medico legal significance and analysis of Organophosphorous, Organochlorine, Carbamate and Pyrethroids insecticides and pesticides.

Unit II: Plant Poisons:

Classification and types (Dhatura, *Abrus precatorious*, *Nerium oleander*, *Calotropis gigantia*, *Gloriosa superba*, Ergot, Mushroom etc.) of Plant Poisons: Nature, extraction from viscera, blood, vomit etc. Fatal dose, fatal period, signs and symptoms, post-mortem findings, detection (preliminary and confirmatory tests) and medico-legal significance

Unit III: Animal Poisons

Classification and types (neurotoxin, myotoxin, cantharides, vasculotoxin, spider, snakes, scorpion, etc.) of Animal Poisons: Nature, extraction from viscera, blood, vomit etc. Fatal dose, fatal period, signs and symptoms, post-mortem findings, detection (preliminary and confirmatory tests) and medico-legal significance

Unit IV: Non-Volatile Organic Poisons:

Classification and types (alkaloids, sedatives, stimulants, hallucinogens, sominiferous, spinal, cardiac etc.): Nature, extraction from viscera, blood, vomit etc. Fatal dose, fatal period, signs and symptoms, post-mortem findings, medico-legal significance and detection (preliminary and confirmatory tests); Asphyxiants (carbonmonoxide, carbondioxide, hyrdrogensulphide, nitrousoxides, war gases, etc)

M.Sc. Forensic Science II Year

4T4 SIII-4: Pharmaceutical and Narcotic Drugs

Marks: 80 **Lecture: 4 hrs/week**

Unit I: Pharmaceutical and crude drugs

Pharmaceutical Drugs:

Antidepressants, antipsychotics, antibiotics, tranquillizers, anti-seizure drugs; Nature, extraction from viscera, blood, vomit, etc; Fatal dose, fatal period, signs and symptoms, post-mortem findings, medico-legal significance and detection (preliminary and confirmatory tests)

Crude Drugs: Definition and aim of Pharmacognosy; drugs from plant, animal and mineral origin, their definition, nomenclature and classification; factors affecting the activity: collection, preservation, storage of crude drugs, toxic effects of crude drugs.

Unit II: Pharmacology

Pharmacokinetics: Active and passive absorption, blood-brain barrier and placental filter. Routes of administration, Drug absorption, distribution, metabolism and elimination; Drug bioavailability, bioequivalence and half-life; Pharmacokinetic parameters evaluation; Time course of drug plasma concentrations after single and repeated administrations by multiple dosage regimens

Pharmacodynamics: Receptor classification, Drug-receptor interactions and signal transduction mechanisms**.** Dose-effect relationships; agonists, partial agonists and antagonists; Factors that modify drug actions; side effects, overdose, idiosyncratic and allergic reactions; teratogenesis and foetal toxicity; Drug interactions and pharmacogenetics

Unit – III: Narcotic Drugs and Other Chemicals

Designer drugs, club drugs, Drugs of abuse in sports: Introduction, common prohibited substances, analytical approach, Solvent Abuse (chlorinated hydrocarbons, Aromatic hydrocarbons, alcohols, glycols, fuel and fuel additives): absorption, distribution, and metabolism, psychological & clinical effects; Collection of sample, extraction and analysis by GC, HPLC

Narcotics Drugs and Psychotropic Substances: Introduction, Cl**a**ssification, Nature, Fatal dose, fatal period, signs and symptoms, post-mortem findings, extraction from viscera, blood, vomit, urine etc. Medico-legal significance of stimulants, hallucinogens, barbiturates, depressants, cannabis, sedatives etc

Unit IV: Analysis of Narcotics Drugs and Psychotropic Substances

Field test, colour test, microcrystal test and TLC analysis of depressants, stimulants, hallucinogens, barbiturates, cannabis, sedatives, etc

HPLC, GC, IR, UV-Visible, mass spectrometric analysis of Opium, Cannabis and their derivatives, depressants, stimulants, hallucinogens, barbiturates, sedatives, etc

M.Sc. Forensic Science II Year

4T6- SIV-1: Steganography and Watermarking

Marks: 80 **Lecture: 4 hrs/week**

UNIT I

Introduction: Information Hiding, Steganography, and Watermarking, Importance of Digital Watermarking, Steganography Applications and Properties: Applications of Watermarking, Applications of Steganography, Properties of Watermarking Systems, Evaluating Watermarking Systems, Properties of Steganographic and Steganalysis Systems, Evaluating and Testing Steganographic Systems

UNIT II :

Models of Watermarking: Communication-Based Models of Watermarking, Geometric Models of Watermarking, Modeling Watermark Detection by Correlation, Basic Message Coding: Mapping Messages into Message Vectors, Error Correction Coding, Detecting Multisymbol Watermarks

UNIT III

Watermarking with Side Information: Informed Embedding, Watermarking Using Side Information, Dirty-Paper Codes Robust Watermarking: Approaches, Robustness to Valumetric Distortions, Robustness to Temporal and Geometric Distortions

UNIT IV :

Watermark Security: Security Requirements, Watermark Security and Cryptography, Some Significant Known Attacks Content Authentication: Exact Authentication, Selective Authentication, Localization, Restoration Steganography: Notation and Terminology, Information-Theoretic Foundations of Steganography, Practical Steganographic Methods, Minimizing the Embedding Impact Steganalysis: Steganalysis Scenarios, Some Significant Steganalysis Algorithms

M.Sc. Forensic Science II Year
4T6- SIV-2: Mobile and Smart Phone Forensics

Marks: 80 **Lecture: 4 hrs/week**

UNIT I : Mobile Forensics
Cell phone and mobile device forensics, Understanding Mobile device forensics, Understanding acquisition procedure, Cell phone Crimes, SIM Architecture, Data Storage, Data Extraction, Files Stored on SIM, Mobile Operating System

UNIT II: Digital Evidence
Mobile Device Forensics • Types of Evidence on Mobile Devices • Handling Mobile Devices as Sources of Evidence • Forensic Preservation of Mobile Devices • Forensic Examination and Analysis of Mobile Devices • Forensic Acquisition and Examination of SIM Cards • Investigative Reconstruction Using Mobile Devices Future trends

UNIT III: Andriod and iOS Systems
Architecture, Differentiation, Technological Composition, Introduction to Andriod Platform, Introduction to iOS Platform

UNIT IV: Mobile File Systems and Data Structures
Introduction, What and How of Data, Types of Memory, File Systems, Rootfs, devpts, sysfs, cgroup, yaffs2, Procedure for handling an Andriod Devices, Logical Techniques VS Digital Techniques, Introduction to Mobile Malware

M.Sc. Forensic Science II Year
4T6- SIV-3: Biometrics

Marks: 80 **Lecture: 4 hrs/week**

Unit I: Biometrics: Introduction, Physiological or Behavioral, Verification Vs Identification, Applications, Biometrics Technologies, Working of Biometrics, Benefits, Application Design. Multi-Modal Biometrics: Introduction to Multi-Modal Biometric Systems, Fusion Methodology, Levels of Fusion, Feature-Extraction Level Fusion, Data-Matching Level Fusion, Probabilistic-Decision level Fusion, Fusion Procedure, Modes of Operation, Integration Strategies, Design Issues, Soft Biometrics, A Biometric Vision.

Unit II: Fingerprint Recognition: What Is Fingerprint Scanning? Practical Applications for Fingerprint Scanning, Accuracy and Integrity, Fingerprint Matching, Fingerprint Classification, Fingerprint Image Enhancement, Fingerprint Feature Extraction, Fingerprint Form Factors, Types of Scanners: Optical - Silicon – Ultrasound, Fingerprint Matching.

Unit III: Speaker Recognition: Algorithms for training, recognition and adaptation to speaker and transmission channel, mainly based on Hidden Markov Models (HMM), methods for reducing the sensitivity to external noise and distortion, acoustic modeling of static and time varying spectral properties of speech, statistic modeling of language in spontaneous speech and written text, specific analysis and decision techniques for speaker recognition.

Unit IV: Face Recognition: Introduction to Face Recognition, How is Face Recognition Technology Currently Being Used? How Well Does Face Recognition Work, Why Face Recognition, Face Recognition: How it Works, Image Quality, Facial Scan Process Flow, Verification vs. Identification, Primary Facial Recognition Technologies, Facial Recognition Applications

M.Sc. Forensic Science II Year

4T6- SIV-4: Malware Forensics

Marks: 80 **Lecture: 4 hrs/week**

Unit I: Introduction to malware analysis

1. What Is Malware?
2. What Is Malware Analysis?
3. Why Malware Analysis?
4. Types Of Malware Analysis
5. Setting Up The Lab Environment

5.1 Lab Requirements
5.2 Overview Of Lab Architecture
5.3 Setting Up And Configuring Linux VM
5.4 Setting Up And Configuring Windows VM

6. Malware Sources
7. Memory Forensic

7.1. Memory Forensics Methodology
7.2. Windows Memory Forensics Tools
7.3. Active, Inactive, and Hidden Processes
7.4. How Windows Memory Forensics Tools Work

Unit II: Malware Incident Response

1. Introduction
2. Building Your Live Response Toolkit
3. Volatile Data Collection Methodology
4. Collecting Process Information
5. Correlate Open Ports with Running Processes and Programs
6. Identifying Services and Drivers
7. Determining Scheduled Tasks
8. Collecting Clipboard Contents
9. Non-Volatile Data Collection from a Live Windows System
10. Forensic Duplication of Storage Media on a Live Windows System
11. Forensic Preservation of Select Data on a Live Windows System
12. Volatile Data Collection Methodology
13. Non-Volatile Data Collection from a Live System

Unit III: Static Analysis of malwares

1. Determining the File Type

1.1. Identifying File Type Using Manual Method
1.2. Identifying File Type Using Tools
1.3. Determining File Type Using Python

2. Fingerprinting the Malware

2.1. Generating Cryptographic Hash Using Tools
2.2. Determining Cryptographic Hash in Python
3. Multiple Anti-Virus Scanning
3.1. Scanning the Suspect Binary with VirusTotal
3.2. Querying Hash Values Using VirusTotal Public API
4. Extracting Strings
4.1. String Extraction Using Tools
4.2. Decoding Obfuscated Strings Using FLOSS
5. Determining File Obfuscation
5.1. Packers and Cryptors
5.2. Detecting File Obfuscation Using Exeinfo PE
6. Inspecting PE Header Information
6.1. Inspecting File Dependencies and Imports
6.2. Inspecting Exports
6.3. Examining PE Section Table And Sections
6.4. Examining the Compilation Timestamp
6.5. Examining PE Resources
6.6. Comparing And Classifying The Malware
6.7. Classifying Malware Using Fuzzy Hashing
6.8. Classifying Malware Using Import Hash
6.9. Classifying Malware Using Section Hash

Unit IV: Dynamic Analysis of Malwares
1. Lab Environment Overview
2. System And Network Monitoring
3. Dynamic Analysis (Monitoring) Tools
3.1 Process Inspection with Process Hacker
3.2 Determining System Interaction with Process Monitor
3.3 Logging System Activities Using Noriben
3.4 Capturing Network Traffic With Wireshark
3.5 Simulating Services with INetSim
4. Dynamic Analysis Steps
5. Putting it All Together: Analyzing a Malware Executable
5.1 Static Analysis of the Sample
5.2 Dynamic Analysis of the Sample
6. Dynamic-Link Library (DLL) Analysis
6.1 Why Attackers Use DLLs
6.2 Analyzing the DLL Using rundll32.exe
6.2.1 Working of rundll32.exe
6.2.2 Launching the DLL Using rundll32.exe
6.3 Analyzing a DLL with Process Checks

M.Sc. Forensic Science II Year
4T7-SV: Specialization V : Forensic Physics and Ballistics
4T7-SV-1 Forensic Physics

Marks: 100 **Lecture: 4 hrs/week**

Unit -I:

Motor Vehicle Crimes: Crimes and vehicles, Road accidents, Theft of Vehicle, Abandoned Vehicles, Vehicle involved in terrorism and Investigation. Evidentiary clues; the vehicle, the scene, the culprit/victim. Collection and Evaluation of; Tyre, tyre marks, tyre residues, tire bursts. Mechanical failure. Crime Scene Management in motor vehicle cases, Forwarding Exhibits in Motor vehicle cases, Important Crime cases, Vehicle involved in Explosion.

Unit -II:

Hit and Run cases and Investigation: Nature and causes, Collection of evidence; paint, automobile window glass, Head light- tail light, scratch marks, bulb filament, fibre and rubber, chassis and engine number, RTO registration number and related documentary clues. Analytical Technique for the analysis of evidence involved in Hit and Run cases; Types of glass and their composition, forensic examination of glass fractures under different conditions, analysis of glass.

Unit -III:

Soil: Physical examinations of soil evidence, Soil mechanics, Structure & Composition, Baking, Compaction and Agro-soil additives, Instrumental analysis of soil, Interpretation of soil evidence, Standard Operating Procedures for examination, Discussion on important case studies of soil evidence.

Paint: Types of paint and their composition, physical examination of paint, instrumental analysis of pigment, interpretation of paint evidence, Standard Operating Procedures for examination, Manufacturing and physical properties of paint. analysis of paint, Raman and IR spectroscopic analysis of Paints. Important case studies of paint evidence.

Unit -IV:

Reconstruction of sequence of events in crimes involving firearms, determination of direction of firing & sequence of shots. Scientific methods of shooting reconstruction, suicide, murder, accident, self-defense and encounter cases. All considerations during direct investigation of shooting incidents without the benefit of original crime scene investigation – the scene of occurrence, medico-legal report, basic ballistic facts, laboratory examination report, firearm and ammunition, clothes of victims, etc. Documentation and evaluation of bullet holes, ricochet marks, pellet pattern in various targets, etc.

M.Sc. Forensic Science II Year
4T7-SV: Specialization V : Forensic Physics and Ballistics

4T7-SV-2 Ballistics Modeling and Analysis

Marks: 100 **Lecture: 4 hrs/week**

Unit-I

Mathematical and Statistical Modeling: System- Model- Classification- Modeling methods-Dimensional analysis-Finite Exploratory data analysis-Goodness of fit – Introduction to Bayesian inference-Bayes estimate and risk-Linear model- Analysis of variance- Describing systems-Dynamic systems- discrete system- system optimization Introduction to system modeling concepts- Gframework for modeling & simulation

Unit-II

Advanced Modeling Techniques: Design of experiments- Model fitting- Missing data analysis- Fuzzy modeling &neural network- Neural network- Reliability and reliability models

Unit -III

Prediction of pressure history and muzzle velocity- Lumped parameter model- gas dynamics model- The mathematical modeling of gun barrel vibration-Validation of computer models.

Unit -IV

Trajectory modeling- The in- vacuo trajectory model- The point-mass model- The modified point- mass model-The six degree- of freedom model.

Fundamental forces in the atmosphere- Basic equations governing the atmospheric circulation-Effect of earth's rotation- Scale analysis and simplification of equations to hydrostatic approximation and geo- strophic approximation- Circulation and vorticity-Numerical model- Weighting factors and differential corrections to trajectories

M.Sc. Forensic Science II Year
4T7-SV: Specialization V : Forensic Physics and Ballistics

4T7-SV-3 Weapon Systems and Ballistics Measurements

Marks: 100 **Lecture: 4 hrs/week**

Unit -I

Ordnance: Classification, small arms, Mortars-Howitzers-Guns, Rocket launchers, Basic components and functional requirements.

