

**RASHTRASANT TUKADOJI MAHARAJ**

**NAGPUR UNIVERSITY,**

**NAGPUR**



*MASTER OF FORENSIC SCIENCE*

*SEMESTERS I to IV*

**SYLLABUS AND SCHEME OF EXAMINATIONS**

**M.Sc. (Forensic Science)**

**Effective from Academic Year**

**2014-2015 onwards**

## Appendix I: Semester I

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

S.No.	Semester	Theory/ Practical/ Paper	Teaching Scheme (Hrs/week)			Credits	Examination Scheme					
			Theory	Practical	Total		Duration (Hrs)	Max. Marks		Total Marks	Minimum Passing marks	
								External Marks	Internal Marks		Th	Pr
1	I	MFS-101:Paper I Criminology	3		3	2	3	50		50	20	
2	I	MFS-102: Paper II Advanced Forensic Science	3		3	2	3	50		50	20	
3	I	MFS-103 Paper III Forensic Biology and Serology	3		3	2	3	50		50	20	
4	I	MFS-104: Paper IV Forensic Chemistry and Toxicology	3		3	2	3	50		50	20	
5	I	MFS-105: Paper V Forensic Physics and Ballistics	3		3	2	3	50		50	20	
6	I	MFS-106: Paper VI Digital and Cyber Forensics	3		3	2	3	50		50	20	
7	I	MFS-107: Paper VI I Forensic and Correctional Psychology I	3		3	2	3	50		50	20	
8	I	MFS-108: Paper VIII Communication Skills and Scientific Report Writing I	3		3	2	3	50		50	20	
9	I	MFS-109 Practical-I		4.5	4.5	2	3-8*	40	10	50		20
	I	MFS-110 Practical-II		4.5	4.5	2	3-8*	40	10	50		20
10	I	MFS-111 Practical-III		4.5	4.5	2	3-8*	40	10	50		20
11	I	MFS-112 Practical-IV		4.5	4.5	2	3-8*	40	10	50		20
17	I	MFS: 113 SEMINAR		2	2	1			25	25		10
18		TOTAL	24	20	44	25				625	160	90

Note: Th = Theory; Pr = Practical/lab, \* = If required, for two days. Applicable to all semesters (I-IV)

## Appendix I: Semester II

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

S.No.	Semester	Theory/ Practical/ Paper	Teaching Scheme (Hrs/week)			Credits	Examination Scheme					
			Theory	Practical	Total		Duration (Hrs)	Max. Marks		Total Marks	Minimum Passing marks	
								External Marks	Internal Marks		Th	Pr
1	II	MFS-201:Paper IX Criminology	3		3	2	3	50		50	20	
2	II	MFS-202:Paper X Advanced Forensic Science	3		3	2	3	50		50	20	
3	II	MFS-203:Paper XI Forensic Biology and Serology	3		3	2	3	50		50	20	
4	II	MFS-204:Paper XII Forensic Chemistry and Toxicology	3		3	2	3	50		50	20	
5	II	MFS-205:Paper XIII Forensic Physics and Ballistics	3		3	2	3	50		50	20	
6	II	MFS-206:Paper XIV Digital and Cyber Forensics	3		3	2	3	50		50	20	
7	II	MFS-207:Paper XV Forensic and Correctional Psychology	3		3	2	3	50		50	20	
8	II	MFS-208:Paper XVI Communication Skills and Scientific Report Writing	3		3	2	3	50		50	20	
9	II	MFS-209 Practical V		4.5	4.5	2	3-8*	40	10	50		20
10	II	MFS-210 Practical VI		4.5	4.5	2	3-8*	40	10	50		20
11	II	MFS-211 Practical VII		4.5	4.5	2	3-8*	40	10	50		20
		MFS-212 Practical VIII		4.5	4.5	2	3-8*	40	10	50		20
17	II	MFS-213 SEMINAR		2	2	1			25	25		10
18		<b>TOTAL</b>	24	20	44	25				625	160	90

## Appendix I: Semester III

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

S.No.	Semester	Theory/ Practical/ Paper	Teaching Scheme (Hrs/week)			Credits	Examination Scheme					
			Theory	Practical	Total		Duration (Hrs)	Max. Marks		Total Marks	Minimum Passing marks	
								External Marks	Internal Marks		Th	Pr
1	III	*MFS-301: Paper XVII Instrumentation, Quality Management, Research Methodology and Statistics	4		4	4	3	100		100	40	
2	III	*MFS-302 : Paper XVIII (Special I) ❖ Questioned Document Analysis/ ❖ Advanced Forensic Toxicology/ ❖ Forensic Serology ❖ Operating System and Web Security	Each 4 = 8		8	Each 3 = 6	3	Each 75=150		150	60	
3	III	*MFS-303: Paper XIX (Special II) ❖ Advanced Fingerprint Development methods/ ❖ Advanced Forensic Chemistry/ ❖ Forensic Biology ❖ Advanced Computer Network and Network Security	Each 4 = 8		8	Each 3 = 6	3	Each 75=150		150	60	
12	III	*MFS-304: (Any Two) Practical IX Practical X Practical XI Practical XII		Each 10=20	20	Each 4 = 8	Each 3-8*	Each 80	Each 20	200		Each 40 = 80
17	III	MFS-305: SEMINAR	2	2	4	1			25	25		10
18		TOTAL	22	22	44	25				625	160	90

**\*Note: Candidate should select five theory papers and two practical as per the following scheme:**

1. MFS 301 is compulsory.
2. There are following four Specializations.
  - i. Specialization I: Questioned Documents & Fingerprint
  - ii. Specialization II: Forensic Chemistry & Toxicology
  - iii. Specialization III: Forensic Biology & Serology
  - iv. Specialization-IV: Cyber Security and Cyber Forensic.
3. Candidate should select any two specializations out of four as above mentioned and corresponding two theory papers from group of Special I and two theory papers from group of Special II
4. Candidate should select any two practical related specializations.

## Appendix I: Semester IV

Scheme of Teaching and Examination under credit based semester pattern for M. Sc. Forensic Science Course. In semester IV, candidate should select any one specialization out of two which has been already opted in semester III.

S.No.	Semester	Theory/ Practical/ Paper	Teaching Scheme (Hrs/week)			Credits	Examination Scheme					
			Theory	Practical	Total		Duration (Hrs)	Max. Marks		Total Marks	Minimum Passing marks	
								External Marks	Internal Marks		Th	Pr
1	IV	<b>MFS-401: Paper XX Instrumentation, Quality Management, Research Methodology and Statistics</b>	4		4	4	3	100		100	40	
2	IV	<b>MFS-402 Paper XXI (Special Paper I)</b> ❖ <b>Forgery and Its Forensic Detection</b> ❖ <b>Advanced Forensic Toxicology</b> ❖ <b>Forensic Anthropology, Odontology and Forensic Pathology</b> ❖ <b>Cyber Security, Cyber Forensic Mobile and Cyber Forensics</b>	4		4	3	3	75		75	30	
3	IV	<b>MFS-403 Paper XXII (Special Paper II)</b> ❖ <b>Automated Fingerprint Identification System</b> ❖ <b>Advanced Forensic Chemistry</b> ❖ <b>DNA Fingerprint and Interpretation</b> ❖ <b>Ethical Hacking and Recovery Forensic</b>	4		4	3	3	75		75	30	
4	IV	<b>MFS-404) Paper XXIII(Special Paper III)</b> ❖ <b>Forensic Linguistics</b> ❖ <b>Forensic Pharmacology</b> ❖ <b>Microbial Forensics and Bioinformatics</b> ❖ <b>Digital Image processing</b>	4		4	3	3	75		75	30	
5	IV	<b>MFS-405) Paper XXIV(Special Paper IV)</b> ❖ <b>Forensic Photography</b> ❖ <b>Forensic Analysis of Drugs</b> ❖ <b>Wildlife and Environmental Forensic</b> ❖ <b>Biometrics</b>	4		4	3	3	75		75	30	
12	IV	<b>MFS-406 Practical :XIII Practical :XIV Practical :XV Practical :XVI</b>		12	12	4	3-8*	80	20	100		40
13	IV	<b>MFS-407 Project Work (Specialization)</b>		10	10	4	3-8*	80	20	100		40
17	IV	<b>MFS-408 SEMINAR</b>		2	2	1			25	25		10
18		<b>TOTAL</b>	20	24	44	25				625	160	90

Note: Th = Theory; Pr = Practical/lab, \* = If required, for two days.

## Semester I

### SYLLABUS M.Sc. FORENSIC SCIENCE SEMESTER-I

#### MFS-101: Paper I- Criminology

Marks: 50

Lecture: 3 hrs/week

---

##### Unit I:

**Criminology:** Advanced study of Crime, Criminal, Criminal Action and Criminal Behaviour, Schools of Criminology, Theories of Criminology (Differential Association theory, Self concept and containment theory, Labeling theory, Barrier theory, etc.), Punitive Aspects (Theories of punishment), Probation & Parole, Correctional Institutions.

##### Unit II:

**Crime Typologies:** Types of Crime (White collar, Blue collar, Black Collar, Organised, Terrorism, etc.) Offences: Criminal Offences, Nature and types, Juvenile Delinquency-Factors responsible. Juvenile Justice Act, Role of Correctional Institutions, Child Abuse-Physical Abuse, Emotional Abuse, Sexual Abuse, Child Neglect, Crime against Women, Crime against Elderly, Youth and Crime. Alcoholism and Drug Addiction.

##### Unit III:

**Sociology:** Sociological contentions about the Causes of Crime (Correlates of crime)- Social, Cultural, Economic, Psychological, Geographical, Immigration etc. The theory of social and environmental determinism, “born-criminals”, “criminoids”, etc.

**Victimology:** Victim, Science of Victimology, Role of Victim in Crime, Victim-Offender relationship, Types of Victims, Effects on the victim post-crime (the feeling of insecurity, mental harassment, feeling victimized throughout life, quest for justice), Justice system to the aid of the Victim, relief and compensatory aids, therapies, etc.

### SEMESTER-I

#### MFS-102: Paper II- Advanced Forensic Science

Marks: 50

Lecture: 3 hrs/week

---

##### Unit I:

**Crime Scene Investigation:** Types of Crime Scenes (Indoor, Outdoor, Mobile, Water), Various Crime Scenes (Homicide, Suicide, Murder, Accidental, HBT, Hit and Run, Hanging, Drowning, Shooting etc.). Various types of Evidences (Physical, Biological, Chemical). Various Crime Scene Search methods. Locating, Collection & Preservation of various evidences. Crime Scene Documentation (Sketching, Photography, Videography and Note-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.