Unit -II

Gun Barrel and Tube Launcher: Theory of thin cylinders, use of plastic region of the material and its application to the pre-stressing tube, theory of failure, approximate Mises Hencky criteria, principle of monoblock non-auto-frettaged and auto-frettaged barrels.
Gun Design: Gun design rules, Design of combustion chambers, Rifling profile and stress due to rifling, Gun tube acoustics, Gun erosion

Unit -III

Ordnance: Obturation, Muzzle brake, fume extractor, Firing mechanism, functions and characteristics of saddle, cradle, traversing and elevating gears, balancing gears.
Recoil System: Elements of recoil mechanism, small arms, method of obtaining automatic fire, factors affecting recoil gas system, feed mechanism, trigger mechanism, sights**.**

Unit -IV

Measurement of velocity and trajectory elements: Foil and counter, Optoelectronic means, Doppler RADAR, Telemetry, High speed Photography, Videography, Photogrammetry.
Measurement of Space: Distometer, LASER range finder, Theodolite, Recoil and Run out, Height of burst, Barrel Vibration

M.Sc. Forensic Science II Year
4T7-SV: Specialization V : Forensic Physics and Ballistics

4T7-SV-4 Rocket Ballistics

Marks: 100 **Lecture: 4 hrs/week**

Unit -I

Ballistics of Rockets: Rocket motors and nozzle design- The internal ballistics of motors-Launch dynamics External ballistics of rockets. **Fundamentals of Aerodynamics:** Fundamental physical quantities- Law of conservation- Different types of flows- Aerodynamic forces- Aerofoil and wings- compressible flow-critical Match number- Drag divergence Mach number-shock wave- Expansion fan- Missile body.

Unit -II

Introduction to Missile Propulsion: Definition of thrust and basic principles- Types of propulsion systems- Combustion chambers- Nozzle types- Basic thermodynamics- Rocket performance parameters- solid and liquid rocket system.

Unit -III

Types of Guidance: Principle of beam rider guidance- Homing guidance system and command guidance system, Introduction to IR laws- IR systems- IR homing head, Introduction to INS, SDINS, MFAR, GPS and WAAS.

Unit -IV

Introduction to Missile Control: Task of missile control system- Control methods- aerodynamic control and thrust vector control- Cartesian and polar control- rear control- canard control and moving wing control-Roll control and its necessity- Missile auto pilot.

M.Sc. Forensic Science II Year
4P3-SI : Practical I

Marks: 100 **Duration: 8 hrs/week**

Semester IV
Practical (Questioned Document and Fingerprint)

1. Examination of typescripts/printed matter/ Scanned documents/ fax.
2. Examination of handwriting on unusual surfaces.
3. Examination of handwriting for individualization.
4. Effect of different surfaces on natural variations in handwriting.
5. Working and handling of Video Spectral Comparator.
6. Working and handling of stereo zoom microscope.
7. Examination of security features of currency notes by VSC.
8. Examination of security features of travel documents by VSC.
9. Examination of security features of plastic money by VSC.
10. Determination of sequence of strokes by VSC.
11. Examination of alterations and obliterations by VSC.
12. Graphological Analysis of handwriting.
13. Preparation of Excel sheet for data entry and use of various statistical and graph functions.
14. Examination of mark sheets/cheques/identification cards etc. by VSC.
15. Development of latent prints on challenging surfaces.

M.Sc. Forensic Science II Year
4P8-SI : Project

Marks: 100 **Duration: 8 hrs/week**

Project relevant to specialization

M.Sc. Forensic Science II Year
4P4-SII : Practical I

Marks: 100 **Duration: 8 hrs/week**

(Forensic Anthropology and Odontology, Microbial Forensics and Bioinformatics, DNA Fingerprinting, Wildlife and Environmental Forensics)

Marks: 100 Lectures: 8hrs/week

Candidate should complete minimum 80% of the total no. of practical.

1. Side and site determination from long bones.
2. Stature estimation from bones.
3. Sex determination from various bones.
4. Age determination from bones.
5. Age estimation from teeth.
6. Bite mark analysis.
7. DNA typing technique (RFLP, PCR, etc.)
8. Separation of serum protein by horizontal submerged gel electrophoresis.
9. Separation of sugar, amino acid by TLC
10. To perform Calibration of refrigerator, centrifuge, micropipette, digital balance.
11. To perform primer designing using bioinformatics tools.
12. To perform Homogenization of various forensic sample.
13. To determine paternity index using serum profile.
14. Chromosome staining by Giemsa.
15. DNA extraction from blood/Semen/Saliva/Epithelialcell/Bones/Teeth/nails
16. Western blotting analysis
17. Extraction of mitochondrial DNA from forensic samples
18. Performe a BLAST of given protein / nucleic acid sequence
19. Perform a primer designing by using bioinformatics tools.
20. Visit to autopsy center at mortuary, Forensic Science Laboratory, Pathology Laboratory, Veterinary Center, Biodiversity and wildlife Center.

M.Sc. Forensic Science II Year
4P8-SII : Project

Marks: 100 **Duration: 8 hrs/week**

(Forensic Anthropology and Odontology, Microbial Forensics and Bioinformatics, DNA Fingerprinting, Wildlife and Environmental Forensics)

Dissertation will be compulsory to all students. Students will carry out dissertation work individually or in the group of not more than three students. Concerned department shall provide all required infrastructure to carry out dissertation work. The format for dissertation report will be similar to the research thesis style; incorporating chapters on Introduction, Review of Literature, Materials and Methods, Results and Discussion and References/Bibliography. The dissertation will be submitted in a type written and bound form. Copy of each dissertation will be submitted to the respective department and the centre will store it permanently. Project work on forensically significant and need based problems in the area(s) of Forensic Biology, Serology, Entomology, Forensic Anthropology, Odontology, Microbial Forensics, Bioinformatics, DNA Fingerprinting, Wildlife and Environmental Forensics etc.

M.Sc. Forensic Science II Year
4P5-SIII : Practical I

Marks: 100 **Duration: 8 hrs/week**

(Forensic Chemistry and Toxicology)

Candidate should complete minimum 20 of the total number of practicals.

1. To perform Colour test and UV-Visible Spectrophotometry of pesticide, insecticides. (2)
2. Analysis of dye and pigments by using TLC technique. (2)
3. Analysis of alcohol content in sample by derivatization into known organic compounds and its analysis by GC-MS.
4. Analysis of Mercury in biological materials by Fresenium-Babo method.
5. Analysis of animal Poisons using TLC.
6. Analysis of Plant poisons using TLC. (2)
7. Determination of alcohol in blood and urine sample.
8. Analysis of blood, urine, stomach wash in emergency cases of poisoning.
9. Comparison of fibres by chemical analysis, TLC/ HPTLC/ FTIR. (2)
10. Gas chromatography analysis of Ganja and Charas.
11. Analysis of food material in case of food poisoning by chemical, microscopic and instrumental techniques. (2)
12. Analysis of viscera in case of food poisoning by chemical, microscopic and instrumental techniques. (2)
13. Interpretation of given spectral data of various compounds. (2)
14. Analysis of viscera for volatile Organic and inorganic poisons.
15. Analysis of non- metallic (anionic) poisons in viscera. (2)
16. Analysis of metallic (anionic) poisons in viscera. (2)
17. Analysis of viscera for organochloro, organophosphoro, carbamates and pyrethroids by colour test/ TLC/ HPTLC/ UV-Visible spectrometry method. (2)
18. UV-Visible Spectrophotometric, HPLC and GC-MS analysis of barbiturates.
19. Determination of poisonous metals in biological materials by AAS.
20. Extraction, Systematic identification of Narcotic Drugs and Psychotropic Substances (opiates, cannabis and barbiturates, benzodiazepines and amphetamines) by spot/ colour tests.
21. Analysis of Na and K contents in soil sample by Flame Photometry.
22. GC-MS, HPLC analysis of explosive residues.
23. Detection of adulteration in oils and fats by chemical analysis and TLC/ HPTLC.
24. Report submission on Industry/ Laboratory visit.

M.Sc. Forensic Science II Year
4P8-SIII : Project

Marks: 100 **Duration: 8 hrs/week**

Description

This course covers the application of analytical chemistry within the field of forensic science. Students learn the fundamental principles behind the analyses of chemical and physical evidence for drugs, combustion and arson, colorants, documents, and fibres. Qualitative analysis is presented by examining the chemical details of presumptive testing from a mechanistic approach. An analytical chemistry perspective is used to explain modern laboratory instrumentation and proper statistical treatment of collected data for quantitative analysis. An overview of chemical toxicology is covered with an emphasis on understanding biochemical pathways and pharmacokinetics.

Objectives

The objective is to introduce students to research in various areas of Forensic Chemistry by engaging them to carry out a project under the supervision of a faculty. The main objective of this course is to teach students how to use critical thinking skills and fundamental scientific principles to approach and solve problems in forensic science. Students should learn how to create an unbiased sampling of evidence and select proper methods to process that evidence. Finally, students should be able to communicate and support the technical details of their findings in a clear, logical manner that can easily be understood in a court of law.

M.Sc. Forensic Science II Year
4P6-SIV : Practical I

Marks: 100 **Duration: 8 hrs/week**

Candidate should complete minimum 20 of the total number of practicals.

1.Live system evidence Capture process
2. Live Network evidence Capture process
3. Working with advance network diagnostic and connectivity commands
4. Advance Mobile device forensic analysis
5. Password encryption techniques
6. Performing Physical port audit
7. Performing VLAN and routing configuration
8. Network administration services and security measure application
9. Password strength assessment
10. Software vulnerability analysis
11. Working with Winhex
12. Working on Cell phone tower site and Cell phone Hub
13. Detail MAC Analysis
14. Scanning for vulnerabilities using (Angry IP, HPing2, IPScanner, Global Network Inventory Scanner, Net Tools Suite Pack.)
15. NetBIOS Enumeration Using NetView Tool, Nbtstat Enumeration Tool (Open Source).
16. How to Detect Trojans by using – Netstat, fPort, TCPView, CurrPorts Tool, Process Viewer.
17. Working with Trojans, Backdoors and sniffer for monitoring network communication
18. Denial of Service and Session Hijacking using Tear Drop, DDOS attack.
19. Penetration Testing and justification of penetration testing through risk analysis
20. Password guessing and Password Cracking.
21. Wireless Network attacks , Bluetooth attacks
22. Firewalls , Intrusion Detection and Honeypots
23. Malware – Keylogger, Trojans, Keylogger countermeasures
24. Understanding SQL Injection
25. Steganography using tools: Tool: Merge Streams, Image Hide, Stealth Files,

Blindside, STools,

M.Sc. Forensic Science II Year
4P8-SIV : Project

Marks: 100 **Duration: 8 hrs/week**

Project relevant to specialization

M.Sc. Forensic Science II Year
4P7-SV : Practical I

Marks: 100 **Duration: 8 hrs/week**

Candidate should complete minimum 10 of the total number of practicals

1. To study proof mark of cartridge.
2. To study lands and grooves in rifled weapons.
3. To estimate the range of firing in rifled and smooth bored firearms.
4. To estimate the trajectory of bullet.
5. To plot a graph and study the various factors effecting the trajectory and range of bullet.
6. Collection and Forensic examination of Gunshot residue.
7. To study brake action of various automobiles.
8. To study the working mechanism of important components of automobile engine.
9. Study of speedometer.
10. Forensic Examination of brake failure in the vehicles.
11. Forensic Examination and analysis of paint chips collected from hit and run cases.
12. Forensic Examination and analysis of glass pieces collected from hit and run cases.
13. Comparison of head light glass and automobile window glass.
14. Forensic Examination of bulb filament.
15. Forensic Examination of soil

M.Sc. Forensic Science II Year
4P8-SV : Project

Marks: 100 **Duration: 8 hrs/week**

Project relevant to specialization

M.Sc. Forensic Science III Year
3T2: Criminology and Forensic Law

Marks: 100 **Lecture: 4 hrs/week**

Unit I: Criminal Law-I

Definitions and General Exceptions under Indian Penal Code, 1860

Offences against Body (section 121A, 299, 300, 302, 304A, 304B, 307, 309,319, 320, 324, 326, 351, 354, 359, 362) and

Offences against Property (Section 378, 383, 390, 391, 405, 415, 420, 441, 463, 489A, 497, 499, 503, 511)

Offences Relating to false evidences and against public justice (Section 191-229)

Unit II: Provisions under Criminal Procedure Code, 1973 and Indian Evidence Act, 1872

Section 291, 292 and 293of Code of Criminal Procedure, 1973

Section 32, 45, 46, 47, 57, 58, 60, 73, 135, 136, 137, 138, 141 of Indian Evidence Act,1872

Relevancy and admissibility of facts; Relevancy of confessions and dying declarations ; Appreciating expert evidence in court.

Unit III: Special Laws-I

Prevention of Corruption Act, 1988(Preliminary, offences and penalties, Investigation of cases under Act);

Standards of Weight and Measures Act, 1976;

Narcotic Drugs and Psychotropic Substances Act, 1985(Object , Definitions, Authorities and officers, Prohibition control and regulation under Act, Offences and Penalties, Special Courts and its Procedure);

Drugs and Cosmetics Act, 1940(Preliminary, Authorities, Import of Drugs and Cosmetics, Provisions as to manufacture, sale and purchase of drugs, miscellaneous provisions);

Introduction to cyber Law- International Regulatory framework- UNCITRAL Model Law, International Conventions on cyber crime

National Framework - Information Technology Act, 2000, Recent Amendments in Information Technology Act, 2000.

E-Commerce and related issues

Unit IV- Rules of Admissibility of Forensic Evidence-I

The Expert Forensic Witness: Definition of expert, Qualification, Knowledge etc.

Pre-trial conference with prosecuting attorney and defence attorney;

Courtroom methodology: Direct examination, Swearing In, assuming the witness stand, courtroom communication, credentials, response to the jury, courtroom courtesy, Verbal and non-verbal Court presentation.

M.Sc. Forensic Science II Year
3T3 SI-1: Questioned Document Analysis– I

Marks: 80 **Lecture: 4 hrs/week**

Unit I: Instruments: Examination of vernacular scripts, effect of mother tongue on foreign language , effect of age, illness, posture, emotions and writing instrument on handwriting. Preliminary examination of documents- various points to be considered during examination, examination of alphabets and numerals, case studies. Working and handling of Stereo Zoom Microscopes, Comparison Microscope, stereomicroscope, Video Spectral Comparator, Electrostatic Detection Apparatus, UV – Vis, TLC.

Unit II: Ink analysis: Historical development- Dating of fountain pen ink, ballpoint and Non ball point ink, Ink analysis and forensic document examination, coordination with handwriting comparison and latent print processing, Ink chemistry- recognition of ink source, chemical composition of Ink. Preliminary method of analysis- Introduction, Pen line microscopy, Ink colour assessment, microscopic specular reflectance, Video spectral analysis, Laser induced fluorescence, Infrared luminescence, Forensic comparison and identification of writing ink by TLC. Instrumental analysis of ink using FTIR, UV-Visible Spectrophotometer, HPLC and HPTLC.
Ink dating- aging process, first date of production method, Ink tag method, relative age comparison method, determination of age of ink by statistical analysis of densitometry data, other methods.

Unit III: Examination of Writing Material: Luminescence, Fluorescence, Phosphorescence, types of paper and Inks, techniques used in the analysis of paper & inks- raw materials, ingredients, and tagging materials etc. including NAA techniques, FTIR, Examination of mechanical impressions - examination of indentation marks, secret writings, examination of rubber stamp and seal impressions, embossed impressions. Determination of sequence of intersecting strokes – all types, examination of creases and folds, determination of sequence of writings over creases & folds. Reconstruction and examination of torn documents, stabilization and examination of charred documents, case studies.

Unit IV: Quality Management: in Document Laboratories, safety management in document laboratories, NABL guidelines for accreditation of document laboratories. Final examination and report writing - opinion writing and writing of reasons for opinion, importance of no opinion / qualified opinion, marking of photographs and their presentation, preparation of juxtapose charts in support of reasons, case studies. Debonair of expert and preparation for presentation of evidence in trial courts, examination-in-chief, cross examination by defense and cross examination by expert, Daubert guidelines and various court rulings. Limitations of forensic document expert, moot Courts

M.Sc. Forensic Science II Year
3T3 SI-2: Advanced Fingerprint Development Method-I

Marks: 80 **Lecture: 4 hrs/week**

Paper: Advanced Fingerprint Development Method-I

Unit I: Powder Method:-Traditional powder, Magnetic Powder, Luminescent powder, Thermoplastic Powder, Nanotechnology Powder, Anti stroke Powder. Powder suspension technique:-Small particle reagent, Black powder suspension, White powder suspension, fluorescent suspension, Operational usages and sequencing, etc

Unit II:Fuming Method Development of Fingerprint: Iodine Fuming Development Method: History, Mechanism of Iodine Fuming, Method of applications: Gun Fuming Method, Cabinet method, dusting, solution, Fixation Method of Iodine fuming, pre-treatment and post-treatment, Advantageous and Disadvantages

Cyanoacrylate Fuming: History, Fingerprint development by cyanoacrylate fuming, Cyanoacrylate pre-treatment, and Post-treatment,atmospheric and vacuum CA fuming, Chemistry of CA dye stains- Ardrox, basic yellow 40, MBD, Rhodamine 6G, MRM 10, RAY, thenoyl europium chelate, gentian violet, sudan black. Iodine fuming, Iodine fixation, Operational uses- vapor method, dusting method, Solution method, miscellaneous fuming method-Osmium/ruthenium Tetroxide, soot method, Disulfurdinitrite, etc.

Unit III: Chemical Method Development of Fingerprint: Silver Nitrate & Reaction Mechanism:Silver Nitrate reagent, Mechanism of silver nitrate development of fingerprint, Procedure of development, silver, pre and post-treatment of silver nitrate.
Chemistry & Reaction Mechanisms of Ninhydrin: Amino acid reagent, Ninhydrin-Chemistry and reaction Mechanism, Forensic application. Metal salt enhancement, Ninhydrin analogous, first analogous, aryl, alkyl and alkoxy analogous, 1,8-Diazafluoren-9-One and 1,2-Indanedione, miscellaneous amino acid reagent-p-Dimethylaminocinamaldehyde, NBD chloride, Dansyal chloride, o-Phthalaldehyde, Fluorescamine, Genipin**.** Cyanoacrylate fuming, health and safety precautions, Pre-treatment and Post Treatment.

Unit IV: Statistics and Probabilities as a means to support Fingerprint Examination:
Admissibility of Fingerprint, Fingerprint examination process, determination of sufficiency at comparison stage and evaluation stage, Limitation of current fingerprint examination process, Error rates for examination of Fingerprint, Statistics and probabilities to support fingerprint examination.

M.Sc. Forensic Science II Year
3T3 SI-3: Forensic Linguistics

Marks: 80 **Lecture: 4 hrs/week**

Paper: Forensic Linguistics

Unit I: Forensic Linguistics & Phonology: Forensic Linguistics, place of forensic linguistics in the applied linguistics, areas of research in the forensic linguistics. Phonetics and phonology, auditory phonetics, acoustics phonetics, voice identification, Author identification, Dialect identification, linguistics proficiency, Forensic phonetics, Speaker identification, Transcription.

Unit II: Morphology and Language Used: Words used for conveying Meaning – symbols – place of Morphology in Forensic linguistics – Morphological analysis of Forensic Materials – identification. Language use in Threatening letters – anonymous letters – Suicide notes – language of SMS – Email threatening – identification – Discourse structure.

Unit III: Psycholinguistics and Literary Forensics: The relationship found between Forensic linguistics and Psycholinguistics – human cognitive system on language processing – use of psychological factors on forensic linguistics.

Unit VI: Speaker Identification and Tape Authentication: Voice production theory – vocal anatomy, Speech signal processing and pattern recognition – basic factors of sound in speech, acoustic characteristics of speech signal, Fourier analysis, frequency and time domain representation of speech signal, analogue to digital signal and conversion, Fast Fourier transform, quantization, digitization and speech enhancement, analysis of audio-video signal for authenticity, Introduction to the techniques of pattern recognition and comparison.

M.Sc. Forensic Science II Year
3T3 SI-4: Forensic Photography

Marks: 80 **Lecture: 4 hrs/week**

Paper: Forensic Photography

Unit I: Basics of Forensic Photography: Introduction, Photographic instruments, fundamentals of light and vision, light source, geometry and photometry of image formation, types of camera, features, camera movement, and Optical filters. Specialized photography - UV, IR, transmitted light and side light photography, close-up, midrange and bird-eye view photography, trick photography, contact photography. Digital photography, software for digital photography, file formats for digital photographs – jpg, gif, bmp, tiff, mpeg, etc. Radiography, Photomicrography, microphotography, photography using scientific equipment, juxtapose charts and demonstrative photographs, photographs as secondary evidence, case studies.

Unit II: Types of Photography: History and Development of Photography. Basic principles and techniques of Black & White and colour photography, Photography in indoor and outdoor scene of crime; aerial photography, Aperture and focus adjustment. Significance of Photography in Forensic Science. Photo prints: Developing techniques and methods of photography, Different kinds of developers and fixers, modern developments in photography, linkage of cameras and film negatives.

Unit III: Surveillance Photography: its methods, techniques and tactics. Surveillance photography – Cameras and accessions for surveillance photography moving surveillance on foot, 2-person foot surveillance moving, surveillance with vehicles, fixed surveillance, Use of photography in reconstructing the scene of crime and its presentation in the court of law. Image magnification, U. V. and I. R. illumination, Art factual evidences (Bloodstain, fingerprint, imprints, and micro evidences)

Unit IV: Digital Photography: Digital water marking and digital imaging, photogrammetric, Videography/highspeed Videography, crime scene and laboratory photography. Photography of objects- Close up, normal, telephoto and processing. Aerial Photography. Remote sensing &Geomapping. Document and finger print photography. Photography in identification of docile and hostile human objects, etc. Digital photography, how digital camera works and basics of digital imaging. 3-D Photography/Videography, videography/high speed videography, High speed photography, legal aspects of visual evidence, Admissibility in the court.

M.Sc. Forensic Science II Year
3T4 SII-1: Forensic Biology and Entomology

Marks: 80 **Lecture: 4 hrs/week**

Unit I:

Hair and Fiber Examination: Sampling, hair examination-temporary mount, scale casting, nail polish/cellulose acetate method, permanent mount, cross-sectioning, micrometry, sex determination from hair root sheath; General characteristics of human hair, morphological characteristics of hair for racial determination; Characteristics of hair from different sites, Animal and human hair-general differences; Fibre examination-microscopic, temporary mount, Maceration of plant fibres, cross-sectioning, physical methods (twist on drying, floatation method, burning test); Cotton, coir, wool, silk, jute, sisal, abaca, rayon silk, wool, asbestos, nylon; Fabrics & cordage- sample handling, analysis, fabric examination, cordage examination.

Unit II:

Forensic Botany: Introduction, types, location, collection evaluation and forensic significance of fungi and plants in forensic science;wood and pollen grains-Methods of identification and comparison;various types of planktons, diatoms and their forensic importance; Diatoms:- types, morphologyand Forensic significance, methods of isolation from different tissues and bones; Study and identification of pollen grains, Identification of starch grains, powder and stains of spices etc.; Paper and Paper Pulp identification, Microscopic and biochemical examination of pulp material; Study of Various types of Poisonous Plants; Identification of wood, physical properties, colour, fluorescence, hardness, weight, odour, lustre, texture, anatomical features, pore/vessel distribution, size and arrangement, pore numbers, pore arrangements, inclusions, colored deposits and Forensic significance.

Unit III:

Other Biological Evidences: Identification of Food stuffs & their stains: Plants used as food, animals used as food; Examination of plant foods (starch, herbs, spices &flavourings, fruits, vegetables); Examination of animal foods(meat & fish) – microscopic and macroscopic examination, chemical examination, muscles, skin, hairs, scales, bones & cartilage; Histopathological examination of tissues. Examination of faecal matter & faecal stains: Physical appearance, microscopic examination, urobilinogen test. Examination of stomach contents- microscopic examination.

Unit IV:

Forensic Entomology: General Classification (Diptera); Insects of forensic importance; collection of entomological evidence during legal investigations; collectionof: meteorological data, specimens before body removal, ground-crawling arthropods on and around the body; entomological samples from the body, entomological samples during autopsy, specimens from buried remains from enclosed structures & aquatic habitats.

Laboratory rearing of insects of forensic significance: Larval rearing, rearing containers, monitoring growth, larval dispersal in laboratory, adult emergence, rearing aquatic insects, unique species requirements, rearing beetles in the laboratory;Factors that influence insect succession on carrion: Attraction to the remains, geographical differences in succession, effects of season, effects of sun exposure, urban versus rural scenarios, bodies found inside buildings, effects of burial, bodies in water, bodies in vehicles, bodies in enclosed spaces, hanged bodies, burnt remains, wrapped remains; Role of aquatic insects in forensic investigations, estimating the post-mortem interval, soil environment, entomo-toxicology, molecular methods for forensic entomology.

M.Sc. Forensic Science II Year
3T4 SII-2: Forensic Serology

Marks: 80 **Lecture: 4 hrs/week**

Unit I:

Blood and blood stains– Physical examination, presumptive test(TMB, Kastle-Meyer Test, Luminol) Confirmatory Tests(Takayama, Teichmann, spectrophotometric);Examination of Menstrual blood & its stains-Physical & Microscopic examination, Identification by Fibrin Degradation product; Identification of other body fluids and their stains; Semen and seminal stains-Physical Examination, Presumptive test(Acid Phosphatase Test),Confirmatory test (microscopic examination) Gram staining, cross-over electrophoresis;Examination of vaginal fluid & stains of vaginal secretions-Physical examination, SAP/VAP electrophoresis, Lugol's stain;Examination of saliva & saliva stains-starMFS-iodine test,salivary haemagglutinin test,radial diffusion test for amylase; Examination of vomit-test for mucus,test for free HCL(Gunzberg's test),endothelial cells;Examination of urine stains-Physical stains, odour test,urea nitrate crystal test, creatinine test.

Unit II:

Types and distribution of body fluids, urine formation, composition, properties, abnormal constituents and clinical significance; Beta HCG; CSF, lymph, amniotic fluid, sweatcomposition, formation and function; semen, synovial fluid, gastrointestinal secretions composition, formation and function; tears, milk, faeces; saliva, aqueous humour, Vaginal fluid, epithelial cells, etc. their analysis and forensic significance.

Unit III:

Serological reagents-Antigens, Antibodies (Polyclonal antibodies, Monoclonal antibodies, antiglobulins), Antigen-antibody binding reactions (Primary, Secondary); Serological techniques- primary binding assays-ELISA Immunochromatographic Assays; Secondary Binding Assaysprecipitin-based Assays (Immunodiffusion, electrophoretic methods);Agglutination based Assays (Direct agglutination Assay, passive agglutination Assay, Agglutination Inhibition assay).

Unit IV:

Electrophoresis and Blotting techniques: Theory and general principles, Various factors affecting electrophoresis, low and high voltage electrophoresis, horizontal and vertical Electrophoresis; Various electrophoretic techniques– Sodium dodecyl sulphate (SDS), Agarose Gel Electrophoresis (AGE), Polyacrylamide Gel Electrophoresis (PAGE), Iso-electric focusing (IEF), Gel immuno-diffusion assay, Southern, Nothern, Western Blotting.

M.Sc. Forensic Science II Year
3T4 SII-3: DNA Fingerprinting

Marks: 80 **Lecture: 4 hrs/week**

Unit I:

Sample collection: DNA sample sources, biological evidence at crime scenes, evidence collection and preservation, collection of reference DNA samples, storage and transport of DNA evidence; sample characterization: blood stain, saliva stains, semen stains, body fluid identification by RNA testing, contamination concerns.

DNA extraction methods: organic (Phenol-chloroform) extraction, chelex extraction, FTA paper; Solid phase DNA extraction methods: Qiagen extraction Chemistry and kits, DNA IQ (Identification & quantification), Differential extraction, Direct PCR.

DNA quantification: Slot blot, Pico-green microtiter plate assay, Aluquant human DNA quantification system, endpoint PCR, real time quantitative PCR (QPCR).

Unit II:

DNA Amplification: Basic PCR cycle. Components of PCR, Factors affecting PCR, Optimization of PCR assay.

Types of PCR: Nested PCR, Touchdown PCR, Gradient PCR, Hot-starts PCR, RT-PCR, multiplex PCR, endpoint PCR, PCR inhibitors & solutions, Contamination Issues, etc. Nanotechnology in PCR.

Genetic analysis of chromosome X (pentaplex/heptaplex PCR assay), multicopy Y-STR analysis.

Unit –III:

Gene frequencies, bi-allelic system, Hardy- Weinberg equilibrium, measurement of frequency distribution, closeness of fit with HWE, combined frequency of occurrence, probability of match and discrimination, discrimination power, power of exclusion, evidence evaluation, errors in interpretation; Paternity index, likelihood of paternity; Simple case genotypic frequencies, Simple case allelic frequencies, Matching of DNA profiles, ANOVA analysis, Population genetics.

Unit IV

Non-human DNA testing: Sources, domestic animal DNA testing (cat DNA, dog DNA), Canine STR Loci and assays, Canine mtDNA Testing; species identification: (mtDNA cytochrome b gene, mtDNA 12S rRNA gene, mtDNA COI gene); Wildlife DNA testing: genetic markers, geographic origin identification (Divergent populations with gene exchange, populations with high gene-exchange, and populations with low gene-exchange); Biosensors, use of remote sensing techniques for population study of endangered plants and animal species; DNA banks for endangered animals and DNA database controversies.

M.Sc. Forensic Science II Year
3T4 SII-4: Forensic pathology and Microbial forensic

Marks: 80 **Lecture: 4 hrs/week**

Unit I:
Thanatology & Forensic Pathology: Introduction of Forensic pathology & thanatology; Cause, manner, characteristics and signs of death, Natural and unnatural death, changes after death, Personal Identity of the Dead; Identification & Examination of Decomposed/Mutilated Bodies & Fragmentary Remains; Medico-legal Aspects of Death, Deaths by poisoning; Signs and symptoms of poisoning- Acute & Chronic, Asphyxial Deaths (Hanging, Strangulation, Throttling, Suffocation, Drowning, Bansdola); Identification of possible causes of death. Medico-legal Aspects.

Unit II:
Thanatology & Forensic Pathology: Sexual Offences (Perversions, Natural, Unnatural); Abortion, Infanticide, Traffic Accident Death (Vehicular, Railway, Aircraft), Impotence and Sterility, Artificial insemination, test-tube baby, surrogate motherhood, Virginity, Criminal Abortion, Medico-legal aspects of female feticide, legitimacy, medico-legal aspect of sterilization; Sexual Offences- Natural & Unnatural (buccal coitus, sodomy, tribadism, bestiality, etc.), Report Writing and Interpretation etc.

Unit III:
Microbial Forensics: Defining the microbial forensics program, epidemiology, Microbial forensic tools; Dynamics of disease transmission, Outbreak Investigation; Deliberate introduction of a biological agent; Emerging Microbial Forensic Techniques- PCR, Terminal Restriction Fragment Length Polymorphism (TRFLP), Amplified Fragment Length Polymorphism (AFLP), Single Stranded Conformation Polymorphism Analysis (SSCP).