### **Unit II:**

**Crime Scene Reconstruction:** Steps involved (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, 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, Artifactual bloodstain patterns, Documentation, Evaluation & importance of Bloodstain evidences, Dealing with risks associated with blood-borne pathogens.

### **Unit III:**

**Fingerprint:** Nature, Location, Classification, Types, Patterns of Fingerprints, Poroscopy & Edgescopy, Classification of Fingerprints: Henry's Classification, Single Digit Classification, Extended Henry's System, Types of Fingerprints (Latent, Patent and Plastic), Invisible Fingermarks 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, Classification, Development, Lifting, Evaluation, Analysis, Forensic Significance.

## **SEMESTER-I**

### **MFS-103: Paper III- Forensic Biology & Serology**

**Marks: 50**

**Lecture: 3 hrs/week**

---

**Unit I: Unit II: 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.

### **SEMESTER-I**

#### **MFS 104: Paper IV- Forensic Chemistry & Toxicology**

**Marks: 50**

**Lecture: 3 hrs/week**

---

#### **Unit I:**

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 nonalcoholic, 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, Drugs and Cosmetic Act, Excise Act, NDPS Act.

#### **Unit II:**

Definition, dosage, administration of poisons, Classification of poisons, action of poisons & 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, Interpreting drug findings, Functions and roles of toxicologists in a forensic science lab. Significance of toxicological findings.

#### **Unit III:**

Techniques used in toxicology. Extraction, Isolation and clean-up procedures from biological samples: using conventional as well as modern techniques such as 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



## SEMESTER-I

### MFS-105: Paper V- Forensic Physics and Ballistics

Marks: 50

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.

## SEMESTER-I

### MFS-106: Paper VI- Digital & Cyber Forensics

Marks: 50

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 Prevention System. Cloud Computing-Its Forensic and Security Aspects.

**SEMESTER-I****MFS-107: Paper VII- Forensic & Correctional Psychology****Marks: 50****Lecture: 3 hrs/week**

---

**Unit I:**

Forensic Psychology: Historical perspective, scenario in India, functions and role of forensic psychologist. Assessment and 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. Psychological 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, diminished responsibility, testamentary capacity.

## SEMESTER-I

### MFS-108: Paper VIII- Communication Skills & Scientific Report Writing

Marks: 50

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.

### MFS-109: Practical-I Criminology

Marks: 50

Lectures: 4.5 hrs/week

---

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

1. Visit to Police Station/Jail (1)
2. Format of Medicolegal report (dying declaration, injuries report)
3. Post-mortem report Interpretation. (1)
4. Format of FIR in various cases. (2)
5. Demonstration of -Interrogation & Interviewing of the criminals/suspects. (2)
6. Examination-in-chief, cross-examination, re-examination (1)
7. Court room Appearance. (Moot Court)

## MFS-110: Practical-II Advanced Forensic Science

**Marks: 50**

**Lectures: 4.5 hrs/week**

---

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

1. Indoor Crime Scene Investigation (Indoor/Outdoor/Mobile/Water)
2. Crime Scene Sketching (Baseline Method, Triangulation Method, Polar-coordinate Method)
3. Blood Spatter Analysis (Height of fall, Angle of Impact, Velocity, etc.)
4. Crime Scene Reconstruction of Various Scenarios (Hit n Run, Burglary, Murder, etc.)
5. Collection and Packaging of different evidences (Biological/Physical/Chemical)
6. Latent Fingerprint Development using Powder Methods
7. Casting/Lifting/Evaluation of Footprints/Footwear Impressions
8. Gait Pattern Analysis
9. Casting/Lifting/Evaluation of Tyre marks/skid marks
10. Casting/Lifting/Evaluation of tool marks on different objects
11. Serial number restoration on various surfaces
12. Classification/Lifting/Analysis of Lip prints
13. Casting/Lifting/Evaluation of Ear prints
14. Casting/Lifting/Evaluation of Bite marks on various surfaces.

## MFS-111: Practical-III Forensic Biology & Serology

**Marks: 50**

**Lectures: 4.5 hrs/week**

---

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

1. Determine species, sex, origin of hair (4)
2. Microscopic characterization of human hairs. (2)
3. Microscopic characterization of animal hairs. (2)
4. Preliminary examination of biological fluids (Blood, semen, saliva, sweat, tear and milk) (5)
5. Extraction and isolation, estimation of DNA from buccal swabs, blood, semen and other biological samples (5)
6. Identification and individualization of blood samples (preliminary & confirmatory tests) (4)
7. Visit to Mortuary- Postmortem Examination (1)
8. Study of injuries and wounds (4)
9. Identification of pollen grains of forensic significance. (2)
10. Extraction/Isolation/Identification of diatoms. (2)

## MFS-112: Practical-IV (Forensic Chemistry and Toxicology)

Marks: 50

Lectures:4.5 hrs/week

---

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

1. Analysis of alcoholic liquor as per BIS specifications.
2. Determination of methanol and ethanol in alcoholic liquors.(wet test, GC,TLC) (2)
3. Analysis of gasoline as per BIS specifications.
4. Estimation of ethyl alcohol in blood sample by wet test, colour test, TLC, GC-MS.(2)
5. Analysis of viscera (simulated sample) for organo-chloro /organo-phosphorus pesticides by TLC.(2)
6. Adulteration of vegetable oils by colour test, GC & HPLC.(2)
7. Systematic analysis of pharmaceutical products as per IPC specification by using HPLC.(2)
8. Systematic analysis of pharmaceutical products as per IPC specification by using GC.
9. Analysis of explosion residues (Preliminary analysis, GC, GC-MS, ion chromatography {for inorganic explosive}).(2)
10. Analysis of fire arson samples (extraction, spot test, GC, GC-MS) (2)
11. Extraction, Isolation and clean-up procedures from biological samples.(2)
12. Analysis of pesticides by colour test and instrumental technique.

## MFS-113: Seminar-I

2 h /week

Marks: 25

---

Seminar of 30 minutes duration will be a part of internal assessment for 20 marks (1 credit). Seminar should be delivered by the student under the guidance of concerned teacher on the topic allotted by the teacher. The topic will be related to the syllabus. Marks will be allotted by a group of teachers.

## SEMESTER-II

### MFS-201:Paper IX- Criminology

Marks: 50

Lecture: 3 hrs/week

---

#### Unit I:

**Law, Courts and Police-** Definition, Scope and Important Sections of I.P.C, Cr.P.C, and I.E.A, Criminal Justice System in India-structural and functional process. Prosecution: Structure and Authority, Framing of Charges, Collection of Evidence and witnesses, Courts: Structure and types- Criminal courts, Juvenile Courts, Family Courts, 'Lok Adalat' and Human Right Courts. Role of Police in Crime Investigation, Accountability of Police to Law, People and Society, Interrogation & Interviewing of the criminals; methods used by the police in getting information from the criminal; the ethical issues related to the same. Custodial Death, Police and Human Rights.

#### Unit II:

**Legal Aspects:** Bailable and Non-bailable offenses, Dying Declaration, dying deposition, Summon, Warrants, Sub-poena, perjury, Cognizable and non-cognizable offenses, FIR, Complaint, Inquest, Inquiry, Search and Seizure, Types of Witnesses (eye witness, hear-say witness, Hostile witness, etc.), leading question, medical certificate, medicolegal report, etc. Punishments- Theories, capital punishments, Imprisonment, Monetary Punishment.

#### Unit III:

**Evidences:** Definition, types (testimonial and real evidence) (oral & circumstantial), admissibility of scientific evidence and importance of physical evidences, Collection, preservation, packing and forwarding of different types of evidences (Fingerprint, hair, fibre, glass, soil, Questioned documents, impression evidences, etc.) to the FSL. Interpretation of Reports, Presentation in the court, Common witness, Expert witness, Expert Testimony: The role of the expert-witness; acceptance of evidence in the court; mental disorder and acceptance of evidence in court; child witness in the court, Examination-in-chief, Direct examination and cross – examination by prosecution and defense.

## SEMESTER-II

### MFS-202: Paper X- Advanced Forensic Science

Marks: 50

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.

**Unit III:**

**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. Rugoscopy.

**SEMESTER-II**

**MFS-203: Paper XI- Forensic Biology & Serology**

**Marks: 50**

**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, glucuronic acid pathway. Dark reactions of Photosynthesis: CO<sub>2</sub> fixation: C<sub>3</sub>, C<sub>4</sub> and CAM pathways. Cyclic overview and reactions. Metabolic sources of acetyl CoA. Regulation and amphibolic nature of the cycle. Glyoxylate cycle.

**Lipid metabolism:**  $\beta$  oxidation of unsaturated and saturated fatty acid and its regulation. 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 cholesterol: Biosynthesis of cholesterol and its regulation, lipoprotein

metabolism, chylomicrons, LDL, HDL, VLDL. 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 Histocompatibility 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. Immunodiagnosics and immunotherapy in virology, immunoelectrophoresis.

## SEMESTER-II

### MFS-204: Paper XII- Forensic Chemistry & Toxicology

**Marks: 50**

**Lecture: 3 hrs/week**

---

#### **Unit I:**

**Arson:** Fire, chemistry and physics of fire behaviour, elements of life cycle of fire, types 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, crime scene investigation & 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 affects, types of hazard, effect of blast wave on structures, human 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, Explosives Act.

**Unit III:**

**Other Chemical Evidences:** Adulterants in food and food products, cement, petroleum products, pharmaceutical products, medicines, beverages.

**SEMESTER-II**

**MFS-205: Paper XIII - Forensic Physics and Ballistics**

**Marks: 50**

**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, revolver, 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.

**SEMESTER-II**

**MFS-206: Paper XIV - Digital & Cyber Forensics**

**Marks: 50**

**Lecture: 3 hrs/week**

---

**Unit I: Cyber Crime Investigations:** Where Evidence Resides on Windows systems, Conducting a Windows investigation, File Auditing and Theft of information, Handling the Departing Employee, Steps in a Unix Investigation, Reviewing Pertinent Logs, Performing

Keywords Searches, Reviewing Relevant Files, Identifying Unauthorized User Accounts or Groups, Identifying Rogue Processes, Checking for Unauthorized Access Points, Analyzing Trust Relationships, Detecting Trojan Loadable Kernel Models. Finding Network based Evidence, Generating Session data with TCP Trace, Reassembling sessions using TCP flow and Ethereal.

**Unit II: 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.

### **Unit III: Biometrics**

Pattern Recognition & Biometrics - Face, Iris & retinal imaging, voice & Speech recognition, Speaker Identification, fingerprint, palm print, gait pattern, signatures, palm vein, Pattern comparison, Computer simulation, Micro dots, Image processing -Image capturing, Image restoration & enhancement. Image editing, Compression Technique- Proactive Forensic science. Automated systems for Database Management in Forensic Science. AFIS, IBIS, etc.