UnitIV:
Microbial Forensics: Thermal and Denaturating Gradient Gel Electrophoresis (TGGE, DGGE), Amplified Ribosomal DNA Restriction Analysis (ARDRA), Randomly Amplified Polymorphic DNA (RAPD); Non-PCR DNA Fingerprinting Techniques with Applicability in Forensic Studies- Restriction Fragment Length Polymorphisms (RFLP) and Ribotyping; Forensic Interpretation of DNA Data, Isotopic Testing and Correlation to Contaminant Source, etc.

M.Sc. Forensic Science II Year
3T4 SIII-1: Instrumentation

Marks: 80 **Lecture: 4 hrs/week**

Unit I: Advanced Chromatography – I

Introduction, review of basic principles and types of chromatography, column chromatography, paper chromatography, TLC and HPTLC: Principle, Theory and instrumentation, visualization, Qualitative and Quantitative concepts and Forensic applications

Principle, theory, instrumentation and applications of HPLC and GC;

Unit II: Atomic Spectroscopy – I

Basic concepts – Atomic and molecular spectroscopy Interaction of electromagnetic radiation with matter and its consequences, Reflection, absorption, transmission, scattering, emission, fluorescence, phosphorescence, comparative account of atomic and molecular spectroscopy

Flame Photometry: Principle, theory, instrumentation, working and forensic applications

Atomic Absorption Spectroscopy: Principle, theory, instrumentation, working and forensic applications

Unit III: Molecular Spectroscopy – I

IR-Spectroscopy: Introduction, Principle of FT-IR, Modes/types of vibrations, functional group and fingerprint region, Attenuated Total Reflectance (ATR) IR, Dispersive and Fourier transform IR spectrophotometers, Instrumentation and Techniques, Interpretation of IR spectra, Forensic applications

Raman Spectroscopy: Basic principles, Theory of Raman spectroscopy, mutual exclusion principle, Instrumentation, analytical applications of Raman spectroscopy; comparative account of FT-IR and FT-Raman Spectroscopy, Forensic applications

Unit IV: Miscellaneous – I

Thermal methods of analysis: Introduction, theory, instrumentation and forensic applications of Differential Scanning Calorimetry, Thermo Gravimetric Analysis and Differential Thermal Analysis

Nephelometry and Turbidometry: Light Scattering, Comparison between Nephelometry and turbidometry, Concentration and Scattering, Instrumentation of Nephelometry and turbidometry, general procedure for operation of Nephelometry, Turbidometric titration, Forensic application.

M.Sc. Forensic Science II Year
3T4 SIII-2: Advanced Forensic Chemistry

Marks: 80 **Lecture: 4 hrs/week**

Unit I: Fire and Arson

Chemistry of fire, difference between Arson and Fire, Material and Chemicals used in initiating fire and arson, Pattern followed by Fire, Fire tetrahedron, Examination of scene of fire/arson recognition and collection of evidence, packing, labelling and forwarding of exhibits, Role of fire investigating officer, methods of extraction from exhibit- direct extraction, distillation and micro-diffusion methods, analysis of arson exhibits by instrumentation techniques; Methods of Investigating an Arson Scene

Unit II: Explosives

Introduction, Chemistry of explosives, Kinetics of explosive reactions, Structure, properties, detonation and identification of: Black powder, Nitrocellulose, Nitroglycerin, Dynamite, Ammonium nitrate, Commercial explosives (permitted explosives, ANFO and slurry explosives), Military explosives (picric acid, TNT, PETN, RDX, HMX and polymer bonded explosives)

Post-blast Investigation: Bombs, Crude bombs, Home-made bombs, Improvised Explosive Devices (IEDs), Molotov cocktail, Disposal of bombs, Explosions effects, Role of Forensic Scientist in Post-blast investigation, TLC and Instrumentation Techniques.

Unit III: Petroleum Products

Petroleum Products, Adulterants, Detection of adulterants of gasoline, diesel and engine oils. Analysis of residues in forensic exhibits, Analysis of recycled engine oils, Analysis of dyes of petrol and kerosene, engine oils, Gas chromatography analysis of petrol, kerosene, diesel and other solvents for detection of adulteration by Flash point, boiling point, ignition method and distillation method

Unit IV: Cement

Cement, Concrete and Mortar: Chemical compositions Portland cement and other type of cements; Methods of sampling of cements, mortar and concrete; Common adulterants of cement and their detection. Methods of analysis: Physical analysis-microscopic examination, Ignition tests, Sieve test, Density Gradient test. Chemical analysis of cement, mortar and concrete Instrumental analysis of cement by TGA, DTA, AAS, etc; Case Studies like Structural Failures, etc

M.Sc. Forensic Science II Year
3T4 SIII-3: Advanced Forensic Toxicology

Marks: 80 **Lecture: 4 hrs/week**

Unit I: Poisons
Classification and Types of Poisons: Metallic, Inorganic, Organic, Volatile, Animal, Plant, Insecticides, Pesticides, etc. their nature, Use, Administration, Fatal dose, fatal period, Symptoms, some common Antidotes, Post-mortem findings, Collection and preservation of viscera and other samples.

Unit II: Isolation and different methods of extraction
Different methods of extraction for poisons from viscera: Solvent extraction, distillation /steam distillation, micro-diffusion, dialysis, dry ashing, wet digestion, modified Stas-Otto method, ammonium sulphate method. Extraction of poisons from blood, urine, stomach washes and vomits, food material. Toxicological analysis of decomposed materials; Interpretation of toxicological finding, limitations of method and troubleshooting in toxicological analysis, disposal of analysis samples

Unit III: Volatile Poisons
Nature, use, administration, symptoms, post-mortem findings, fatal dose, fatal period and medico-legal significance of: Ether, Acetone, Oxalic Acid, Phenols, Camphor, Chloral Hydrate, Chloroform, Carbon tetrachloride, Methyl alcohol, ethyl alcohol, phosgene etc. Analysis by colour tests, chromatographic techniques, FT-IR, NMR, GC, GC-MS, etc.

Unit IV: Metallic and Non-metallic Poisons
Metallic poisons: Nature, use, administration, symptoms, post-mortem findings, fatal dose, fatal period, detection, of metallic poisons including: Lead, Copper, Mercury, Arsenic, Barium, Cadmium, Chromium, Selenium, Zinc, Antimony, Thallium, etc.
Non-metallic poisons: Nature, use, administration, symptoms, post-mortem findings, fatal dose, fatal period and detection of: chloride, bromide, iodide, cyanide, thiocyanate, chlorate, bromate, iodate, etc. Analysis by colour tests, AAS, FT-IR etc

M.Sc. Forensic Science II Year
3T4 SIII-4: Advanced Chemistry

Marks: 80 **Lecture: 4 hrs/week**

Unit I: Nuclear Chemistry

Radioactivity, radioactive decay and half-life, methods of detection of radioactivity by Geiger Muller and Scintillation counter, applications of radioisotopes; Introduction to nuclear forensics, nuclear threats, nuclear explosive devices, hazards of radiation, safety measures

Neutron Activation Analysis: Principle, instrumentation, steps involved in neutron activation analysis; Radiochemical and instrumental methods of analysis, important forensic applications of NAA.

Unit II: Chemical and biological warfare agents

Chemical warfare agents: Introduction, classification, physical and biochemical properties, toxic effects, detection by sensors and other instrumental methods, current scenario about use of chemical weapons

Biological warfare agents: Introduction, Categories of biological weapons, study of potential bacteria, fungi, viruses, and their toxins, mode of action, identification, preventive measures during handling, current scenario about use of biological weapons

Unit III: Colloidal State

Introduction definition of colloids, Classification of colloids, Sols, Properties of sols; kinetic, optical and electrical stability of colloids; Hardy-Schulze law and gold number, Emulsion, types of emulsion, emulsifier, gel classification, preparation and Properties, forensic applications of colloids.

Unit IV: Industrial Toxicology and Nanotoxicology

Industrial Toxicology: Introduction, sources of toxicity, forms of toxicity, dose-response relationship, factors affecting toxicity, health hazards, prevention and safety measures, clinical toxicologist, and forensic significance.

Nanotoxicology : Introduction, sources of toxicity, routes of administration, mechanism of toxicity, factors affecting toxicity, health hazards, methods of analysis, prevention and safety measures, forensic significance

M.Sc. Forensic Science II Year
3T6- SIV-1: File System

Marks: 80 **Lecture: 4 hrs/week**

Unit I:

File System Analysis. What Is a File System?. File System Category.Content Category.Metadata Category.File Name Category.Application Category.Application-level Search Techniques.

Specific File Systems.

FAT Concepts, Data Structures and Analysis. Introduction, File System Category, Content Category, Metadata Category, File Name Category, Boot Sector, FAT32 FSINFO, FAT, Directory Entries, Long File Name DirectoryEntries

Unit II:

NTFS Concepts, Data Structures and Analysis Introduction, Everything is a File, MFT Concepts, MFT Entry Attribute Concepts, Other Attribute Concepts, Indexes, Analysis Tools, Analysis : File System Category, ContentCategory, Metadata Category, File Name Category, Application Category. NTFS Data Structures: Basic Concepts, Standard File Attributes, Index Attributes andData Structures, File System Metadata Files.

Unit III:

Ext2 and Ext3 Concepts and Analysis. Introduction.File System Category. Content Category. Metadata Category.File Name Category.Application Category.The Big Picture.Other Topics.Summary.Bibliography.Ext2 and Ext3 Data Structures.

Superblock.Group Descriptor Tables.Block Bitmap.Inodes.Extended Attributes.Directory Entry.Symbolic Link.Hash Trees. Journal Data Structures.Summary.Bibliography.

Unit IV:

UFS1 and UFS2 Concepts and Analysis.Introduction.File System Category.Content Category.Metadata Category.

File Name Category.The Big Picture.Other Topics.Summary.Bibliography.UFS1 and UFS2 Data Structures.UFS1 Superblock.UFS2 Superblock.Cylinder Group Summary.UFS1 Group Descriptor.UFS2 Group Descriptor.

Block and Fragment Bitmaps.UFS1 Inodes.UFS2 Inodes.UFS2 Extended Attributes.Directory Entries.

M.Sc. Forensic Science II Year

3T6- SIV-2: Digital Image Processing

Marks: 80 **Lecture: 4 hrs/week**

UNIT I:

Digital image fundamentals and Image Enhancement;Steps in Digital Image Processing – Components – Elements of Visual Perception– Image Sensing and Acquisition – Image Sampling and Quantization –Relationships between pixels.Image Enhancement:Spatial Domain: Gray level transformations – Histogram processing – Basics ofSpatial Filtering– Smoothing and Sharpening Spatial Filtering. FrequencyDomain: Introduction to Fourier Transform– Smoothing and Sharpeningfrequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement

UNIT II

Image restoration and image segmentation;Image Restoration – degradation model, Properties, Noise models – Mean Filters– Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters –Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering

Image Segmentation - Edge detection, Edge linking via Hough transform –Thresholding – Region based segmentation – Region growing – Region splittingand merging

UNIT III:

Image compression and recognition;Need for data compression, Huffman, Run Length Encoding, Shift codes,Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature,Texture – Patterns and Pattern classes – Recognition based on matching.

UNIT IV :

Image Forensic:

Detecting traces of re-sampling, more images are spliced together, detect highquality and consistent image forgeries, detect geometric transformations such asscaling, rotation or skewing re-sampling and interpolation. Detecting near–duplicated image regions, common type of digital image forgery, copy–moveforgery, Noise inconsistencies analysis to conceal traces of tampering alteredimage regions. Application of cyclostationarity analysis to image forensics,(cyslostationary signals) exhibit periodicity in their statistics. Find the traces ofgeometric transformation shows promising results. Double JPEG compression,CFA analysis, quantization tables analysis, etc.

M.Sc. Forensic Science II Year

3T6- SIV-3: Network Forensics

Marks: 80 **Lecture: 4 hrs/week**

Unit I Fundamentals of network forensics

1. Introduction
1.1. Definition
1.2. Classification of network forensics
1.3. Recent trends in network forensics
1.4. Challenges in network forensics
2. Network forensic process model
2.1. Digital Forensic process model
2.2. Hierarchical process model
2.3. Network Forensic process model
3. Network Forensic Frameworks
3.1. Distributed system –bases framework
3.2. Soft computing- based Framework
3.3. Honeynet-based Framework
4. Network Forensic Tools
4.1. Network Forensic Analysis Tool (NFAT)
4.2. Vulnerability Assessment Tools
4.3. Network Sniffing and Packet Analysis Tools
4.4. Network Scanning and monitoring tools
4.5. Intrusion Detection Systems

Unit II Network Forensic Techniques

1. Network Forensic Acquisition
1.1. TCP/ IP Protocol Suite
1.2. Packet Capture Format
1.3. Pcapng dump File Format
1.4. Netflow Record Format
2. Network Forensic Analysis
2.1. Misuse Detection
2.2. Anomaly Detection
3. Network Forensic Attribution
3.1. Probabilistic packet marking
3.2. Deterministic packet marking
3.3. Autonomous system based Traceback
3.4. Router and Interface Marking
3.5. Network Forensic Traceback

Unit III Botnet Forensics

1. Introduction
15 Lectures each unit
2. Acquisition
3. Analysis

4. Attribution
5. Research challenges

Unit IV Cloud Forensic

1. Definition
2. Generic Process Model
3. Investigation of Cloud Infrastructure
4. Cloud forensic attribution
5. Investigation using VMI in cloud environment

M.Sc. Forensic Science II Year

3T6- SIV-4: Applied Cryptography

Marks: 80 **Lecture: 4 hrs/week**

Unit I:

Number Theory Basics: Modular arithmetic, primes, GCD and Chinese reminder theorems.

Unit II:

Block Ciphers: DES, AES; ECB, CBC, OFB,CFB, CTR and GCM modes, Double and triple encryptions.
Public Key Cryptography: RSA, ElGamal, Diffe-Hellman Key exchange, practical digital signatures. ECC

Unit III:

Hash Functions: oneway, collision resistant, preimage resistant HASH functions, Real-world examples. Message Authentication Codes: MAC from Hash functions, MAC from block ciphers.

Unit IV:

Side Channel Analysis: Power / timing analysis of crypto-implementations
Applications : Key Establishment Protocols, Blockchains, etc.

M.Sc. Forensic Science II Year
3T7-SV: Specialization V : Forensic Physics and Ballistics

3T7-SV-1 Instrumentation in Forensic Physics

Marks: 100 **Lecture: 4 hrs/week**

Unit I:
Spectrophotometry: Introduction to spectrophotometry, Interaction of electromagnetic radiations with matter: phenomena of absorption, emission, reflection, fluorescence, phosphorescence. Basic concepts of atomic spectra, energy levels, quantum numbers, designation of states, selection rules, atomic spectra.

Unit II:
Spectroscopy: Raman Spectroscopy; Atomic Absorption Spectroscopy, Atomic Emission Spectroscopy, Fluorescence and phosphorescence spectroscopy, Infrared spectrophotometry, Ultra violet and visible spectroscopy: Basic principles, Instrumentation, sample handling and illumination, analysis, detection limit and sensitivity, Applications in Forensic Physics. Advantages over each other.