## **SEMESTER-II**

### **MFS-207: Paper XV - Forensic & Correctional Psychology**

**Marks: 50**

**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.

**SEMESTER-II**

**MFS-208: Paper XVI - Communication Skills & Scientific Report Writing**

**Marks: 50**

**Lecture: 3 hrs/week**

---

**Unit I:**

**Speaking for Employment**

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

**Unit II:**

**Research, Report Writing & Presentation:** Key elements- Objective, Introduction, design or rationale of work, Guidelines for design of experiments, material and methods, designing biological experiments, compilation and documentation of data. Drawing Conclusions. Patents. Format of research 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 III:**

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

**MFS-209: Practical-V (Forensic Physics and Ballistics)**

**Marks: 50**

**Lectures: 4.5 hrs/week**

---

**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. Chemical tests for powder residues (GSR) (Walker's test) and Barrel wash.
6. Examination of air guns / rifles as per Arms Act 1959.
7. Accident reconstruction sample calculations.
8. Velocity estimation from skid marks.
9. Restoration of erased / obliterated marks.
10. Examination and analysis of paint chips collected from hit and run cases.
11. Examination and analysis of glass pieces collected from hit and run cases.
12. Comparison of head light glass and automobile window glass.
13. Examination of vehicle identification numbers.
14. Examination of soil sample.(chemical and microscopic)
15. Analysis of dyes.

### **MFS-210: Practical-VI (Cyber Crime Investigations)**

**Marks: 50**

**Lectures: 4.5 hrs/week**

---

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

1. C Program Structure, data input and output, control statements, functions arrays etc.
2. Basics of Java programming. Servlet and JSP Programs and Java Script.
3. Structure of HTML, XML and PHP : Creating webpage using Structure of HTML, XML and PHP.
4. Speaker identification and verification using speaker verification tool.
5. Study of wireless devices.
6. Study of wireless networks and wireless network analysis.
7. Understanding dynamic and static pages, Viewing HTML Source and HTTP Headers, Understanding Header Information.
8. Working with wireshark for Network analysis.
9. Studying of packets and packet formats.
10. Log Collections and analysis.
11. Network evidence collection offline and online.

### **MFS-211: Practical-VII (Forensic Psychology)**

**Marks: 50**

**Lectures: 4.5 hrs/week**

---

**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
8. Brain mapping- Demo/working/principle/Interpretation of results
9. NEO-PI
10. Minnesota Multiphasic Personality Inventory-2/A (MMPI-2/A)
11. Rorschach Test
12. Bhatia's Battery for Intelligence
13. Thematic Apperception Test
14. Social intelligence Test
15. Free association test

**MFS-212: Practical-VIII (Communication Skills and Scientific Report Writing)**

**Marks: 50**

**Lectures: 4.5 hrs/week**

**Four Case studies on the topic related with Forensic Science and Curriculum: Case study submission and Presentation**

**MFS-213: Seminar-II**

2 h/week

Marks: 25

Seminar of 30 minutes duration will be a part of internal assessment for 20 marks (1 credit). Seminar should be delivered by the student under the guidance of concerned teacher on the topic allotted by the teacher. The topic will be related to the syllabus. Marks will be allotted by a group of teachers.

**Suggested Reading:**

**1. Criminology and Advanced Forensic Science**

1. Bevel, T., Gardner, M. R., Bloodstain Pattern Analysis with an Introduction to Crime Scene Reconstruction, Third Edition.
2. Bevel, T., Gardner, M. R., Practical Crime Scene Analysis and Reconstruction
3. Lee, C. H., Palmbach, T., Miller, T. M., Henry Lee's Crime Scene Handbook
4. Moenssens : Finger Prints Techniques, 1975, Chitton Book Co., Philadelphia, New York.
5. Mehta, M. K. : Identification of Thumb Impression & Cross Examination of Finger Prints, 1980 N. M. Tripathi (P) Ltd. Bombay.
6. Bridges : Practical Finger Printing, 1942, Funk and Washalls Co. New York.
7. Holt : Genetics of Dermal Ridges.
8. William J. Bodziak (1989) Footwear Impression Evidence Elsevier Science Publishing Co. New York, 1989.
9. James, S.H and Nordby, J.J.. (2003) Forensic Science : An introduction to scientific and investigative techniques CRC Press, USA.
10. Saferstien : Forensic Science, Handbook, Vol. I, II & III, Prentice Hall Inc. USA.

11. Kirk : Criminal Investigation, 1953, Interscience Publisher Inc. New York.
12. Cummins & Midlo : Finger Prints, Palms and Soles, 1943, The Blakiston office London.
13. O'Hara & Osterburg : Introduction to Criminalistics, 1949, The MacMillan Co., 1964.
14. Saferstein : Forensic Science Handbook, Vol I, II & III, Prentice Hall Inc. USA.
15. Sharma B. R. : Footprints, Tracks and Trials. 1980. Central Law Agency. Allahabad.
16. C.G.G. Aitken and D.A Stoney; The use of statistics in Forensic Science, Ellis Horwood Limited, England 1991.
17. Nanda, B.B. and Tewari, R.K. (2001) : Forensic Science in India : A vision for the twenty first century Select Publisher, New Delhi.
18. Cherril, F.R.: The Finger Prints. System at Scotland Yard, 1954; Her Majesty's office, London.
19. Saferstein : Criminalistics, 1976, Prentice Hall Inc., USA.
20. Deforest, Gansellen & Lee : Introduction to Criminalistics.
21. Sharma, B.R. : Forensic Science in Criminal Investigaion and Trials, Central Law Agency, Allahabad, 1974.
22. Wentworth & Wilder : Personal Identification, 1948. R. G. Badger. Boston.
23. Lundquest & Curry : Forensic Science, Vol I to IV, 1963, Charls C. Thomas, Illinosis, USA.
24. Visweswara Rao. K: Biostatistics, A Manual of Statistical Methods for Use in Health, Nutrition & Anthropology.
25. Sokal, R.R & Rolf, F.J: Biometry, Principles & Practices of Statistics in Biological Research
26. Rao, C. R Advanced Statistical Methods in Biometric Research.
27. Iannarelli, A V; Ear Identification, Forensic Identification series, Paramount (1989)
28. Henry C. Lee & R. E. Ganesslen; Advances in Finger Print Technology, CRC Press, London (1991)
29. James, H. Stuart, Kish, E. Paul, T. Paulette Sutton, Principles of Bloodstain Pattern Analysis: Theory and Practice
30. Stuart, H. J., Scientific and Legal Applications of Bloodstain Pattern Interpretation
31. E. Roland Menzel; Fingerprint Detection with Lasers, 2nd Ed., Marcel Dekker, Inc. USA (1999)
32. Menzel, E Roland; Fingerprint detection with lasers, Marcel Dekker, NY (1999)
33. Ratha Nalini; Automatic Fingerprint recognition system, Springer Pub., NY (2004)
34. C. G. G. Aitken and D. A. Stoney; The use of statistics in Forensic Science, Ellis Harwood Limited, England (1991)
35. Kasprzak J; Possibilities of Cheiloscopy in Forensic Science (1980)
36. Mehta, M. K. : The identification of Handwriting & Cross Examination of Experts, N.M. Tripathi, Allahabad. 1970.
37. Sulner, H.F. : Disputed Document, 1966 Oceana Publications Inc., New York.
38. Saxena's : Saxena's Law & Techniques Relating to Finger Prints, Foot Prints & Detection of Forgery, Central Law Agency, Allahabd (Ed. A.K. Singla).
39. Quirke, A.J. : Forged, Anonymous & Suspect Documents, 1930, Reorge Rontledge & Sons Ltd., London.
40. Osborn, A. S. : Questioned Documents 1929, Boyd Printing Co., Chicago.

41. Ellen David; Questioned Documents- Scientific Examination, Taylor & Francis, Washington (1997)
42. Roy A Huber, A.M. Headrick; Handwriting Identification- Facts and Fundamental, CRC Press (1999)
43. Morris (2000) : Forensic Handwriting Identification (fundamental concepts and Principals)
44. Madinger J. and zalopany, A.R. (1999) : Money Laundering CRC Press.
45. Manning, C.A (1999) : Financial Investigations and Forensic Accounting CRC Press.
46. Harrison, W.R. : Suspect Documents & their Scientific Examination, 1966, Sweet & Maxwell Ltd., London.
47. Roy A. Huber and A.M. Headrick; Handwriting Identification:- Facts and fundamentals, CRC LLC, 1999.
48. Conway, J.V.P. : Evidential Documents, 1959, Charles C. Thomas, Illinois.
49. Hilton, O : The Scientific Examination of Questioned Document, 1982, Elsevier North Holland Inc., New York.
50. Brewster, F, : Contested Documents and Forgeries, The Eastern Law House, Calcutta. 1932.
51. Ordway Hilton; Scientific Examination of Questioned Documents, Rev ED, Elsevier, NY (1982)
52. Mcmenamin, Gerald R; Forensic Linguistics- Advances in Forensic Stylistics, CRC Press, Washington, D.C. (2002)Ellen, D (1997) : The scientific examination of Documents, Methods and techniques. 2nd ed., Taylor & Francis Ltd.
53. Krishnamurthy, R., Introduction to Forensic Science in Crime Investigation, 2011, Selective & Scientific Books, New Delhi.
54. Constitution of India.
55. Indian Evidence Act, 1872.
56. Indian Penal Code, 1860.

## **2. Forensic Biology & Serology**

1. Understanding enzymes 3<sup>rd</sup> ed. (1991): Trevor Palmer, Prentice Hall
2. Kuby Immunology: Kindt, Goldsey, Osborne.
3. Immunology: Roitt, Brostoff, male.
4. The elements of Immunology: Fahim Halim Khan
5. Fundamental immunology William E. Paul
6. Microbial Forensics : Roger G Breeze, Bruce Budowle, Steven E Schutzer
7. Handbook of computational molecular biology: Edt by SrinivasAluru
8. S.C. Rastogi, N. Mendiratta & P. Rastogi; Bio-informatics- Methods & Applications, PHI learning pvt. Ltd., (2009)
9. Dr. Westhead, J.H. Parish & R.M. Twyman, Bio-informatics, Viva Books Pvt Ltd., (2003)
10. Introduction to bioinformatics : Lesk
11. Blood biochemistry : Nicholas J Russell
12. Human blood groups-Chemical and biochemical basis of antigen specificity (Second edition): Helmut Schenkel –Brunner, Springer Wein New York

13. Blood: Principles and practice of hematology (2003): Robert L Handin, Samuel Lux, Thomas Stossel
14. Medical laboratory techniques: Godkar and Godkar
15. Blood group typing: Danford and bowly.
16. Blood grouping on man: R.R. Race and Sanger.
17. Blood grouping techniques: Boorman, Dodd. B, Lincoln. PB
18. Typing of blood stains: Callifird, Bryan
19. Bioinformatics - A Practical Guide to the Analysis of Genes and Proteins. 2nd Edition by Baxevanis.
20. Bioinformatics: Sequence, structure and Data Bank: A Practical Approach by Higgis.
21. Bioinformatic methods and protocols: Misener.
22. Introduction to Bioinformatics by Altwood.
23. Bioinformatics sequence and genome analysis 2<sup>nd</sup> ed.: David Mount.
24. Forensic Biology by Mr. Srikant Ladha, Dr. Trupti Khedkar and Dr. Rukmani Krishnamurthy
25. Krishnamurthy, R., Introduction to Forensic Science in Crime Investigation, 2011, Selective & Scientific Books, New Delhi.
26. Biotechnology by B.D. Singh
27. Biotechnology by S.N. Jogdand
28. Encyclopaedia of Forensic Science by Jay Siegel (Vol 1 to 5 )
29. Medical Laboratory techniques by Godkar
30. Medical laboratory techniques by Mukherjee (vol1 to 3)
31. Medical Laboratory Science theory & Practise by J Ochei & Kolhatkar
32. Clinical Biochemistry by Lexton
33. Practical Biochemistry by Sadashivam
34. Practical Biochemistry by Plummer
35. Dr.M.S.Rao etal Crime Scene Management(A Forensic Approach)
36. Forensic Biology by Mr.Srikant Ladha, Dr.Trupti Khedkar and Dr.Rukmani Krishnamurthy
37. Molecular Biology by David Friefilder
38. Molecular Biology by Clark
39. Molecular Biology of Gene by Watson
40. Molecular biology by T.A. Brown
41. Lehninger Biochemistry by Nelson & Cox
42. Immunology by Kuby
43. Immunology by Riott
44. Immunology by Tizard
45. Microbiology by Prescott
46. Microbiology by Tortora
47. Microbiology by Pelzcar
48. Microbiology by Anantnarayan
49. Principles of enzymology by Trevor & Palmer
50. Recombinant DNA technology by Glick
51. Practical Microbiology by Dubey & Maheshwari
52. Forensic Science by Alan Gunn



53. Handbook of forensic Science by Richard Saferstein
54. Human Physiology by Gytton
55. Microbial Forensics by Roger Breeze & Bruce Budowle
56. ISSUES IN ENVIRONMENTAL SCIENCE AND TECHNOLOGY- Environmental Forensics (2008)- R.E. Hester and R.M. Harrison. The Royal Society of Chemistry
57. Microbial Forensics (2005) - Second Edition Bruce Budowle, Steven E. Schutzer, Roger G. Breeze, Paul S. Keim and Stephen A. Morse. Elsevier
58. Introduction to Bioinformatics Lesk, A.
59. Introduction to Bioinformatics Attwood.
60. Instant notes in Bioinformatics Westhead, Parish & Twyman.
61. Bioinformatics: A practical guide to the analysis of genes and proteins—Baxevanis, Quellette, John Wiley & Sons, NY.
62. Environmental Forensics - contaminant specific guide (2006) Ed- Robert D. Morrison and Brian L. Murphy. Elsevier.

### **3. Forensic Chemistry & Toxicology**

1. Curry A.S; Analytical Methods in Human Toxicology, Part II, CRC Press Ohio (1986)
2. Krishnamurthy, R., Introduction to Forensic Science in Crime Investigation, 2011, Selective & Scientific Books, New Delhi.
3. Clark, E.G.C.; Isolation and Identification of Drugs, Vol. I and Vol. II, Academic Press, (1986).
4. Sunshine I; Year book of Toxicology, CRC Press Series, USA (1989 – 93).
5. Michael J. Deverlanko et al: Hand Book of Toxicology CRC Press, USA (1995)
6. Prakash M. et al; Methods in Toxicology Anmol Publication, New Delhi (1998)
7. Parikh C.K; Text Book of Medical Jurisprudence Forensic Medicines and Toxicology. CBS Pub. New Delhi (1999)
8. Balraj S. Parmar et al; Pesticide Formulation, CBS Publishers, New Delhi (2004)
9. Reiss C et al; Advance in Molecular Toxicology, Utrecht, Netherlands (1998)
10. Morgan B.J.T; Statistics in Toxicology, Clarendon Press, Oxford (1996)
11. Jorg Rombke et al; Applied & Ecotoxicology Lewis publishers NY (1995)
12. Shayne C.Gad et al; Acute Toxicology Testing Academic Press California USA (1998)
13. Chadha PV; Hand Book of Forensic Medicine and Toxicology, Jaypee Brothers New Delhi (2004) Semester-II FS-10832
14. Turner Paul; Recent Advances in Pharmacology & Toxicology, Churchill Livingstone, Elenburgh (1989)
15. Modi, Jaisingh P; Textbook of Medical jurisprudence & Toxicology, M.M. Tripathi Pub. (2001)
16. Cravey R.H, Baselt, R.C; Introduction to Forensic Toxicology, Biochemical Pub. Davis C A (1981)
17. Working Procedure Manual - Toxicology, BPR&D Publication (2000)
18. Ballantyne B; General and Applied Toxicology Vol-1-3 2<sup>nd</sup> Ed., Macmillan, NY (2000)
19. Gossel T.A; Principles of Clinical Toxicology 3rd Ed., Roven, NY (1994)
20. Gossel S S; Handbook of Highly Toxic Materials handling and Management, Marcel Dekker NY (1995)
21. Niesink RJM; Toxicology- Principles and Applications, CRC Press (1996).

### **Practical References:**

1. Practical Organic chemistry; J.B. COHEN
2. Spot test in Organic chemistry; Feigl
3. Handbook of Organic Analysis; Clark H.T.
4. Practical Organic chemistry; Vogel
5. Identification of Organic; G.G. Neave, Heilbran
6. Quantitative inorganic analysis; vogel
7. The Merck index; Stetchar & others
8. Organic Electronic spectral data; Vol.-I; Mortiman Kamlet
9. Organic Electronic spectral data; Vol.-III; Mortiman Kamlet
10. Inorganic Semi micro qualitative analysis; Griffin & Plunky
11. Food Adulteration & we; V.C.Sane
12. Peerson's Chem. Analysis of food; H.Egan, Kirk
13. Vogel's Book of Macro & Semi micro qualitative inorganic Analysis; G.Svehla
14. Explosive (4<sup>th</sup> Rev.Ed); J.Kohler, Redolf)
15. Clerk's Analysis of Drugs & Poisons VOL.-I & II; Clerke
16. Handbook of Laboratory Safety; A.Keith. Furr.
17. Development & Validation of Analytical Methods; Christopher, M.Riley, Thomas W
18. Petroleum solvents & Their functions & Handling; Esso Standard Estern inc.
19. Scientific protocols for fire investigation; John J. Lentini
20. Tech.Handbook of Oil Fat & waxes; Weston
21. Steroid analysis by HPLC; Marie P. Kautsky
22. TLC VOL.-II; Jork, Funk & Others
23. Medical Jurisprudence; J. P. Modi

### **4. Forensic Physics and Ballistics**

1. Brian J Heard, Handbook of Fire arm and ballistics.
2. B R Sharma, Fire arms in criminal investigation and trials
3. Dr. Rukmani Krishnamurthy, Introduction to Forensic Science in Crime Investigation.
4. Krishnamurthy, R., Introduction to Forensic Science in Crime Investigation, 2011, Selective & Scientific Books, New Delhi.
5. Barry A J Fisher, Techniques of Crime scene investigation
6. Kausalendra Kumar, Forensic ballistics in Criminal Justice
7. A J R Cormack, The world encyclopaedia of modern guns
8. Staut H James; John J Nordby, Forensic Science: An introduction to scientific and investigative techniques
9. Tom Warlow, Firearm, the law, and Forensic Ballistics
10. High school Physics/projectile motion-Wikibooks, open books for an open world.en.wikibooks.org/wiki/High\_school\_Physics/projectile\_motiontrajectory
11. Trajectory-wikipedia, the free encyclopedia - en.wikipedia.org/wiki/trajectory
12. Trjectories: hyperphysics.phy.astr.gsu.edu/hbase/traj.html
13. J A Siegel, Pekka J Saukko et al. ; Encyclopaedia of Forensic Science Vol.1.
14. Laboratory Procedural manual , Physics Section, DFSL, Mumbai.

15. Laboratory Procedural Manual, Forensic Ballistics, DFS, New Delhi.
16. Dr.M.S.Rao et al Crime Scene Management(A Forensic Approach)
17. Forensic Science in Crime investigation by Dr. (Mrs) Rukmani Krishnamurthy Selective and Scientific Books Publishers and distributors.
18. Footwear Impressions Evidence Detectio, Recovery, and Examination Second Edition by William J. Bodziak CRC Press.
19. Brian J Heard, Handbook of Fire arm and ballistics.
20. B R Sharma, Fire arms in criminal investigation and trials
21. Kausalendra Kumar, Forensic ballistics in Criminal Justice
22. S N Gaur et al., Fire Arms, Forensic Ballistics, Forensic Chemistry and Criminal Jurisprudence.
23. Norman R Dalrymple et al, The Encyclopaedia of Criminalistics Analysis.
24. J A Siegel, Pekka J Saukko et al. ; Encyclopaedia of Forensic Science Vol.1.
25. Tire Imprint Evidence by Peter McDonald CRC Press
26. Staut H James; John J Nordby, Forensic Science: An introduction to scientific and investigative techniques
27. Integrated Ballistics Identification System (IBIS) operating Manual.
28. Dr.M.S.Rao et al Crime Scene Management(A Forensic Approach)

## **5. Forensic & Correctional Psychology**

1. 'Criminology' by Larry Siegel
2. 'Introduction to Forensic Psychology' by Bruce Arrigo
3. 'Forensic & Criminal Psychology' by Dennis Howitt.
4. 'Abnormal Psychology' by Halgin&Whitbourne.
5. 'Abnormal Psychology', by Robert C. Carson, James N. Butcher, Susan Mineka, Jill M. Hooley thirteenth Edition, Thirteenth Edition.
6. 'Encyclopedia of Forensic Science' by Jay A. Siegel, PekkaJ. Saukko, Geoffey C. Knupfer, Volume-1 to Volume-5.
7. 'Mental Disorders and Treatment' by Katherine Marsland.
8. 'Handbook of Forensic Psychology' by Prof. Dr.VimalaVeeraraghavan.
9. 'Handbook of Polygraph Testing' by Murray Kleine.
10. 'Brain Mapping-The Methods' by Arthur W. Toga & John C. Mazziotta, Second Edition.
11. 'Criminal Profiling and Introduction to Behavioural Evidence Analysis' by Brent Turve, Second Edition.
12. Krishnamurthy, R., Introduction to Forensic Science in Crime Investigation, 2011, Selective & Scientific Books, New Delhi.
13. 'Forensic Psychology' by Graham Towel& David Crighton
14. Serial Crime, Theoretical & Practical issues in Behavioural Profiling, Petherick, Woodworth Publication.
15. 'Introduction to Forensic Psychology', by Bruce Arrigo.
16. Diagnostic & Statistical Manual-IV TR, American Psychological Association
17. DSM-IV Mental Disorders Diagnostics, Etiology and Treatment, by Michaen, Allan.
18. 'Psychological Testing' by Anne Anastasi, Susana Urbina, Seventh Edition.
19. 'Psychological Testing' by Robert J. Gregory, Fourth Edition.