Unit III:
Elements of X-ray spectrometry: X-ray absorption and fluorescence, Energy Dispersive X-ray Analysis (EDX), wavelength Dispersive X-ray analysis (WDX), X-ray diffraction, Auger emission spectroscopy and applications.
Radio Techniques: Basic principles and theory introduction about nuclear reactions and radiations, Neutron sources, Neutron Activation Analysis. Basics of Electrostatic

Unit IV: Microscopy - Microscope, Compound Microscope, Polarized Light Microscopy, Fluorescence Microscopy, Comparison Microscope, Stereo-zoom Microscope. Transmission Electron Microscope, Video-zoom Microscope. Scanning Electron Microscope – Energy Dispersive X-Ray. Atomic Force Microscope: Principle, working, Forensic significance, advantages over each other.

M.Sc. Forensic Science II Year
3T7-SV: Specialization V : Forensic Physics and Ballistics

3T7-SV-2 Internal Ballistics

Marks: 100 **Lecture: 4 hrs/week**

Unit -I

Explosives: Explosive compounds and explosive mixtures-classification of explosives: Initiatory, high explosives, propellants and pyrotechnics-characteristics of explosives initiation, burning and detonation- Explosive burning and deflagration- Deflagration to detonation transition- burning mechanism of propellants- Explosive parameters- Measurement of various explosive parameters.

Unit -II

Chemical Thermodynamics of Gun Propellant: Introduction to gun, ammunition, projectiles and missiles- Energetic of gun propellants-Composition of gaseous products- Corrections to the basic calculations, prediction of propellant performance-The ratio of heat capacities.

Unit -III

Internal Ballistics: General introduction –Propellants-Driving Band engraving process, and the resistance to the in–bore motion of a projectile- Heating of gun barrel- Heat conduction in thick walled barrels- Numerical solution for heat conduction- Wear in gun barrels- Prediction of pressure history and muzzle velocity- The internal ballistics of leaking gun.

Unit -IV

In-Bore Dynamics: Introduction – Some historical back ground- Firing from a moving gun- The vibration of a gun barrel while the projectile is in the bore- Practical consequences of barrel vibration – Effect on the projectile of in-born motion.

Intermediate Ballistics: Gas dynamics of the muzzle flow fluid- Muzzle brakes, sabots, and blast suppressors- Store separation and sub- munitions discharge.

Recoil of Guns: Introduction-The rigid body motion of the rifling parts- Longitudinal vibration of a barrel

M.Sc. Forensic Science II Year
3T7-SV: Specialization V : Forensic Physics and Ballistics

3T7-SV-3 External Ballistics

Marks: 100 **Lecture: 4 hrs/week**

Unit -I

Projectile Aerodynamics: General introduction-yaw-The aerodynamic forces and moments acting on a projectile-linearised aerodynamics-centre of pressure and stability-Aerodynamic coefficients-Drag laws-Angular motion of projectiles-Gyroscopic stability-Yawing behaviour-The linearised theory of yawing motion-projectiles with slight configurational asymmetries-projectiles not obeying classical linear theory.

Unit -II

Projectile Transitional Motion: The ICAO standard atmosphere-Motion in vacuum-Motion of a point mass-Trajectory modeling-constant corrections to the plane-particle trajectory, biases-variable corrections to the plane-particle trajectory, dispersion-the effect of wind-The effect of initially yaw and yawing rate-the effect of projectile asymmetries.

Unit -III

Aeroballistic Design: Introduction-Artillery shell-Design criteria-Low drag design for artillery shell-stability of artillery shell.

Direct Fire Projectiles: Direct fire projectiles-spin-stabilized K.E. penetrators-statically stable K.E. penetrators and long rods-Aircraft fired projectiles-Bombs and sub munitions.

Aerodynamic prediction for Design purposes : Numerical solution of the full Navier-stokes equations-Analytical estimation methods- Numerical estimation methods-semi-empirical estimation methods.

Unit -IV

Measurement of Pressure: Copper Crusher Gauge- Piezo electric gauge- Buffer pressure- pressure, space and time curve- Strain measurement- Blast measurement.

Ballistic Measurements: Heat- Jump- Yam- Motion analysis- Height of burst-Frequency- illumination- Laser interferometry.

M.Sc. Forensic Science II Year
3T7-SV: Specialization V : Forensic Physics and Ballistics

3T7-SV-4 Terminal Ballistics

Marks: 100 **Lecture: 4 hrs/week**

Unit-I
Munitions: Introduction-penetration of spherical projectiles into earth-Fracture mechanics under impact- Fragmentation warheads-shaped charge warheads-High explosive squash head.

Unit-II
Kinetic Energy projectiles: Penetration into resisting medium-Empirical formulae for the prediction of penetration-Analytical models of failure modes-Numerical methods-plate charges.

Unit -III
Design and Defeat of Armour: Introduction –Mechanical property requirements-Armour material characteristics –Armour structure-stress-strain relationship-Waves in rods-Defeat of armour-Failure mechanism- Ballistics limit.

Unit -IV
Hydro-Ballistics: Transformation of coordinates related to torpedo- Hydrodynamic drag lift and coefficients- Underwater shocks- Underwater trajectories- Cavitation and impact phase, Prediction and Dispersion of Fire. Dispersion- Consistency-Accuracy- Precision-Probability of a hit- Circular probability areas –Dispersion of fire against aerial targets-Ricochet- Safety zones

M.Sc. Forensic Science II Year
3P3-SI: Practical I & II

Marks: 100 **Duration: 8 hrs/week**

Semester III

Practical I : Questioned Document Analysis& Forensic Linguistics

1. Examination of anonymous letters.
2. Application of Forensic Stylistics in personal identification.
3. Working and handling of Stereo Zoom Microscope and Comparison Microscope.
4. Forensic examination of inks.
5. Evaluation of copy-move forgery.
6. Comparison of disputed handwriting with specimen handwriting.
7. Study the natural variations and evolution of handwriting.
8. Examination of audio tapes/recordings for speaker identification and tape authentication.
9. Paper and ink examination by FTIR
10. Examination of rubber stamp impressions and other mechanical impressions.
11. Examination of alterations and obliterations in the Questioned Documents.
12. Decipherment of secret writing by various methods.
13. To perform TLC of inks using different solvent systems.
14. Examination of forgeries in security documents.
15. Study of psychological aspects of Suicide Notes/threatening letters/ransom notes.
16. Restoration of torn documents.

Practical II: Fingerprints and Forensic Photography

1. Development of fingerprint by physical methods (powder dusting method)
2. Development of fingerprint by Iodine fuming.
3. Development of fingerprint by chemical methods (Ninhydrin, Silver nitrate)
4. Development of fingerprints by cyanoacrylate fuming method.
5. Examination of creases and folds and determination of sequence of strokes.
6. Examination of Stamp Papers and Lottery Tickets.
7. Development of fingerprint on electronic media (pen drive, CD, DVD, hard disk etc.)
8. Photography of different crime scenes. (Indoor and Outdoor)
9. Document photographic techniques-close up photography, UV, IR, Transmitted and Oblique light photography.
10. To perform Contact and trick photography.
11. To perform various types of Surveillance Photography.
12. Digital photography of fingerprints and questioned documents.
13. Enlargement and printing of photographs (digital/films).

14. Presentation of evidence through photographs and charts.
15. Videography of the crime scene.
16. To photograph watermarks in the document.

M.Sc. Forensic Science II Year
3P4-SII : Practical I & II

Marks: 100 **Duration: 8 hrs/week**

Practical-I & II
(Forensic Biology and Entomology, Forensic Serology, DNA Fingerprinting, Forensic pathology and Microbial forensic)

Candidate should complete minimum 80% of the total no. of practical.

1) Microscopic examination of hair- scale casting
2) Species, race, sex determination from hair.
3) Examination of fiber (cotton, silk, wool, jute, rayon, nylon, asbestos etc.)
4) Identification and comparison of diatoms.
5) Biochemical examination of wood, pulp, paper.
6) Examination of plant and animal foods.
7) Examination of faecal matter and faecal stains.
8) Estimation of time since death from entomological evidences.
9) Preliminary examination of blood,semen,saliva, vomit etc.
10) Confirmatory tests of blood, semen, vomit etc.
11) Identification of origin of species (precipitin test)
12) Blood grouping by absorption inhibition method.
13) ABO blood grouping from other body fluids
14) Examination of Menstrual blood by microscopic, spectroscopic, electrophoretic method
15) Visit to autopsy center at mortuary, Forensic Science Laboratory, Pathology Laboratory, Veterinary Center, Biodiversity and wildlife Center.

M.Sc. Forensic Science II Year
3P5-SIII : Practical I & II

Marks: 100 **Duration: 8 hrs/week**

Practical-I &II

Candidate should complete minimum 20 of the total number of practicals.

1. TLC, GC analysis of anabolic steroids.
2. TLC, UV-Visible, HPLC Analysis of phenolphthalein in trap cases.
3. Analysis of alcohol content in sample by derivatization into known organic compounds and its analysis by GC, HPLC.
4. Determination of Mercury in biological materials by spectrophotometry.
5. Analysis of animal and insect toxins. (2)
6. To study the separation of metal ions by paper chromatography. (2)
7. TLC, GC analysis of barbiturates, benzodiazepine and amphetamines. (2)
8. Detection and identification of pesticide in a given formulation by colour test, TLC and UV-Visible spectrometer. (2)
9. Detection of metallic poisons in food stuff (simulated samples). (2)
10. Spectrophotometric/ Colorimetric determination of toxic metal ions. (2)
11. Spectrophotometric/ Colorimetric determination of non- metal ions. (2)
12. Extraction of different metals from viscera, urine, blood and other biological samples. (2)
13. Estimation of paints and pigments by spectrophotometry (UV, FTIR). (2)
14. Comparison of polythene films by IR spectrophotometry.
15. Separation of sample of forensic interest by column chromatography as a separation technique. (2)
16. Analysis of viscera for volatile poisons (Organic and Inorganic). (2)
17. Analysis of non- metallic (anionic) poisons in viscera. (2)
18. Chemical analysis of explosion residues.
19. Chemical analysis of cement samples (Silica percentage, acid insoluble percent etc.)
20. Analysis of petroleum product by chemical and instrumental methods.
21. Analysis of Plant poisons using TLC.
22. Extraction of organic poison from biological material by using solvent extraction technique.
23. Extraction of metallic poisons from biological materials by dry ashing/ wet digestion method.
24. Report submission on Industry/ Laboratory visit.

M.Sc. Forensic Science II Year
3P6-SIV : Practical I & II

Marks: 100 **Duration: 8 hrs/week**

Practical-I &II

Candidate should complete minimum 20 of the total number of practicals

Semester III Practical:

1. Wireless Network attacks , Bluetooth attacks
2. Firewalls , Intrusion Detection and Honeypots
3. Malware – Keylogger, Trojans, Keylogger countermeasures
4. Understanding Data Packet Sniffers
5. Understanding the buffer overflow and format string attacks
6. Using NMAP for ports monitoring
7. Understanding SQL Injection
8. Working with Trojans, Backdoors and sniffer for monitoring network communication
9. Denial of Service and Session Hijacking using Tear Drop, DDOS attack.
10. Penetration Testing and justification of penetration testing through risk analysis
11. Implementing Web Data Extractor and Web site watcher.
12. Using IP TABLES on Linux and setting the filtering rules
13. Lan Scanner using look@LAN, wireshark.
14. Understanding DoS Attack Tools- Jolt2, Bubonic, Land and LaTierra, Targa, Nemesy Blast,
Panther2, Crazy Pinger, Sometrouble, UDP Flood, FSMax.
15. Email header and URL analysis
16. Drive and partition carving process

M.Sc. Forensic Science II Year
3P7-SV : Practical I & II

Marks: 100 **Duration: 8 hrs/week**

Practicals

16. To Study the caliber and rifling characteristics
17. Forensic Examination of firearm(s).
18. To study assembling and dismantling of firearms.
19. To study the working mechanism of firearm(s).
20. Forensic Examination of rifles.
21. Forensic Examination of shotguns.
22. Forensic Examination of country-made firearms (desi-katta).
23. Forensic Examination of ammunition.
24. Dismantling of shotgun cartridge.
25. Determination of shot number from size and weight of shots.
26. Physical examination of propellant of ammunition.
27. Examination of choking in shotgun.
28. Study of constructional features of improvised firearms.
29. To study proof mark of firearm.
30. Study of constructional features of cartridge.

M.Sc. Forensic Science II Year
4T2: Criminology and Forensic Law

Marks: 100 **Lecture: 4 hrs/week**

Unit I: Criminal Law- II
Offences Relating to Coin and Government Stamps (Section 230-263A)
Offences affecting public health and safety(section 268-279)
Offences Relating to Forgery (Section 463- 477A)
Changes introduced in Indian Penal Code, 1860, Code of criminal procedure and Indian Evidence Act,1872 by Information Technology Act, 2000;

Unit II: Environmental Legislation
Constitutional Provisions for Environment protection in India;
Indian Forest Act, 1927
Environmental Protection Act, 1986;
Water (Prevention and Control of Pollution) Act, 1974;
Air (Prevention and Control of Pollution) Act,1981;
Wildlife Protection Act, 1972;
Hazardous Waste Management and Handling Rules,2008;

Biomedical Waste Management and Handling Rules, 2016;
Environmental Impact Assessment;
Supreme Court on Environmental protection.

Unit III: Special law- II
Provisions under Constitution of India (Articles 14, 15, 20, 21, 22, 51A);
Small Coins (Offences) Act, 1971;
Explosive substances Act, 1908;
The Arms Act, 1959;
The Food Safety and Standards Act, 2006 (Preliminary, Food safety and Standard Authority of India, General principles of Food safety, General provisions as to articles of food, Analysis of Food, Enforcement provisions, Offences and Penalties)
Intellectual property rights in cyberspace- (Copyright issues in cyberspace, Trademark issues in cyberspace, Computer software and related IPR Issues)

Unit IV: Rules of Admissibility of Forensic Evidence-II
Scientific evidence and Principles of General Acceptance;
Federal Rules of Evidence;
Admissibility of Fingerprint Evidence, Handwriting Evidence, Digital evidence etc.;
Ethical expectations from Expert witness;
Constitutional Validity of DNA fingerprinting, Narco-analysis test and Polygraph test;
Supreme Court on Admissibility of Expert Evidence.

M.Sc. Forensic Science II Year

4T3 SI-1: Questioned Document Analysis– I

Marks: 80 **Lecture: 4 hrs/week**

Unit I Forensic Accounting: What is Forensic Accounting, Mindset of the Forensic Accountant, Forensic Accounting Services, Investigative Services, Fraud Detection, Fraud examination, Fraud deterrence, Litigation Services, Expert Witness Service, Consulting Services, Forensic accountant vs Transactional accountant and auditors, Forensic Accounting Skills- Critical Thinking, Reasoning, Communication.
Fraud and White-Collar Crime, Types of white-collar crime, victim of white-collar crime, Fraud theory: Fraud Triangle, Fraud Diamond, conducting a fraud investigation, Gathering evidence- Interviews and Observations. Calculus of Fraud, Organizational Misconduct,Risk assessment.

Unit II: Financial Crimes: Characteristics of Financial Crimes, Spending, Saving, The structure, Conspiracy, categories of theft, Burglary, Larceny, Robbery, Embezzlement, Swindle, Schemes, Paper Liabilities trail, check registers, stocks and Bonds, Real property, Vehicle, other assets, jewelry, Furs and Clothing, Antiques, Philately, Numismatic, Artwork.

Unit III: Collection and Preservation of Evidences: Interviewing, gathering documentary evidences, Materiality, Competency, gathering evidence through observation, surveillance, Moving surveillance, Electronic surveillance and monitoring, Telephonic Intercepts, Undercover operation and boy wires.