20. 'Mental Health Act' 1987.
21. 'Juvenile Justice Act' 2000.

## 6. Digital & Cyber Forensics

1. Yeshwant Kanetkar, Let us C
2. Balguruswami, Programming with C
3. Balguruswami, Programming with JAVA
4. Michael Morrison, Faster Samrter HTML & XML, Microsoft Press
5. William McCarty, PHP 4: A Beginners Guide, McGraw Hill
6. Gonzalez & Woods, Digital Image Processing, Pearson Education Publication
7. Tinku Acharya and Ajay K Ray, Image Processing Principal and Application, Wiley Publication
8. Computer Forensic Investigating Data and Image Files, EC Council Press
9. Forouzan Data Communication and Networking McGraw Hill
10. Jochen Schiller Mobile Communication Addison Wisely Pearson Eduction
11. Robert Jones, Internet Forensics Using Digital Evidence to Solve Computer Crimes, *O'Reilly Media Publication*
12. John R. Vacca, Network and System Security, Syngrees Publication
13. Stallings, "Cryptography And Network Security: Principles and practice"
14. C. P. Pfleeger, and S. L. Pfleeger, "Security in Computing", Pearson Education.
15. Matt Bishop, "Computer Security: Art and Science", Pearson Education.
16. Kevin Mandia, Chris Prosize and Matt Pepe, Incident response and computer forensics, *McGraw Hill Publication*
17. Stallings, "Cryptography And Network Security: Principles and practice"
18. C. P. Pfleeger, and S. L. Pfleeger, "Security in Computing", Pearson Education.
19. Matt Bishop, "Computer Security: Art and Science", Pearson Education
20. Cory Altheide, Harlan Carvey, Digital Forensics with Open source Tools, Syngress Publication
21. Michael E Whitman and Herbert J Mattord, "Principles of Information Security", Vikas Publishing House, New Delhi, 2003
22. Micki Krause, Harold F. Tipton, " Handbook of Information Security Management", Vol 1-3 CRC Press LLC, 2004.
23. Stuart Mc Clure, Joel Scrambray, George Kurtz, "Hacking Exposed", Tata McGraw-Hill, 2003
24. Matt Bishop, " Computer Security Art and Science", Pearson/PHI, 2002.`
25. Indian Patents Law and Procedure, D. P. Mittal, 2002, New Delhi, Allied Services (P) Ltd. 1999
26. Patent Act,1970.
27. Copyright Act, 1957.
28. Trade Mark Act,1999.
29. Information Technology Act,2000.

## 7. Communication Skills & Scientific Report Writing

## M.Sc. FORENSIC SCIENCE SEMESTER-III

### MFS-301: Paper XVII- Instrumentation, Quality Management, Research Methodology and Statistics

Marks: 100

Lecture: 4 hrs/week

---

#### Unit I: Microscopy

Basic principles, working, mechanism, uses & Forensic Applications of Simple and Compound microscope, Comparison microscope, Phase contrast Microscope, Stereoscopic microscope, Polarizing microscope, Fluorescent Microscopy, Infra red Microscopy, Scanning Electron Microscope (SEM) & Transmission Electron Microscope (TEM)

#### Unit II: Immuno-chemical & Electrophoretic Technique

**Immuno-chemical Techniques:** General principles, Production of antibodies, Precipitin reaction, Gel immuno-diffusion, Immuno-electrophoresis, complement fixation, Radio Immuno Assay (RIA), ELISA, Fluorescence immuno assay. Uses & Forensic Applications.

**Electrophoretic Techniques:** General principles, Factors affecting electrophoresis, Electrophoresis, Low voltage thin sheet electrophoresis, High voltage electrophoresis, Sodium dodecylsulphate (SDS) polyacrylamide gel electrophoresis, Isoelectric focusing (IEF), Isoelectrophoresis, Preparative electrophoresis, Horizontal and Vertical Electrophoresis. Uses & Forensic Applications.

#### Unit III: Research Methodology

Identification and criteria of selecting a research problem (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), sampling statistics, sampling and physical state, homogenization of samples, sample size and hazards in sampling. Methods of Research- Survey, experimental, Ex-post facto, case study methods, and content analysis, etc. Tools of Data Collection - Observation, interview schedule, questionnaire, semantic differential.

#### Unit IV: Statistics

Introduction, Descriptive Statistics: Frequency distribution, class intervals, graphical presentation: bar diagram, histogram, pie chart; Measures of Central Tendency; measures of dispersion, Mean and standard deviation: Distribution of random errors, reliability of results, tests of significance, confidence interval, Paired t-test, Correlation and linear regression, the number of replicate determination, analysis of variance, the value of statistics in forensic science. Correlation, Methods of correlation, skewness and Kurtosis variance, Types of

correlation (Pearson r & Rho) (+/-); Tests of significance. Parametric and nonparametric statistics; level of significance (Chi-square, t test, F test, Z test), the various nonparametric tests with one sample, two samples and k-samples, Kruskal-Wallis ANOVA. Regression Analysis, Multi-factorial Analysis, etc. Introduction to probability theory and distributions.

### SEMESTER III

#### Specialization I: Questioned Documents & Fingerprint

##### MFS-302: Paper XVIII- (Special Paper I: Questioned Documents Analysis)

Hrs./week-4

Marks-75

**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, 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, 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,

**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. 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

**MFS-303: Paper XIX (Special Paper-II: Advanced Fingerprint Development Methods)**

**Hrs./week-4**

**Marks-75**

**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: 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. Glows- Deposition and development latent print on glows. Adhesive tape-Tape separation method, processing the adhesive and non adhesive side of tape. Skin- Iodine silver plate transfer, Electronography, Powder method, Cyno-acrylate fuming, Iodine-Naphthoflavone, Direct lifting method.

**Unit III: Chemistry & Reaction Mechanisms:** 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, Dansyl chloride, o-Phthalaldehyde, Fluorescamine, Genipin. Cyanoacrylate fuming, health and safety precaution, Cyanoacrylate pretreatment, 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, Disulfur dinitrite, etc.

**Unit IV: Metal Deposition Methods:** Silver nitrate, Physical developer- Chemistry and mechanism, Sequencing, reagent 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, European chelate, etc. Nanoparticles in Fingerprinting.

## MFS-304: Practical IX (Special: Questioned Documents & Fingerprint)

**10 Hrs./week-**

**Marks-100**

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

1. To study the initials and handwriting written on unusual surfaces.
2. To perform TLC of inks used in printing documents.
3. To photograph watermarks in the document.
4. To examine currency notes.
5. Examination of paper.
6. Forensic comparison and identification of writing ink by TLC. Instrumental analysis of Ink
7. Examination of vernacular scripts.
8. Examination of secret writing.
9. Stabilization and restoration of charred documents.
10. Dating of documents.
11. To study alterations in the document.
12. To study the indented and visible writings.
13. To study the type scripts and printed matter from various computer printing devices
14. Examination of computer printouts.
15. Examination of photocopies and scanned documents.
16. Examination of Security Documents-Indian Bank Notes.
17. Examination of fax copies.
18. Examination of Travel Documents –Indian Passports and Visas.
19. To perform SPR method to develop latent prints.
20. Fingerprint identification and comparison.
21. Development of fingerprint by physical methods (powder dusting method, Iodine fuming)  
(2)
22. Development of fingerprint by chemical methods (Ninhydrin, Silver nitrate )
23. Working and handling of Stereo Zoom Microscope and Comparison Microscope.
24. Working and handling of Video Spectral Comparator, Electrostatic Detection Apparatus.
25. Preparation of fingerprint powder. To perform Cyano-acrylate method to develop latent fingerprints.

### Semester III

#### Specialization II: Forensic Chemistry & Toxicology

#### MFS-302: Paper XVIII (Special Paper I- Advanced Forensic Toxicology-I)

**Hrs/week-4**

**Marks-75**

**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 star-otto method, ammonium sulphate method, residue levels, toxic levels and therapeutic levels, fatal levels of commonly encountered poisons in blood, urine and tissues. Extraction of poisons from blood, urine, stomach washes and vomits, food material and toxicological analysis of decomposed materials. Interpretation of toxicological finding and preparation of reports, limitation of method and trouble shooting in toxicological analysis, disposal of analysis samples, some interesting and their importance in view of specific approach in examination.

**Unit III: Volatile Poisons:** Nature, use, administrations, symptoms, post-mortem findings, fatal dose, fatal period, isolation, detection, qualitative and quantitative estimation of: Acetone, Ether, Oxalic Acid, Phenols, Camphor, Chloral Hydrate, Chloroform, Acetaldehyde Methyl alcohol, ethyl alcohol, illicit liquor, country-made liquor, etc. Analysis by color tests, chromatographic techniques (TLC, FTIR, NMR, GC, GC-MS, etc.)

**Unit IV: Metallic and Non-metallic Poisons:** Nature, use, administrations, symptoms, post-mortem findings, fatal dose, fatal period, isolation, detection, qualitative and quantitative estimation of metallic poisons including: Lead, Copper, Mercury, Arsenic, Barium, Selenium, Magnesium, Aluminium etc. Non-metallic poisons including: chlorine, bromine, iodine, phosphorus etc. Nature, use, administrations, symptoms, post-mortem findings, fatal dose, fatal period, isolation, detection, qualitative and quantitative estimation. Analysis by color tests, AAS, FTIR etc.

### **Semester III- Specialization: Forensic Chemistry & Toxicology**

#### **MFS 303: Paper- XIX (Special Paper II- Advanced Forensic Chemistry-I)**

**Hrs/week-4**

**Marks-75**

**Unit I: Arson and Fire:** Chemistry of fire, difference between Arson and Fire, Material and Chemicals use in initiating fire and arson. Direction of fire, origin of fire, Pattern followed by Fire, Fire triangle, Examination of scene of fire/arson recognition and collection of evidence, packing, labeling and forwarding of exhibits, 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, Temperature of chemical explosion, Force and pressure of explosion, Kinetics of explosive reactions. Types of explosives (primary & secondary explosives) Differentiation between High and Low Explosives. General methods of manufacture of explosives. Development of explosives : Black powder, Nitro Cellulose, Nitro Glycerin, Dynamite, Ammonium nitrate, Commercial explosives (permitted explosives, ANFO and slurry explosives), Military explosives (picric acid, tetry TNT, Nitro guanidine, PETN, RDX, HMX and polymer bonded explosives), IEDs.

**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, Collection of samples, Color tests, TLC & Instrumentation Techniques. Technical report frame work, Evaluation and assessment of explosion site and reconstruction of sequence of events.

**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 and building materials. Methods of sampling of cements, mortar and concrete Common adulterant 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 by TGA, DTA, ICP, AAS and XRD, etc.. Case Studies like Structural Failures, etc.

**MFS-304: Practical X (Special: Practical Forensic Chemistry & Toxicology)**

**Hrs/week-10**

**Marks-100**

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

1. M.P, B.P and flash point determination.
2. TLC, GC and GC-MS separation of anabolic steroids.
3. TLC, UV-Visible, HPLC Analysis of phenolphthalein in trap cases.
4. Analysis of alcohol content in sample by derivatization into known organic compounds and its analysis by GC, GCMS, HPLC.
5. Determination of Mercury in biological materials by spectrophotometry.
6. Analysis of animal and insect toxins. (2)
7. To study the separation of metal ions by paper chromatography. (2)
8. TLC, GC analysis of barbiturates, benzodiazepine and amphetamines.
9. Detection and identification of pesticide in a given formulation by colour test, TLC and UV-visible spectrometer
10. Detection of metallic poisons (arsenic and mercury) in food stuff (simulated samples). (2 Nos.)
11. Detection and identification of pesticide in a given formulation by colour test, TLC and UV-visible spectrometer. (
12. Spectrophotometric/ Colorimetric determination of metal ions. (2)
13. Spectrophotometric/ Colorimetric determination of non- metal ions. (2)
14. Extraction of different metals from viscera, urine, blood and other biological samples (6)
15. Estimation of paints and pigments by spectrophotometry (UV, FTIR, etc) (2 Nos.)
16. Comparison of polythene films by IR spectrophotometry.
17. Separation of sample of forensic interest by column chromatography as a separation technique. (4 Nos.)
18. Analysis of viscera for volatile poisons (Organic and Inorganic). (2 Nos.)
19. Analysis of non- metallic (anionic) poisons in viscera. (2 Nos.)

## Specialization III: Forensic Biology & Serology

### MFS 302: Paper- XVIII (Special Paper I- Forensic Serology)

**Hrs. /Week-4**

**Marks: 75**

#### 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, sweat, composition, 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, anti-globulins), Antigen-antibody binding reactions (Primary, Secondary). Serological techniques- primary binding assays-ELISA Immunochromatographic Assays, Secondary Binding Assays-precipitin-based Assays (Immunodiffusion, electrophoretic methods).Agglutination based Assays (Direct agglutination Assay, passive agglutination Assay, Agglutination Inhibition assay)

#### Unit IV:

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.

## Semester III- Specialization: Forensic Biology & Serology

### MFS 303: Paper- XIX (Special Paper II- Forensic Biology)

**Hrs. /Week-4**

**Marks: 75**

**Unit I: Hair & 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, Akmund, 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 and diatoms and their forensic importance; Limnology, Diatoms types and morphology, methods of isolation from different tissues. 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, etc.

**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 & flavorings, 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, etc.), Insects of forensic importance, collection of entomological evidence during legal investigations; collection of : 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 postmortem interval, soil environment and forensic entomology, entomo-toxicology, molecular methods for forensic entomology

### **MFS-304: Practical XI (Special: Forensic Biology & Serology)**

**Hrs/week-10**

**Marks-100**

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

- 1) Microscopic examination of hair.
- 2) Examination of morphological characteristics of human and animal hair.

- 3) Species, race, sex determination from hair.
- 4) Examination of fiber (cotton, silk, wool, jute, rayon, nylon, asbestos etc.)(7)
- 5) Identification and comparison of diatoms.
- 6) Microscopic and biochemical examination of wood, pulp, paper.(3)
- 7) Examination of plant and animal foods.
- 8) Examination of faecal matter and faecal stains.
- 9) Estimation of time since death from entomological evidences.
- 10) Histopathological examination of tissues.
- 11) Preliminary examination of blood, semen, saliva, vomit etc.
- 12) Confirmatory tests of blood, semen, saliva, vomit etc.
- 13) Identification of species (precipitin test)
- 14) Blood grouping.

### Semester III

#### Specialization IV: Digital & Cyber Forensics

##### MFS 302: Paper- XVIII (Special Paper I- Operating System and Web Security)

**Hrs/week-4**

**Marks-75**

**Unit-I Introduction to Operating Systems:** Introduction Mainframe systems, Desktop Systems, Multiprocessor Systems, Distributed Systems, Clustered Systems, Real Time Systems, Handheld Systems, Hardware Protection, System Components, Operating System Services, System Calls, System Programs, Process Concept, Process Scheduling, Operations on Processes, Cooperating Processes, Inter-process Communication. Threads – Overview – Threading issues - CPU Scheduling – Basic Concepts – Scheduling (Criteria, Algorithms, Multiple-Processor, Real Time), The Critical-Section Problems with Synchronization. **Other Operating Systems:** Windows, Mac, Linux, Unix, Android, Ubuntu boot process and file systems, Working with those operating system on command prompt, understanding basic commands in operating systems, Operating system security, models of security and security evaluation criteria. Networking & network security concepts of these operating systems, Vulnerabilities of these operating system.

**Unit-II :** System Model – Deadlock Characterization – Methods for handling Deadlocks - Deadlock Prevention – Deadlock avoidance – Deadlock detection – Recovery from Deadlocks - Storage Management – Swapping – Contiguous Memory allocation – Paging – Segmentation – Segmentation with Paging. Virtual Memory – Demand Paging – Process creation – Page Replacement – Allocation of frames – Thrashing - File Concept – Access Methods – Directory Structure – File System Mounting – File Sharing – Protection File System Structure – File System Implementation – Directory Implementation – Allocation Methods – Free-space Management. Kernel I/O Subsystems - Disk Structure – Disk Scheduling – Disk Management – Swap-Space Management. Case Study: The Linux System, Windows

**Unit-III:** Understanding vulnerabilities in traditional client server application and web applications, client state manipulation, cookie based attacks, SQL injection, cross domain attack (XSS/XSRF/XSSI) http header injection. Introduction to PHP, MySQL, Apache, Server modules, HTML, CSS, Javascript/Jquery: Browser Security, Authentication and

session management, HTTPS goals and pitfalls, web application security, secure web application, web threat models, web attacker, network attacker, malware attacker, secure user interface, secure user communication, cookies, frames and frame busting. http request, http response, rendering and events, html image tags, image tag security issue, java script on error, Javascript timing, port scanning, remote scripting, running remote code, frame and iframe, browser sandbox, policy goals, same origin policy, library import, domain relaxation, window, post message syntax, legacy browser behavior, mixed content and network attack, cookies client state, cookie authentication, cookie security policy, secure cookies, http only cookies.

**Unit IV: Secure Website Design:** Architecture and Design Issues for Web Applications, Deployment Considerations Input Validation, Authentication, Authorization, Configuration Management, Sensitive Data, Session Management, Cryptography, Parameter Manipulation, Exception Management, Auditing and Logging, Design Guidelines Summary Sql and command injection: Forms and validity, Technical implementation, Incorrectly filtered escape characters, Incorrect type handling, Blind SQL injection, Conditional responses, Mitigation, Parameterized statements, Enforcement at the coding level, Escaping, Pattern check, Database permissions, Examples, Sql injection Commands. Securing web application XACS.

### Semester III

**MFS 303: Paper- XIX (Paper II- Advanced Computer Networks & Network Security)**  
**Hrs/week-4** **Marks-75**

---

#### **Unit-I: Circuit Switched Networks**

SONET - DWDM -Fiber to the Home - DSL - CATV - ISDN – Broadband ISDN. Wireless Networks: Mobile Communications technologies- wireless channel- Network design-Ad hoc Networks-Bluetooth technology. Recent Trends: Optical Networks - VoIP –Advanced intelligent Networks-Home networking.

#### **Unit-II:**

OSI, TCP/IP, IP, Addressing, CIDR, DHCP, IPV6, TCP, ARP, RARP, ICMP, VPN, VLAN, DNS, RIP, Wireless, IEEE 802.11, IEEE 802.16, Bluetooth, SIP, VOIP, CTI, ATM: Addressing Signaling & Routing - Header Structure - ATM Adaptation layer -Management control. Internetworking with ATM: LAN - IP over ATM - Multiprotocol over ATM - Frame Relay over ATM.

#### **Unit III: Importance of Security & Authentication:**

Threats to data, who are enemies, what can these enemies do, security tools, antivirus packages, Security policies, Access Control, firewalls encryption, intrusion detection, Zero day or Zero hour attack, data interception, intranet and extranet services data protection system, routing protocols, Distributed denial of service attacks, DNS Security, critical infrastructure protection, real time communication security. **Authentication:** password based, address based , machine based, distributed system, electronic mail security ,PGP , IP security, network management security, covert channel, captcha, ARP attacks route table modification, GSM & CDMA, TDMA, FDMA, SDMA Networks. Mobile ad-hoc networks, WAP.