Unit IV: Scope and Limitations of Document Examination: Handwriting examination, Imprint examination, Reprographic examination, dating examination etc. Problems faced during examination of questioned document. Implications of Frye and Daubert Standards in case works.
Graphology:Definition, History of Graphology, Characteristics of handwriting, Emotions and feeling, loops, Envelopes, graphomania, Signature, Position on the page, doodles, numbers, etc.

M.Sc. Forensic Science II Year
4T3 SI-2: Advanced Fingerprint Development Method-I

Marks: 80 **Lecture: 4 hrs/week**

Unit- I Metal Deposition Methods: Silver nitrate, Physical developer- Chemistry and mechanism, Sequencing, regent reliability test, bleach toning, potassium iodide toning, other toning process. Single Metal Deposition, Multi-metal deposition- I, II, III, IV, fluorescent and vacuum metal deposition-reaction mechanism, conventional gold zinc process, sequencing. Lipid Reagent: Sudan black, chemistry and mechanism of Oil red O, nile red, Europian chelate, etc.

Unit-II Nanotechnology in Fingerprints: Introduction, Structure and properties of nanoparticles, Role of nanotechnology in Forensics, role of nanotechnology in fingerprint development, stability of nanoparticles in solution: Van der Waals interactions, electrostatic repulsion, Steric Hindrance, Optical properties, Types of nanoparticles,Visualizing Fingermarks using nanoparticles, Future Perspectives.

Unit III:.Advanced Methods: Radioactive technique, Biological technique, reflected ultraviolet Imaging system, X-ray fluorescence, Chemical imaging. Challenging surface: Thermal Surface- Solvent treatment, amino acid/Protein reagent, Fuming method. Metallic reagent- Gun bleaching method, Oxidation reduction method, Electrochemical/corrosion method, Fuming method. Gloves- Deposition and development latent print on gloves. Adhesive tape-Tape separation method, processing the adhesive and non adhesive side of tape. Skin- Iodine silver plate transfer, Electronography, Powder method, Iodine-Napthoflavone, Direct lifting method.

Unit-IV: Enhancement Techniques for Fingerprints in Blood: Introduction, Development of techniques for proof and enhancement of blood, Heme Techniques, Protein staining blood enhancement techniques, Powder suspension techniques, amino

acid techniques, Spectrophotometric and spectrofluorimetric methods, Application of enhancement techniques, Aging of bloodstains, Sequencing of techniques to maximize enhancement and number of fingerprints.

M.Sc. Forensic Science II Year
4T3 SI-3: Forgery and Its Forensic Detection

Marks: 80 **Lecture: 4 hrs/week**

Unit I:Forgery: Types of forgery, attributes of assisted hand signatures, disguise, discriminators of device, flag of forgery and characters of genuineness, indicators of illiteracy, sign of senility, symbol of sinistrality, gender discrimination. Physical constraints, Scope of questioned document examination. Anachronistic features and their importance, detection and decipherment of alterations and erasures including additions, over writings, obliterations.

Unit II:Signatures and Handwriting: Examination of signatures – characteristics of genuine & forged signatures, examination of builtup of documents, identification of writer of forged writings/signatures. Importance of tremor in identification of writings and signatures, difference between tremors of fraud and genuine tremors in writings and signatures, hesitations, factors responsible for variations (under threat, while travelling, illness, old age, mental state, etc.)

Unit III:Security Documents: Use of computers in document examination, automated Signature verification system, determination of age of documents- relative and absolute age of documents, case studies. Examination of security documents by VSC including currency notes, Revenue stamps, travel documents - passports, visas, air - tickets, identity cards, lottery tickets, driving license, Bills, educational and financial documents, etc. different types of security features and their examination including watermarks, wire marks, security fibre/threads, Ghost/imitated marks/ security printing, optical variable inks, holograms and all other security features.

Unit IV:Other Documents: Types and working of Photostat machine, fax machine, printers, scanners. Identification & linkage of Photocopies and photocopier, typewriter, fax machine, scanner, Desktop printing including image processing device, their role in counterfeit currency and certificate etc. Holographic mark and their examination, Examination of credit, debit and other plastic cards, examination of photocopies, scanned documents, Fax copies etc., and case studies. Numismatic forgery- Introduction, tool, equipments and other resource, method of forgery- alteration, tooling, embossing, application and plating, Casting: Rubber mold model, wax model from mold, Burn out wax, treatment of casting, Creating dye- Cutting by hand, plating, casting and hubbing. Explosive impact copying preparation of detail report with reasons and illustrative charts, uses of standard terminology.

M.Sc. Forensic Science II Year

4T3 SI-4: Automated Fingerprint Identification System

Marks: 80 **Lecture: 4 hrs/week**

Unit-I :Fingerprints and AFIS: History of automated identification system: Early print, single database, growth and development of AFIS system, Transmission standard, ANSI standard, compression standard. NCIC classification system, Henry and American classification system, working of AFIS- Database, processing ten print, latent print processing, latent search. Types of AFIS searches: Ten print to Ten print search, Latent to ten print search, Latent to latent search. AFIS report: Ten print report and latent print report.

Unit-II: Automated Fingerprint classification systems: History of pattern recognition-development of fingerprint classification system, forensic fingerprint classification system, Forensic Fingerprint Identification, Diffusion of Fingerprint system, Automation fingerprint system. Mathematical model of fingerprint topology, Fingerprint verification system, Fingerprint representation, Fingerprint matching. Transition of configuration.

Unit-III: Identification of Latent Print: Introduction, recognition and examination, Identification and Individualization by Osborn grid method, Seymour method, Photographic strip method, Polygon method, Overlay method, Osterburg method, microscopic triangulation method, conventional method. Identification protocol and reconstruction of latent print. Fingerprint quality assessment: Introduction, assessing fingerprint quality, non uniform contact, Inconsistent contact, enhancing Fingerprint image by Directional fourier filtering. Advances in Fingerprint sensor using RF Imaging Technique- Introduction, taxonomy of Fingerprint sensing method, Intrinsic advances of Electric sensing, Commercial capacitive sensor implementation, RF Imaging, RF electric field model, Circuit model.

Unit-IV: The Expert Fingerprint Witness: Definition of expert, Qualification, Knowledge- History and classification of fingerprint, latent print procedure. Evidence examination, pretrial conference with prosecuting attorney and defense attorney. Courtroom methodology: Direct examination, Swearing In, assuming the witness stand, courtroom communication, credentials, response to the jury, courtroom courtesy. Verbal and non-verbal Court presentation.

M.Sc. Forensic Science II Year

4T4 SII-1: Forensic Anthropology and Odontology

Marks: 80 **Lecture: 4 hrs/week**

Unit I: Theories for Anthropology: The scope of anthropology (Paleoanthropology, skeletal biology and human osteology, Paleopathology and Bio-archeology, Forensic Anthropology); Fossil formation, taphonomy, Relative dating techniques, Chronometric dating techniques; Bio-cultural and evolutionary approaches to disease, Birth, growth and aging; infectious disease and bio-cultural evolution; Role of anthropology in mass disaster, Physical Anthropology and its forensic aspects.

Unit II: Forensic Anthropology:Bio-archeology- Field recovery methods, Laboratory processing, curation and chain of custody, Age at death, sex, ancestry, height and weight, premortem injury and disease, taphonomy, peri-mortem trauma, post-mortem trauma, DNA Kinship and identity; Identification and forensic Anthropology: Time since death, ante-mortem records and positive ids, facial reconstruction, (Biological anthropology: The natural history of human kind: Craig Stanford, John S Allen and Susan C Anton).

Unit III: Personal Identification of Living & Dead- Identification through somatometric and somatoscopic observation, nails, occupation marks, scars, tattoo marks and deformities, handwriting and mannerisms; Genetic traits of forensic significance: ear lobe, brachydactyly, polydactyly, widow's peak, eye and hair-color, face form, frontal eminences, nasal profile, nasal tip, lips, chin form; Skeletal age (Earlier years): Prenatal ossification, Postnatal appearance and union of centers of ossification, Differences due to race; Skeleton age (Later years): Cranial suture closure, pubic symphysis; Sexing skeletal Remains: General consideration and age factors, Sex differences in skull, Pelvis and long bones. Calculation of stature of long bones: Studies on stature reconstruction in various population groups;Uses of fragmentary long bones in stature reconstruction; Racial differences in human skeleton; distinguishing humans from other nonhuman skeletal remains.

Unit IV: Forensic Odontology: Definition and Scope of Forensic Odontology, Types of dentition, Basic structure of human teeth, types of teeth & their morphology, and determination of age from teeth using various methods, dental anomalies and their role in Personal Identification; Bite marks: Types & forensic importance; Collection and preservation of samples, analysis of Bite marks, presentation of bite mark evidences in court of law; Role of Forensic Odontology in mass disaster victim identification; Dental Charting; Comparison of Ante-mortem and postmortem dental records.

M.Sc. Forensic Science II Year

4T4 SII-2: Microbial Forensics and Bioinformatics

Marks: 80 **Lecture: 4 hrs/week**

Unit I:

Microbes of Forensic Importance: *Bacillus anthracis, Yersinia pestis, Francisellatularensis, Brucella spp., Burkholderiapseudomallei, Clostridium botulinum, Listeriamonocytogenes* and their morphological & biochemical studies;DNA of microbes in soil for crime detection; Fungi of forensic importance: Opportunistic mycoses, *Chytridiomycota zygomycota, Aspergillus fumigates, Microsporidum, Pneumocytosisjiroveci, Asp.flavus& Candida sp,* epidemiology; Antifungal agents; Food borne – *Shigella, Salmonella,*etc.; Forensic Aspects of Biological Toxins; Microbial Forensic Analysis of Trace and Unculturable Specimens etc.

Unit II:

Biological agents in warfare: Collection, transportation and preservation of microbial forensic samples, Categories of biological weapons; study of potential bacteria, fungi, viruses, and their toxins, mode of action, identification, preventive measures during handling; laboratory setup, epidemiologic investigation for public health, investigation of suspicious disease outbreak; Biosafety and biosecurity, Biosurveillance documentation and case studies, Toxin analysis using mass spectrometry, Non-DNA methods for Biological Signatures, Electron beam based methods for bio-forensic investigations, proteomics development and application for bio-forensics, design of genomics, design of nucleic acid signature for pathogen identification and characterization.

Unit III:

Bioinformatics & its Applications: Public domain databases for nucleic acid and protein sequences (EMBL, Gene Bank), database for protein structure (PDB); Bioinformatics methods for microbial detection and forensic diagnostic design: Whole genome analysis, DNA analyses for repeats (Direct and inverted); palindromes, open reading frames, annotations of genes, identification of gene.

Sequence alignment: Concept of local and global sequence alignment, Pairwise sequence alignment, scoring an alignment, substitutional matrices, multiple sequence alignment.

Unit IV:

Bioinformatics & its Applications: Overview of comparative genomics, Computational methods, homology algorithms (BLAST, FASTA) for proteins and nucleic acids,Oligonucleotide probe synthesis, artificial gene synthesis, primer and probe designing, CODIS and NDIS.

Phylogenetic analysis: Basic concept of phylogenetic analysis, rooted/unrooted trees, approaches for phylogenetic tree construction (UPGMA, Neighbor joining, Maximum parsimony, Maximum likelihood).

M.Sc. Forensic Science II Year

4T4 SII-3: DNA Fingerprinting

Marks: 80 **Lecture: 4 hrs/week**

Unit I:

Advanced techniques in DNA profiling: Uni-parentally inherited genetic markers in ethnic and geographical origin detection, DNA Profiling Kits (Easy DNA, Pro-filer, etc.) DNA fingerprinting of degraded samples, next generation sequencing, Drug- DNA interactions, SNP microarray for supplementary paternity testing; mitochondrial DNA analysis, DNA multi-reverse parental analysis, cytochrome b analysis, eDNA Personal Effects and DNA analysis(sources and problems)

Unit II:

DNA Fingerprinting Applications: Case studies in disputed paternity cases, child swapping, missing person's identity, civil immigration, veterinary, wild life and agriculture cases;Legal perspectives– legal standards for admissibility of DNA profiling – procedural & ethical concerns, status of development of DNA profiling in India & abroad; Limitations of DNA profiling; Population databases of DNA markers –STRs, Mini STRs, SNPs, Uses of STR Typing; New & future technologies: Microarrays technology, Synthetic DNA, analysis of Degraded DNA, Low Copy Number DNA, MALDI-ToF, Mass Spectrometry.

Unit III:

Forensic DNA evidence interpretation: Interpretation of DNA typing results-Complicating Factors (Multiple contributors, degradation, and extraneous substances), Systemspecific Interpretational Issues (RFLP, PCR systems); Assessing strength of evidence: Determination of Genetic Concordance, Evaluation of Results, Frequency Estimate Calculations, Population Substructure, Likelihood Ratios, and Uniqueness of DNA Profile; Admissibility standards: Frye, Daubert, and the Federal Rules of Evidence, Landmark cases, The State of Debate; Prosecutor's fallacy, defendant's fallacy; Ethics of DNA analysis and Post-conviction DNA analysis.

Unit IV:

The DNA Databank and Quality Assurance– Premise of a data bank; Elements of a successful databank – legislation, collection of samples, analysis of samples; Transformation of analyzed data into a databaseQuality Assurance– Certification and Accreditation, SWDAM, NRC I and II

M.Sc. Forensic Science II Year

3T4 SII-4: Wildlife and Environmental Forensics

Marks: 80 **Lecture: 4 hrs/week**

Unit I:

Wildlife Forensic: Protected and endangered species of animals and plants; Sanctuaries and their importance; Relevant provision of wild life and environmental act; Types of wildlife crimes, different methods of killing and poaching of wildlife animals; Enforcement of wildlife protection policy, Wild animals as pharmacopeias, Wildlife artifacts(Bones, skin, fur, hair, nails, blood, feather, etc.); Trade in wild animals- elephant, Indian rhino, wild cat, poisonous snakes for venom and skin, crocodiles, salamanders, deer, birds (feathers Macau parakeets, whales, sharks, spectacle bear, Himalayan antelopes.

Unit II:

Wildlife Forensic: Recovering evidence at poaching scenes; Locating the burial: Anomalies on the surface international trade in reptile skins, Challenges to species identification of reptile skin products, species and products represented in the reptile skin trade, reptile scale morphology basics and current limitations, Identifying features of major reptile groups.

Unit III:

Environmental Forensics: Introduction to Environmental Forensics; Mercury- Natural and anthropogenic sources, detecting mercury in indoor environment and forensic aspects; Asbestos-sources and detection in air, water, fibres etc; Sewage, Lead- sources, compounds, analytical methods and lead forensics; Arsenicsources, compounds, analytical methods and forensic aspects; Pesticides- Types, analytical testing and forensic techniques; Polycyclic aromatic hydrocarbons (PAHS)- sources, types and analytical techniques; Crude oil and refined products- oil analysis methods, oil spill analysis protocol.

Unit IV:

Environment and Ecosystems: Ecosystem characteristics structure and function,environmental pollution, xenobiotic and recalcitrance, Introduction to BOD and COD, use of biosensors to determine the quality of environment, Introduction and scope of environmental management, basic concepts of sustainable development, Environmental Impact Assessment (EIA), general guidelines for the preparation of environmental impact statement (EIS), international organization for standardization (ISO), ISO 14000 standards and certification, environmental safety, risk management and emergency preparedness, international summit and treaties, important dates dedicated to environmental management.