**Unit-IV: Network Architecture & Security:** Network Scanning, Eavesdropping techniques and countermeasures. Network security including firewalls. Internet and E-commerce security issues. Networks and vulnerabilities, networking software - Client side and server side, secure network infrastructure, security protocol layers, create usage policy, conduct risk analysis, security violation, restoration. Network security zone , encapsulation of network services, allocation of traffic control functions. Internal boundary systems. **Hardening a Network** - Basic services, extended services, Perimeter defense tools, Cryptographic tools, Systems penetration testing, Studying computer forensics issues associated with computer networks, telecommunications and distributed systems. Wireless Network Security – Introduction and Standards, Vulnerabilities, Countermeasures, Management Issues of Wireless and Mobile Devices

**MFS-304: Practical XII –(Digital & Cyber Forensics-II)**

**Hrs/week-10**

**Marks-100**

**Candidate should complete minimum 80% of the total no. of 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. Password guessing and Password Cracking.
12. Windows Hacking – NT LAN Manager, Secure 1 password recovery
13. Implementing Web Data Extractor and Web site watcher.
14. Using IP TABLES on Linux and setting the filtering rules
15. Configuring S/MIME for e-mail communication
16. Lan Scanner using look@LAN, wireshark.
17. Understanding DoS Attack Tools- Jolt2, Bubonic, Land and LaTierra, Targa, Nemesy Blast, Panther2, Crazy Pinger, Sometrouble, UDP Flood, FSMax.
18. Email header and URL analysis
19. Drive and partition carving process
20. Advance firewall auditing
21. Auditing with and without network traffic
22. Auditing Authentication, Authorization, accounting and logging configuration
23. Intrusion detection and prevention configuration
24. Implementing Web Data Extractor and Web site watcher.
25. Using IP TABLES on Linux and setting the filtering rules
26. Configuring S/MIME for e-mail communication

27. Understanding Data Packet Sniffers
28. Windows Hacking – NT LAN Manager, Secure 1 password recovery
29. Understanding the buffer overflow and format string attacks

### **MFS-305: Seminar-III**

2 h /week

Marks: 25

Seminar of 30 minutes duration will be a part of internal assessment for 20 marks (1 credit). Seminar should be delivered by the student under the guidance of concerned teacher on the topic allotted by the teacher. The topic will be related to the syllabus. Marks will be allotted by a group of teachers.

### **M.Sc. FORENSIC SCIENCE SEMESTER- IV**

#### **MFS-401: Paper XX (Instrumentation, Research Methodology and Statistics)**

**Marks: 100**

**Lecture: 4 hrs/week**

---

#### **Unit I:**

**Chromatographic Techniques:** General principles, Working, uses and Forensic Applications of Paper chromatography, column chromatography, Thin Layer Chromatography, Adsorption chromatography, Partition chromatography, Gas chromatography, Gas- liquid chromatography, Ion-exchange chromatography, Exclusion (permeation) chromatography, Affinity chromatography, HPLC, HPTLC, Capillary Chromatography.

#### **Unit II:**

**Spectrophotometry:** Ultra violet and visible spectrophotometry: Types of sources and stability, wavelength selection, filters-cells and sampling devices, detectors, resolution, qualitative and quantitative methods for detection, Fluorescence and phosphorescence spectrophotometry, Atomic absorption spectrometry, Atomic emission spectrometer, X-ray spectroscopy, Infrared spectrophotometry, Mass spectrophotometer. Uses & Forensic Applications.

#### **Unit III:**

**Other Instrumental Techniques:** Nuclear Magnetic Resonance, MalDI-ToF, X-Ray Diffraction, Neutron Activation Analysis, ESDA, Video Spectral Comparator and other hyphenated advanced techniques and methods: Working, Principle, Advantage, Disadvantages and Forensic Applications

#### **Unit IV:**

**Quality Management:** Quality Management System: Quality, Total Quality, Quality assurance, Quality control, Quality Planning, Quality Audit: Internal and External Audit, Relevant Accreditation & Certification, NABL, ISO, IEC, BIS, etc. General requirements for the competence of testing and calibration laboratories. Lab manuals, laboratory reports,



laboratory records, Storage and Retrieval. Laboratory security, Personnel and Training, Organizational & document control, subcontracting of tests and calibrations control of Non conforming testing- corrective and preventive actions. Technical Requirements: - Test and calibration methods and their validation, measurements, standards and reference material, traceability, sampling. Bio-Safety.

## **SEMESTER- IV**

### **SPECIALIZATION I: QUESTIONED DOCUMENTS & FINGERPRINTS**

#### **MFS-402: Paper XXI (Special Paper-I: Forgery and Its Forensic Detection)**

**Hrs./week-4**

**Marks-75**

**Unit I:**

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. Scope of questioned document examination. Anachronistic features and their importance, detection and decipherment of alterations and erasures including additions, over writings, obliterations, examination of carbon copies and carbonless copies.

**Unit II:**

Examination of signatures – characteristics of genuine & forged signatures, examination of built-up 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:**

Corporate frauds, forensic accounting and auditing, 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 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:**

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.

## SEMESTER- IV

### **MFS-403: Paper XXII (Special Paper II: Automated Fingerprint Identification System)**

**Hrs./week-4**

**Marks-75**

#### **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.

## SEMESTER- IV

### MFS-404: Paper XXIII (Special Paper III: Forensic Linguistics)

Marks: 75

Lecture: 4 hrs/week

---

#### Unit I:

**Forensic Linguistics & Phonology:** Forensic Linguistics – Theories – analytical methods of linguistics – place of forensic linguistics in the applied linguistics – area of research in the forensic linguistics.

Phonetics and phonology – 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: Forensic Linguistics and Psycholinguistics

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

## SEMESTER- IV

### MFS-405: Paper XXIV (Special Paper IV-Forensic Photography)

Marks: 75

Lecture: 4 hrs/week

---

**Unit I: 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 & Geo-mapping. 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.

### **MFS 406: Practical XIII (Special: QUESTIONED DOCUMENTS & FINGERPRINTS)**

**Hrs./week-12**

**Marks-100**

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

1. To study the initials and handwriting written on unusual surfaces.
2. To examine currency notes.
3. Photography of indoor crime scene.
4. Photography of outdoor crime scene.
5. Digital photography.
6. Enlargement and printing of photographs (digital/films).
7. Presentation of evidence through photographs and charts.
8. Examination of Travel Documents –Indian Passports and Visas.
9. To perform SPR method to develop latent prints.

10. Fingerprint identification and comparison.
11. Working and handling of Stereo Zoom Microscope and Comparison Microscope.
12. Working and handling of Video Spectral Comparator, Electrostatic Detection Apparatus.
13. Working and handling of UV-VIS, TLC.
14. Reconstruction of torn sheets of paper.
15. Examination of paper.
16. Dating of documents.
17. Examination of torn document.
18. Examination of charred Documents.
19. Examination of creases and folds and determination of sequence of strokes.
20. Examination of Stamp Papers and Lottery Tickets.
21. Examination of inks
22. Evaluation of copy-move forgery.
23. Comparison of disputed handwriting with specimen handwriting.
24. Studying the natural variations and evolution of handwriting.
25. Preparation of court opinions.
26. Preparation for examination-in-chief & cross-examination.
27. Document photographic techniques-close up photography, UV, IR, Transmitted and Oblique light photography.
28. Contact and trick photography.
29. Photography of secret writings.
30. Examination of anonymous letters.
31. Application of Forensic Stylistics in personal identification.
32. Examination of rubber stamp impressions and other mechanical impressions.
33. Examination of alterations and obliterations in the Questioned Documents.
34. Decipherment of secret writing by various methods.
35. Development of fingerprint on electronic media (pen drive, CD, DVD, hard disk etc.)
36. Examination of forgeries on security documents
37. Study of psychological aspects of Suicide Notes.
38. Examination of typescripts/printed matter/ Scanned documents/ fax.
39. Methods of cross-examination of experts who have submitted wrong opinions.

### **MFS-407: Project Work (Specialization)**

**Hrs./week-10**

**Marks-100**

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 of Questioned Document, Handwriting analysis and Fingerprint examination etc.

## SEMESTER IV

### Specialization II: Forensic Chemistry & Toxicology

#### MFS-402: Paper XXI (Special Paper I-Advanced Forensic Toxicology)

**Hrs/week-4**

**Marks-75**

---

#### **Unit I :**

**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.

**Food Adulteration:** Food Adulteration Act, Various adulterants in household and food products, their detection

#### **Unit II: Plant And Animal Poisons:**

**Plant Poisons:** Classification and types (*Datura*, *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.

**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 III: 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, hydrogensulphide, nitrous oxides, war gases, etc.)

**Unit IV: Narcotics and Psychotropic substances:** Classification and types of Narcotics (cannabis, cocaine, opium etc.) and Psycotropic Substances (stimulants, hallucinogens, depressants, sedatives 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). Drugs and Cosmetic Act, NDPS Act, Control Substance Act.

**SEMESTER IV**  
**Specialization: Forensic Chemistry & Toxicology**

**MFS-403: Paper XXII (Special Paper II-Advanced Forensic Chemistry)**

**Hrs/week-4**

**Marks-75**

---

**Unit I:**

**Dyes:** Different type of dyes, role of dyes in crime investigation, food colours (edible and non-edible dyes), dyes used in cosmetic and pharmaceutical. Chemical analysis and instrumental methods of analysis of dyes. Analysis of trace evidence: cosmetics, dyes, Trap related evidence materials, fibers, oils, fats, greases, industrial dusts, 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: Hair, urine, blood, viscera, methods of extraction of drugs/consultation 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 type of fertilizers and classification, substandard and sub-standard adulterated fertilizers, common adulterants. Chemical and instrumental methods of analysis of fertilizers. Quantitative and qualitative forensic analysis of organic and inorganic Industrial products, chemical fertilizers, pesticides, insecticides, metallic and non metallic products, consumer items such as gold, silver, tobacco, tea, sugars, salts, 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 color tests, TLC, 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 as per BIS and PFA Act, Detection and Determination of ethanol, furfural, organic acids, aldehydes, chloral hydrate, methanol and ethylene glycol in liquors by colour tests, TLC, GC and GC-MS methods and Case Studies.

## SEMESTER- IV

### MFS-404: Paper XXIII (Special Paper III: Forensic Pharmacology)

**Hrs/week-4**

**Marks-75**

---

**Unit I: Pharmaceutical Drugs:** Antidepressants, diuretics, antibiotics, antipyretics, anti-histamines, hallucinatory 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).

**Unit II: Pharmacodynamics-I** Sites and mechanisms of action of drugs; 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. Variability of drug effects: factors depending on the drug, on the patient, on the treatment schedule. Drug interactions.

**Unit III : Pharmacokinetics:** The movement of drug molecules across cell membranes, the blood-brain barrier and the placental filter. Routes of administration and drug adsorption. Binding to plasma proteins. Drug distribution, metabolism and elimination. Drug bioavailability and half-life. Pharmacokinetic parameters evaluation. Time course of drug plasma concentrations after single and repeated administrations.

**Unit IV: Pharmacognosy:** Definition and aim of Pharmacognosy; definition and classification of plant drug; factors affecting the activity: natural, endogenous, exogenous and preparation-dependent. Plant drug: conditions of preservation, analysis, identification, quality control, distinctive characters, endogenous active substances, therapeutic strategies, toxic effects. Signs and symptoms of addiction, the identification of addict, interpreting drug findings.