M.Sc. Forensic Science II Year

4T4 S III-1: Instrumentation

Marks: 80 **Lecture: 4 hrs/week**

Unit I: Advanced Chromatography – II

Principle, theory, instrumentation and applications of Electrophoresis, Ion-exchange and Size Exclusion (Gel Permeation) Chromatography

Introduction to hyphenated techniques: GC-MS, LC-MS and related hyphenated techniques

Unit II: Atomic Spectroscopy – II

Principle, theory, instrumentation and applications of Inductively Coupled Plasma-Mass Spectrometry, Inductively Coupled Plasma-Optical Emission Spectroscopy, X-ray Fluorescence (XRF) and X-ray diffraction (XRD)

Unit III: Molecular Spectroscopy – II

Mass Spectrometry: Introduction, Review of Mass spectrometry, Basic Principles and Theory, Instrumentations and technique, Ionization methods, Fragmentations in Mass spectrometry, high resolution mass spectrometry

Nuclear Magnetic Resonance Spectroscopy: Introduction, Nuclear Spin States, Resonance, Basic principle, Chemical Shift and Shielding effect, Chemical equivalence, Spin-spin splitting (n+1 Rule), Introduction to ^{13}C NMR, Problem based on ^{1}H and ^{13}C NMR, Use of NMR in Forensic analysis.

Unit IV: Miscellaneous – II

Scanning Electron Microscopy and Transmission Electron Microscopy: Basic theory and principles, instrumentation, forensic applications of SEM, SEM-EDS, TEM and HR-TEM

Isotope dilution analysis: Principle, types of isotope dilution analysis, typical applications of isotope dilution analysis.

M.Sc. Forensic Science II Year

3T4 SIII-2: Advanced Forensic Chemistry

Marks: 80 **Lecture: 4 hrs/week**

Unit I: Dyes andPigments

Dyes: Different types of dyes, role of dyes in crime investigation, food colours (edible and non- edible dyes); dyes used in cosmetic and pharmaceutical products. Chemical and instrumental methods of analysis of dyes; Analysis of trace evidence: cosmetics, dyes, Trap related evidence materials, fibers, oils, fats, grease, chemicals and plant material.

Pigments: Introductions, white pigments, Manufacturing process and properties of blue pigment, red pigment, green pigment, yellow pigment

Unit II: Illicit Drugs

Illicit drug types, search of clandestine laboratory, precursors and their analysis, estimation of morphine in opium and heroin in smack. Analysis of drugs in biological samples and their importance: Urine, blood, viscera, etc. Methods of extraction of drugs, limitations of chemical analysis of drugs, report writing and interpretation of drugs.

Unit III: Fertilizers, Pesticides and Other Chemicals

Introduction to fertilizer, different types of fertilizers and classification, substandard and sub-standard adulterated fertilizers, common adulterants; Chemical and instrumental methods of analysis of fertilizers; forensic analysis of organic and inorganic fertilisers, pesticides, insecticides, metallic and non-metallic products, consumer items such as gold, silver, tobacco, tea, sugars, acids and alkalis etc.

Unit IV: Analysis of Beverages & Prohibited Substances

Introduction of alcohol (ethyl alcohol, methyl alcohol) and illicit liquor, Extraction methods of alcohol (Distillation), Proof spirit, absorption, metabolism, de-toxification and excretion of alcohol, Analysis of alcohol by colour tests, GC,GC-MS, Consequences of drunken driving, breath analysis by Breath Analyzer, Detection of alcohol in blood and urine, Alcohol and prohibition.

Analysis of Beverages: Analysis of alcoholic beverages, Detection and Determination of ethanol, furfural, organic acids, aldehydes, chloral hydrate, methanol and ethylene glycol in liquors by colour tests, GC and GC-MS methods and Case Studies.

M.Sc. Forensic Science II Year

3T4 SIII-3: Advanced Forensic Toxicology

Marks: 80 **Lecture: 4 hrs/week**

Unit I: Food Poisons, Pesticides and Insecticides

Food Poisons: Introduction, Food poisoning due to chemical, bacterial and fungal, Sign and symptoms of food poisoning, collection and preservation of evidence material, extraction and isolation, from food material, Biological material, detection and identification by colour test and instrumental techniques.

Pesticides and insecticides: Classification, nature, fatal dose, fatal period, symptoms, post-mortem findings, medico legal significance and analysis of Organophosphorous, Organochlorine, Carbamate and Pyrethroids insecticides and pesticides.

Unit II: Plant Poisons:

Classification and types (Dhatura, *Abrus precatorious*, *Nerium oleander*, *Calotropis gigantia*, *Gloriosa superba*, Ergot, Mushroom etc.) of Plant Poisons: Nature, extraction from viscera, blood, vomit etc. Fatal dose, fatal period, signs and symptoms, post-mortem findings, detection (preliminary and confirmatory tests) and medico-legal significance

Unit III: Animal Poisons

Classification and types (neurotoxin, myotoxin, cantharides, vasculotoxin, spider, snakes, scorpion, etc.) of Animal Poisons: Nature, extraction from viscera, blood, vomit etc. Fatal dose, fatal period, signs and symptoms, post-mortem findings, detection (preliminary and confirmatory tests) and medico-legal significance

Unit IV: Non-Volatile Organic Poisons:

Classification and types (alkaloids, sedatives, stimulants, hallucinogens, sominiferous, spinal, cardiac etc.): Nature, extraction from viscera, blood, vomit etc. Fatal dose, fatal period, signs and symptoms, post-mortem findings, medico-legal significance and detection (preliminary and confirmatory tests); Asphyxiants (carbonmonoxide, carbondioxide, hyrdrogensulphide, nitrousoxides, war gases, etc)

M.Sc. Forensic Science II Year

4T4 SIII-4: Pharmaceutical and Narcotic Drugs

Marks: 80 **Lecture: 4 hrs/week**

Unit I: Pharmaceutical and crude drugs

Pharmaceutical Drugs:

Antidepressants, antipsychotics, antibiotics, tranquillizers, anti-seizure drugs; Nature, extraction from viscera, blood, vomit, etc; Fatal dose, fatal period, signs and symptoms, post-mortem findings, medico-legal significance and detection (preliminary and confirmatory tests)

Crude Drugs: Definition and aim of Pharmacognosy; drugs from plant, animal and mineral origin, their definition, nomenclature and classification; factors affecting the activity: collection, preservation, storage of crude drugs, toxic effects of crude drugs.

Unit II: Pharmacology

Pharmacokinetics: Active and passive absorption, blood-brain barrier and placental filter. Routes of administration, Drug absorption, distribution, metabolism and elimination; Drug bioavailability, bioequivalence and half-life; Pharmacokinetic parameters evaluation; Time course of drug plasma concentrations after single and repeated administrations by multiple dosage regimens

Pharmacodynamics: Receptor classification, Drug-receptor interactions and signal transduction mechanisms**.** Dose-effect relationships; agonists, partial agonists and antagonists; Factors that modify drug actions; side effects, overdose, idiosyncratic and allergic reactions; teratogenesis and foetal toxicity; Drug interactions and pharmacogenetics

Unit – III: Narcotic Drugs and Other Chemicals

Designer drugs, club drugs, Drugs of abuse in sports: Introduction, common prohibited substances, analytical approach, Solvent Abuse (chlorinated hydrocarbons, Aromatic hydrocarbons, alcohols, glycols, fuel and fuel additives): absorption, distribution, and metabolism, psychological & clinical effects; Collection of sample, extraction and analysis by GC, HPLC

Narcotics Drugs and Psychotropic Substances: Introduction, Cl**a**ssification, Nature, Fatal dose, fatal period, signs and symptoms, post-mortem findings, extraction from viscera, blood, vomit, urine etc. Medico-legal significance of stimulants, hallucinogens, barbiturates, depressants, cannabis, sedatives etc

Unit IV: Analysis of Narcotics Drugs and Psychotropic Substances

Field test, colour test, microcrystal test and TLC analysis of depressants, stimulants, hallucinogens, barbiturates, cannabis, sedatives, etc

HPLC, GC, IR, UV-Visible, mass spectrometric analysis of Opium, Cannabis and their derivatives, depressants, stimulants, hallucinogens, barbiturates, sedatives, etc

M.Sc. Forensic Science II Year

4T6- SIV-1: Steganography and Watermarking

Marks: 80 **Lecture: 4 hrs/week**

UNIT I

Introduction: Information Hiding, Steganography, and Watermarking, Importance of Digital Watermarking, Steganography Applications and Properties: Applications of Watermarking, Applications of Steganography, Properties of Watermarking Systems, Evaluating Watermarking Systems, Properties of Steganographic and Steganalysis Systems, Evaluating and Testing Steganographic Systems

UNIT II :

Models of Watermarking: Communication-Based Models of Watermarking, Geometric Models of Watermarking, Modeling Watermark Detection by Correlation, Basic Message Coding: Mapping Messages into Message Vectors, Error Correction Coding, Detecting Multisymbol Watermarks

UNIT III

Watermarking with Side Information: Informed Embedding, Watermarking Using Side Information, Dirty-Paper Codes Robust Watermarking: Approaches, Robustness to Valumetric Distortions, Robustness to Temporal and Geometric Distortions

UNIT IV :

Watermark Security: Security Requirements, Watermark Security and Cryptography, Some Significant Known Attacks Content Authentication: Exact Authentication, Selective Authentication, Localization, Restoration Steganography: Notation and Terminology, Information-Theoretic Foundations of Steganography, Practical Steganographic Methods, Minimizing the Embedding Impact Steganalysis: Steganalysis Scenarios, Some Significant Steganalysis Algorithms

M.Sc. Forensic Science II Year
4T6- SIV-2: Mobile and Smart Phone Forensics

Marks: 80 **Lecture: 4 hrs/week**

UNIT I : Mobile Forensics
Cell phone and mobile device forensics, Understanding Mobile device forensics, Understanding acquisition procedure, Cell phone Crimes, SIM Architecture, Data Storage, Data Extraction, Files Stored on SIM, Mobile Operating System

UNIT II: Digital Evidence
Mobile Device Forensics • Types of Evidence on Mobile Devices • Handling Mobile Devices as Sources of Evidence • Forensic Preservation of Mobile Devices • Forensic Examination and Analysis of Mobile Devices • Forensic Acquisition and Examination of SIM Cards • Investigative Reconstruction Using Mobile Devices Future trends

UNIT III: Andriod and iOS Systems
Architecture, Differentiation, Technological Composition, Introduction to Andriod Platform, Introduction to iOS Platform

UNIT IV: Mobile File Systems and Data Structures
Introduction, What and How of Data, Types of Memory, File Systems, Rootfs, devpts, sysfs, cgroup, yaffs2, Procedure for handling an Andriod Devices, Logical Techniques VS Digital Techniques, Introduction to Mobile Malware

M.Sc. Forensic Science II Year
4T6- SIV-3: Biometrics

Marks: 80 **Lecture: 4 hrs/week**

Unit I: Biometrics: Introduction, Physiological or Behavioral, Verification Vs Identification, Applications, Biometrics Technologies, Working of Biometrics, Benefits, Application Design. Multi-Modal Biometrics: Introduction to Multi-Modal Biometric Systems, Fusion Methodology, Levels of Fusion, Feature-Extraction Level Fusion, Data-Matching Level Fusion, Probabilistic-Decision level Fusion, Fusion Procedure, Modes of Operation, Integration Strategies, Design Issues, Soft Biometrics, A Biometric Vision.

Unit II: Fingerprint Recognition: What Is Fingerprint Scanning? Practical Applications for Fingerprint Scanning, Accuracy and Integrity, Fingerprint Matching, Fingerprint

Classification, Fingerprint Image Enhancement, Fingerprint Feature Extraction, Fingerprint Form Factors, Types of Scanners: Optical - Silicon – Ultrasound, Fingerprint Matching.

Unit III: Speaker Recognition: Algorithms for training, recognition and adaptation to speaker and transmission channel, mainly based on Hidden Markov Models (HMM), methods for reducing the sensitivity to external noise and distortion, acoustic modeling of static and time varying spectral properties of speech, statistic modeling of language in spontaneous speech and written text, specific analysis and decision techniques for speaker recognition.

Unit IV: Face Recognition: Introduction to Face Recognition, How is Face Recognition Technology Currently Being Used? How Well Does Face Recognition Work, Why Face Recognition, Face Recognition: How it Works, Image Quality, Facial Scan Process Flow, Verification vs. Identification, Primary Facial Recognition Technologies, Facial Recognition Applications

M.Sc. Forensic Science II Year

4T6- SIV-4: Malware Forensics

Marks: 80 **Lecture: 4 hrs/week**

Unit I: Introduction to malware analysis

1. What Is Malware?
2. What Is Malware Analysis?
3. Why Malware Analysis?
4. Types Of Malware Analysis
5. Setting Up The Lab Environment

5.1 Lab Requirements
5.2 Overview Of Lab Architecture
5.3 Setting Up And Configuring Linux VM
5.4 Setting Up And Configuring Windows VM

6. Malware Sources
7. Memory Forensic

7.1. Memory Forensics Methodology
7.2. Windows Memory Forensics Tools
7.3. Active, Inactive, and Hidden Processes
7.4. How Windows Memory Forensics Tools Work

Unit II: Malware Incident Response

1. Introduction
2. Building Your Live Response Toolkit
3. Volatile Data Collection Methodology
4. Collecting Process Information
5. Correlate Open Ports with Running Processes and Programs
6. Identifying Services and Drivers
7. Determining Scheduled Tasks
8. Collecting Clipboard Contents
9. Non-Volatile Data Collection from a Live Windows System
10. Forensic Duplication of Storage Media on a Live Windows System
11. Forensic Preservation of Select Data on a Live Windows System
12. Volatile Data Collection Methodology
13. Non-Volatile Data Collection from a Live System

Unit III: Static Analysis of malwares

1. Determining the File Type
1.1. Identifying File Type Using Manual Method
1.2. Identifying File Type Using Tools
1.3. Determining File Type Using Python
2. Fingerprinting the Malware
2.1. Generating Cryptographic Hash Using Tools
2.2. Determining Cryptographic Hash in Python
3. Multiple Anti-Virus Scanning
3.1. Scanning the Suspect Binary with VirusTotal
3.2. Querying Hash Values Using VirusTotal Public API
4. Extracting Strings
4.1. String Extraction Using Tools
4.2. Decoding Obfuscated Strings Using FLOSS
5. Determining File Obfuscation
5.1. Packers and Cryptors
5.2. Detecting File Obfuscation Using Exeinfo PE
6. Inspecting PE Header Information
6.1. Inspecting File Dependencies and Imports
6.2. Inspecting Exports
6.3. Examining PE Section Table And Sections
6.4. Examining the Compilation Timestamp
6.5. Examining PE Resources
6.6. Comparing And Classifying The Malware
6.7. Classifying Malware Using Fuzzy Hashing
6.8. Classifying Malware Using Import Hash
6.9. Classifying Malware Using Section Hash

Unit IV: Dynamic Analysis of Malwares

1. Lab Environment Overview
2. System And Network Monitoring
3. Dynamic Analysis (Monitoring) Tools
3.1 Process Inspection with Process Hacker
3.2 Determining System Interaction with Process Monitor
3.3 Logging System Activities Using Noriben
3.4 Capturing Network Traffic With Wireshark
3.5 Simulating Services with INetSim
4. Dynamic Analysis Steps
5. Putting it All Together: Analyzing a Malware Executable
5.1 Static Analysis of the Sample
5.2 Dynamic Analysis of the Sample
6. Dynamic-Link Library (DLL) Analysis
6.1 Why Attackers Use DLLs
6.2 Analyzing the DLL Using rundll32.exe
6.2.1 Working of rundll32.exe
6.2.2 Launching the DLL Using rundll32.exe
6.3 Analyzing a DLL with Process Checks

M.Sc. Forensic Science II Year
4T7-SV: Specialization V : Forensic Physics and Ballistics

4T7-SV-1 Forensic Physics

Marks: 100 **Lecture: 4 hrs/week**

Unit -I:

Motor Vehicle Crimes: Crimes and vehicles, Road accidents, Theft of Vehicle, Abandoned Vehicles, Vehicle involved in terrorism and Investigation. Evidentiary clues; the vehicle, the scene, the culprit/victim. Collection and Evaluation of; Tyre, tyre marks, tyre residues, tire bursts. Mechanical failure. Crime Scene Management in motor vehicle cases, Forwarding Exhibits in Motor vehicle cases, Important Crime cases, Vehicle involved in Explosion.

Unit -II:

Hit and Run cases and Investigation: Nature and causes, Collection of evidence; paint, automobile window glass, Head light- tail light, scratch marks, bulb filament, fibre and rubber, chassis and engine number, RTO registration number and related documentary clues. Analytical Technique for the analysis of evidence involved in Hit and Run cases;

Types of glass and their composition, forensic examination of glass fractures under different conditions, analysis of glass.

Unit -III:

Soil: Physical examinations of soil evidence, Soil mechanics, Structure & Composition, Baking, Compaction and Agro-soil additives, Instrumental analysis of soil, Interpretation of soil evidence, Standard Operating Procedures for examination, Discussion on important case studies of soil evidence.

Paint: Types of paint and their composition, physical examination of paint, instrumental analysis of pigment, interpretation of paint evidence, Standard Operating Procedures for examination, Manufacturing and physical properties of paint. analysis of paint, Raman and IR spectroscopic analysis of Paints. Important case studies of paint evidence.

Unit -IV:

Reconstruction of sequence of events in crimes involving firearms, determination of direction of firing & sequence of shots. Scientific methods of shooting reconstruction, suicide, murder, accident, self-defense and encounter cases. All considerations during direct investigation of shooting incidents without the benefit of original crime scene investigation – the scene of occurrence, medico-legal report, basic ballistic facts, laboratory examination report, firearm and ammunition, clothes of victims, etc. Documentation and evaluation of bullet holes, ricochet marks, pellet pattern in various targets, etc.

M.Sc. Forensic Science II Year
4T7-SV: Specialization V : Forensic Physics and Ballistics

4T7-SV-2 Ballistics Modeling and Analysis

Marks: 100 **Lecture: 4 hrs/week**

Unit-I

Mathematical and Statistical Modeling: System- Model- Classification- Modeling methods-Dimensional analysis-Finite Exploratory data analysis-Goodness of fit – Introduction to Bayesian inference-Bayes estimate and risk-Linear model- Analysis of variance- Describing systems-Dynamic systems- discrete system- system optimization Introduction to system modeling concepts- Gframework for modeling & simulation

Unit-II

Advanced Modeling Techniques: Design of experiments- Model fitting- Missing data analysis- Fuzzy modeling &neural network- Neural network- Reliability and reliability models

Unit -III

Prediction of pressure history and muzzle velocity- Lumped parameter model- gas dynamics model- The mathematical modeling of gun barrel vibration-Validation of computer models.

Unit -IV

Trajectory modeling- The in- vacuo trajectory model- The point-mass model- The modified point- mass model-The six degree- of freedom model.

Fundamental forces in the atmosphere- Basic equations governing the atmospheric circulation-Effect of earth's rotation- Scale analysis and simplification of equations to hydrostatic approximation and geo- strophic approximation- Circulation and vorticity-Numerical model- Weighting factors and differential corrections to trajectories

M.Sc. Forensic Science II Year
4T7-SV: Specialization V : Forensic Physics and Ballistics

4T7-SV-3 Weapon Systems and Ballistics Measurements

Marks: 100 **Lecture: 4 hrs/week**

Unit -I

Ordnance: Classification, small arms, Mortars-Howitzers-Guns, Rocket launchers, Basic components and functional requirements.

Unit -II

Gun Barrel and Tube Launcher: Theory of thin cylinders, use of plastic region of the material and its application to the pre-stressing tube, theory of failure, approximate Mises Hencky criteria, principle of monoblock non-auto-frettaged and auto-frettaged barrels.
Gun Design: Gun design rules, Design of combustion chambers, Rifling profile and stress due to rifling, Gun tube acoustics, Gun erosion

Unit -III

Ordnance: Obturation, Muzzle brake, fume extractor, Firing mechanism, functions and characteristics of saddle, cradle, traversing and elevating gears, balancing gears.
Recoil System: Elements of recoil mechanism, small arms, method of obtaining automatic fire, factors affecting recoil gas system, feed mechanism, trigger mechanism, sights**.**

Unit -IV

Measurement of velocity and trajectory elements: Foil and counter, Optoelectronic means, Doppler RADAR, Telemetry, High speed Photography, Videography, Photogrammetry.
Measurement of Space: Distometer, LASER range finder, Theodolite, Recoil and Run out, Height of burst, Barrel Vibration

M.Sc. Forensic Science II Year
4T7-SV: Specialization V : Forensic Physics and Ballistics

4T7-SV-4 Rocket Ballistics

Marks: 100 **Lecture: 4 hrs/week**

Unit -I

Ballistics of Rockets: Rocket motors and nozzle design- The internal ballistics of motors-Launch dynamics External ballistics of rockets. **Fundamentals of Aerodynamics:** Fundamental physical quantities- Law of conservation- Different types of flows- Aerodynamic forces- Aerofoil and wings- compressible flow-critical Match number- Drag divergence Mach number-shock wave- Expansion fan- Missile body.

Unit -II

Introduction to Missile Propulsion: Definition of thrust and basic principles- Types of propulsion systems- Combustion chambers- Nozzle types- Basic thermodynamics- Rocket performance parameters- solid and liquid rocket system.

Unit -III

Types of Guidance: Principle of beam rider guidance- Homing guidance system and command guidance system, Introduction to IR laws- IR systems- IR homing head, Introduction to INS, SDINS, MFAR, GPS and WAAS.

Unit -IV

Introduction to Missile Control: Task of missile control system- Control methods- aerodynamic control and thrust vector control- Cartesian and polar control- rear control- canard control and moving wing control-Roll control and its necessity- Missile auto pilot.

M.Sc. Forensic Science II Year
4P3-SI : Practical I

Marks: 100 **Duration: 8 hrs/week**

Semester IV
Practical (Questioned Document and Fingerprint)

16. Examination of typescripts/printed matter/ Scanned documents/ fax.
17. Examination of handwriting on unusual surfaces.
18. Examination of handwriting for individualization.
19. Effect of different surfaces on natural variations in handwriting.
20. Working and handling of Video Spectral Comparator.
21. Working and handling of stereo zoom microscope.
22. Examination of security features of currency notes by VSC.
23. Examination of security features of travel documents by VSC.
24. Examination of security features of plastic money by VSC.
25. Determination of sequence of strokes by VSC.
26. Examination of alterations and obliterations by VSC.
27. Graphological Analysis of handwriting.
28. Preparation of Excel sheet for data entry and use of various statistical and graph functions.
29. Examination of mark sheets/cheques/identification cards etc. by VSC.
30. Development of latent prints on challenging surfaces.

M.Sc. Forensic Science II Year
4P8-SI : Project

Marks: 100 **Duration: 8 hrs/week**

Project relevant to specialization

M.Sc. Forensic Science II Year
4P4-SII : Practical I

Marks: 100 **Duration: 8 hrs/week**

(Forensic Anthropology and Odontology, Microbial Forensics and Bioinformatics, DNA Fingerprinting, Wildlife and Environmental Forensics)

Marks: 100 Lectures: 8hrs/week

Candidate should complete minimum 80% of the total no. of practical.

21. Side and site determination from long bones.
22. Stature estimation from bones.
23. Sex determination from various bones.
24. Age determination from bones.
25. Age estimation from teeth.
26. Bite mark analysis.
27. DNA typing technique (RFLP, PCR, etc.)
28. Separation of serum protein by horizontal submerged gel electrophoresis.
29. Separation of sugar, amino acid by TLC
30. To perform Calibration of refrigerator, centrifuge, micropipette, digital balance.
31. To perform primer designing using bioinformatics tools.
32. To perform Homogenization of various forensic sample.
33. To determine paternity index using serum profile.
34. Chromosome staining by Giemsa.
35. DNA extraction from blood/Semen/Saliva/Epithelialcell/Bones/Teeth/nails
36. Western blotting analysis
37. Extraction of mitochondrial DNA from forensic samples
38. Performe a BLAST of given protein / nucleic acid sequence
39. Perform a primer designing by using bioinformatics tools.
40. Visit to autopsy center at mortuary, Forensic Science Laboratory, Pathology Laboratory, Veterinary Center, Biodiversity and wildlife Center.

M.Sc. Forensic Science II Year
4P8-SII : Project

Marks: 100 **Duration: 8 hrs/week**

(Forensic Anthropology and Odontology, Microbial Forensics and Bioinformatics, DNA Fingerprinting, Wildlife and Environmental Forensics)

Dissertation will be compulsory to all students. Students will carry out dissertation work individually or in the group of not more than three students. Concerned department shall provide all required infrastructure to carry out dissertation work. The format for dissertation report will be similar to the research thesis style; incorporating chapters on Introduction, Review of Literature, Materials and Methods, Results and Discussion and References/Bibliography. The dissertation will be submitted in a type written and bound form. Copy of each dissertation will be submitted to the respective department and the centre will store it permanently. Project work on forensically significant and need based problems in the area(s) of Forensic Biology, Serology, Entomology, Forensic Anthropology, Odontology, Microbial Forensics, Bioinformatics, DNA Fingerprinting, Wildlife and Environmental Forensics etc.

M.Sc. Forensic Science II Year
4P5-SIII : Practical I

Marks: 100 **Duration: 8 hrs/week**

(Forensic Chemistry and Toxicology)

Candidate should complete minimum 20 of the total number of practicals.

25. To perform Colour test and UV-Visible Spectrophotometry of pesticide, insecticides. (2)
26. Analysis of dye and pigments by using TLC technique. (2)
27. Analysis of alcohol content in sample by derivatization into known organic compounds and its analysis by GC-MS.

28. Analysis of Mercury in biological materials by Fresenium-Babo method.
29. Analysis of animal Poisons using TLC.
30. Analysis of Plant poisons using TLC. (2)
31. Determination of alcohol in blood and urine sample.
32. Analysis of blood, urine, stomach wash in emergency cases of poisoning.
33. Comparison of fibres by chemical analysis, TLC/ HPTLC/ FTIR. (2)
34. Gas chromatography analysis of Ganja and Charas.
35. Analysis of food material in case of food poisoning by chemical, microscopic and instrumental techniques. (2)
36. Analysis of viscera in case of food poisoning by chemical, microscopic and instrumental techniques. (2)
37. Interpretation of given spectral data of various compounds. (2)
38. Analysis of viscera for volatile Organic and inorganic poisons.
39. Analysis of non- metallic (anionic) poisons in viscera. (2)
40. Analysis of metallic (anionic) poisons in viscera. (2)
41. Analysis of viscera for organochloro, organophosphoro, carbamates and pyrethroids by colour test/ TLC/ HPTLC/ UV-Visible spectrometry method. (2)
42. UV-Visible Spectrophotometric, HPLC and GC-MS analysis of barbiturates.
43. Determination of poisonous metals in biological materials by AAS.
44. Extraction, Systematic identification of Narcotic Drugs and Psychotropic Substances (opiates, cannabis and barbiturates, benzodiazepines and amphetamines) by spot/ colour tests.
45. Analysis of Na and K contents in soil sample by Flame Photometry.
46. GC-MS, HPLC analysis of explosive residues.
47. Detection of adulteration in oils and fats by chemical analysis and TLC/ HPTLC.
48. Report submission on Industry/ Laboratory visit.

M.Sc. Forensic Science II Year
4P8-SIII : Project

Marks: 100 **Duration: 8 hrs/week**

Description

This course covers the application of analytical chemistry within the field of forensic science. Students learn the fundamental principles behind the analyses of chemical and physical evidence for drugs, combustion and arson, colorants, documents, and fibres. Qualitative analysis is presented by examining the chemical details of presumptive testing from a mechanistic approach. An analytical chemistry perspective is used to explain modern laboratory instrumentation and proper statistical treatment of collected data for quantitative analysis. An overview of chemical toxicology is covered with an emphasis on understanding biochemical pathways and pharmacokinetics.

Objectives

The objective is to introduce students to research in various areas of Forensic Chemistry by engaging them to carry out a project under the supervision of a faculty. The main objective of this course is to teach students how to use critical thinking skills and fundamental scientific principles to approach and solve problems in forensic science. Students should learn how to create an unbiased sampling of evidence and select proper methods to process that evidence. Finally, students should be able to communicate and support the technical details of their findings in a clear, logical manner that can easily be understood in a court of law.

M.Sc. Forensic Science II Year
4P6-SIV : Practical I

Marks: 100 **Duration: 8 hrs/week**

Candidate should complete minimum 20 of the total number of practicals.

1.Live system evidence Capture process
2. Live Network evidence Capture process
3. Working with advance network diagnostic and connectivity commands
4. Advance Mobile device forensic analysis
5. Password encryption techniques
6. Performing Physical port audit
7. Performing VLAN and routing configuration

8. Network administration services and security measure application
9. Password strength assessment
10. Software vulnerability analysis
11. Working with Winhex
12. Working on Cell phone tower site and Cell phone Hub
13. Detail MAC Analysis
14. Scanning for vulnerabilities using (Angry IP, HPing2, IPScanner, Global Network Inventory Scanner, Net Tools Suite Pack.)
15. NetBIOS Enumeration Using NetView Tool, Nbtstat Enumeration Tool (Open Source).
16. How to Detect Trojans by using – Netstat, fPort, TCPView, CurrPorts Tool, Process Viewer.
17. Working with Trojans, Backdoors and sniffer for monitoring network communication
18. Denial of Service and Session Hijacking using Tear Drop, DDOS attack.
19. Penetration Testing and justification of penetration testing through risk analysis
20. Password guessing and Password Cracking.
21. Wireless Network attacks , Bluetooth attacks
22. Firewalls , Intrusion Detection and Honeypots
23. Malware – Keylogger, Trojans, Keylogger countermeasures
24. Understanding SQL Injection

25. Steganography using tools: Tool: Merge Streams, Image Hide, Stealth Files,

Blindside, STools,

M.Sc. Forensic Science II Year
4P8-SIV : Project

Marks: 100 **Duration: 8 hrs/week**

Project relevant to specialization

M.Sc. Forensic Science II Year
4P7-SV : Practical I

Marks: 100 **Duration: 8 hrs/week**

Candidate should complete minimum 10 of the total number of practicals

31. To study proof mark of cartridge.
32. To study lands and grooves in rifled weapons.
33. To estimate the range of firing in rifled and smooth bored firearms.
34. To estimate the trajectory of bullet.
35. To plot a graph and study the various factors effecting the trajectory and range of bullet.
36. Collection and Forensic examination of Gunshot residue.
37. To study brake action of various automobiles.
38. To study the working mechanism of important components of automobile engine.
39. Study of speedometer.
40. Forensic Examination of brake failure in the vehicles.
41. Forensic Examination and analysis of paint chips collected from hit and run cases.
42. Forensic Examination and analysis of glass pieces collected from hit and run cases.
43. Comparison of head light glass and automobile window glass.
44. Forensic Examination of bulb filament.
45. Forensic Examination of soil

M.Sc. Forensic Science II Year
4P8-SV : Project

Marks: 100 **Duration: 8 hrs/week**

Project relevant to specialization