## SEMESTER- IV

### MFS-405: Paper XXIV (Special Paper IV: Forensic Analysis of Drugs)

Hrs/week-4

Marks-75

---

#### **Unit – I:**

##### **Drugs, Other Chemicals & Related Laws:**

Introduction, Pharma drugs (barbiturates, benzodiazepine & other pharma drugs), Substance abuse, Drug abuse in sports & Date rape drugs: Introduction, common prohibited substances, analytical approach, Forensic Pharmacological studies, Ingestion of drugs, absorption, distribution, metabolism, pathways of drug metabolism, drug metabolism and drug toxicity, excretion of drugs, detection of drugs on the basis of their Metabolic studies.

Solvent Abuse (chlorinated hydrocarbons, Aromatic hydrocarbons, alcohols, glycols, fuel and fuel additives): absorption, distribution, and metabolism, psychological & clinical effects.

Analysis: collection of sample, distillation & extraction, Analysis by GC, HPLC.

**Legal Aspect:-** Case Studies and Relevant Provisions of – The Drugs Control Act, 1940. The Drugs and Cosmetics Act, 1940. Etc.

**Unit II:** Classification of Drugs, commonly encountered for analysis: Narcotic drugs, depressants, stimulants, hallucinogens, designer drugs, club drugs, drugs of sports and precursors. Field test, colour test, micro crystal test, thin layer chromatography. Performance Enhancing Drugs in sports.

#### **Unit III:**

Analysis of Narcotic & Psychotropic drugs: Opium (alkaloids, morphine, heroin and opioids), Cannabis and its derivatives (Bhang, ganja, hashish (Charas) and Cocaine, Depressants: Barbiturates, methaqualone, benzodiazepines Stimulants: Methaquinolines, amphetamines and related derivatives, Hallucinogens: LSD, Mushroom and Cactile, etc.

**Unit IV:** Detection of common adulterants and determination of percentage purity in seized samples, detection identification, quantitation of drugs in pharmaceutical products. Analysis of illicit drugs and 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: Hair, urine, blood, viscera, methods of extraction of drugs/consultation of drugs. Limitation of chemical analysis of drugs. Report writing and interpretation of drugs. Court testimony in NDPS Act cases. Case studies and ground for acquittal and grant of bail.

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

1. M.P, B.P and flash point determination.
2. To perform Colour test and UV-Visible Spectrophotometry of pesticide, insecticides.
3. Analysis of dye and pigments by using TLC technique.
4. Analysis of phenolphthalein in trap cases by UV-Visible.
5. Analysis of phenolphthalein in trap cases by TLC And HPLC.
6. Analysis of alcohol content in sample by derivatization into known organic compounds and its analysis by GC.
7. Analysis of alcohol content in sample by derivatization into known organic compounds and its analysis by GCMS, HPLC
8. Determination of Mercury in biological materials by spectrophotometry.
9. Analysis of animal Poisons using TLC.
10. Analysis of Plant poisons using TLC.
11. To study the separation of metal ions by paper chromatography.
12. Determination of alcohol in blood and urine sample. .
13. Analysis of blood, urine, stomach wash in emergency cases of poisoning.
14. Comparison of fibres by chemical analysis, TLC/HPTLC/ FTIR.
15. Gas chromatography analysis of Ganja and Charas.
16. Analysis of food material in case of food poisoning by chemical, microscopic and instrumental techniques.
17. Analysis of viscera in case of food poisoning by chemical, microscopic and instrumental techniques.
18. Interpretation of given spectral data of various compounds.
19. Estimation of paints and pigments by UV Spectrophotometry/FTIR.
20. Comparison of polythene films by IR spectrophotometry.
21. Analysis of viscera for volatile Organic and inorganic poisons.
22. Analysis of non- metallic (anionic) poisons in viscera.
23. Analysis of viscera for organochloro, organophosphoro, carbamates and pyrethroids by colour test TLC/HPTLC and UV-visible spectrometry method.
24. UV-Vis Spectrophotometric, GC and GC-MS analysis of barbiturates.
25. Detection of metallic poisons in viscera and food stuff.
26. Detection and identification of pesticide in a given formulation, TLC.
27. Interpretation of given spectral data of various compounds. Determination of poisonous metals in biological materials by AAS.
28. Extraction, Systematic identification of Narcotic Drugs and Psychotropic substances (opiates, cannabis and barbiturates, benzodiazepines and amphetamines) by spot colour tests
29. Analysis of Na and K contents in soil sample by Flame Photometry.
30. GC-MS, HPLC analysis of explosive residues.
31. Detection of adulteration in oils and fats by chemical analysis and TLC/ HPTLC.
32. Detection and identification of metallic poisons in viscera and food material by chemical test and instrumental technique.

33. Systematic extraction, and identification and non-volatile drugs and poisons by various techniques.

### MFS-407: Project Work (Specialization)

**Hrs/week-10**

**Marks-100**

#### 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

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.

## SEMESTER IV

### Specialization III: Forensic Biology & Serology

#### MFS-402: Paper XXI (Special Paper-I Forensic Anthropology, Odontology and Forensic Pathology)

**Hrs. /Week-4**

**Marks: 75**

**Unit I: Forensic Anthropology:** 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. **Bio-archeology:** Field recovery methods, Laboratory processing, curation and chain of custody, Age at death, sex, ancestry, height and weight, pre-mortem injury and disease, taphonomy, peri-mortem trauma, postmortem 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 Susan C Anton)

**Unit II: 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 .Use of fragmentary long bones in stature reconstruction. Racial differences in human skeleton; distinguishing humans from other non- human skeletal remains; Forensic odontology, DNA isolation from bones and teeth. Age estimation, . Facial Reconstruction 2-D, 3-D, etc.

**Unit III: 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 post-mortem dental records.

**Unit IV: 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. 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.

## SEMESTER- IV

### MFS-403: Paper XXII (Special Paper II-DNA Fingerprinting and Interpretation)

**Hrs. /Week-4**

**Marks: 75**

**Unit I: DNA Fingerprinting:** Possible sources for DNA, collection, transportation and preservation of various forensic samples for DNA profiling. DNA extraction techniques for different forensic samples (early techniques, solid phase extraction, differential extraction, chelex extraction, automated techniques, commercial extraction kits), RNA extraction from different forensic samples. Determining quality and Quantity of DNA and RNA, Gel elution technique. **DNA Amplification:** Types of PCR: Nested PCR, Touchdown PCR, Gradient

PCR, Hot-starts PCR, Quantitative PCR, multiplex PCR. DNA quantification by Slot- blot assay, Pico-green micro-titer plate assay, AluQuant human DNA quantification system, endpoint PCR, PCR inhibitors & solutions, Contamination Issues, etc.

**Unit II: 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, Slot-blot assay for quantification of DNA, DNA-DNA Hybridization, next generation sequencing, Nano-particle technology in PCR, Drug-DNA interactions, SNP microarray for supplementary paternity testing. Genetic analysis of chromosome X (pentaplex/heptaplex PCR assay), multicopy Y-STR analysis, mitochondrial DNA analysis, DNA multi-reverse parental analysis, cytochrome b analysis, eDNA Personal Effects and DNA analysis(sources and problems)

**Unit III: 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 IV: Forensic DNA evidence interpretation:** Interpretation of DNA typing results: Complicating Factors (Multiple contributors, degradation, and extraneous substances), System-specific 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.

## SEMESTER- IV

**MFS-404: Paper XXIII (Special Paper III: Microbial Forensics and Bioinformatics)**  
**Hrs/week-04 Marks-75**

**UNIT I: 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), Thermal and Denaturing 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.

**Unit II: Microbes of Forensic Importance:** *Bacillus anthracis*, *Yersinia pestis*, *Francisella tularensis*, *Brucella spp.*, *Burkholderia Pseudomallei*, *Clostridium botulinum*, *Listeria monocytogenes* and their morphological & biochemical studies. DNA of microbes in soil for crime detection. Fungi of forensic importance: Opportunistic mycoses, *Chytridiomycota* *zygomycota*, *Aspergillus fumigates*, *Microsporidium*, *Pneumocytosis jiroveci*, *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 III: 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, Bio surveillance, 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 IV: 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 (1): Whole genome analysis, DNA analyses for repeats (Direct and inverted); palindromes, open reading frames, annotations of genes, identification of gene. 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

## SEMESTER- IV

**MFS-405: Paper XXIV (Special Paper IV: Wildlife and Environmental Forensics)**

**Hrs/week-4**

**Marks-75**

### 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. 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. Wildlife (Protection) Act-1972

## **Unit II: 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. Arsenic- sources, 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 III:**

**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;

## **Unit IV**

**Environmental Legislation:** central and state boards for the prevention and control of environmental pollution, powers and functions of pollution control boards, penalties and procedure, duties and responsibilities of citizens for environmental protection. The Water (Prevention and Control of Pollution) Act 1974. Prevention and Control of Air Pollution Act 1981, Forest Conservation Act 1981, Environment (protection) Act 1986, Hazardous waste (Management and Handling) Rules, 1989, Bio-Medical Waste (Management and Handling) Rules, 1998. Issues involved in enforcement of environmental legislation, public awareness, and public interest litigations (PILs) and its role in control of environmental pollution in India.

### **MFS-406: Practical XV (Special: Forensic Biology & Serology)**

**Hrs/week-12**

**Marks-100**

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

1. Side and site determination from long bones.
2. Stature estimation from bones. (4)
3. Sex determination from various bones. (5)

4. Age determination from bones. (5)
5. Age estimation from teeth (2)
6. Analysis of bite marks.
7. Bite mark analysis.
8. Examination of nails, occupation, scars, tattoo marks, and other deformities. (4)
9. Collection, transportation and preservation of various forensic samples for DNA profiling.
10. DNA typing technique (RFLP, PCR, etc.)
11. Determination of Genetic Concordance, Evaluation of results, frequency Microscopic study of normal/abnormal RBC's
12. Microscopic study of semen/sperms
13. Working of Scanning Electron Microscope (SEM)
14. Separation of bacterial cells from culture media by differential centrifugation,
15. Separation of serum proteins by density gradient centrifugation
16. Separation of serum protein by horizontal submerged gel electrophoresis.
17. Separation of sugar, amino acid by TLC
18. To perform Calibration of refrigerator, centrifuge, micropipette, digital balance.
19. To perform primer designing using bioinformatics tools.
20. To perform Homogenization of various forensic sample.
21. Determination of the paternity index of given data
22. To determine the combined frequency of occurrence.
23. To determine the discrimination power and power of exclusion.
24. To determine paternity index using serum profile.
25. Determination of correlation
26. Problems on population genetics
27. Chromosome staining by Giemsa.
28. Separation of SAP/VAP.
29. DNA extraction from blood/Semen/Saliva/Epithelial cell/Bones/Teeth/nails
30. DNA extraction from other forensic samples
31. Amplification of 16 s rDNA by using PCR
32. Amplification of 18 s r DNA by using PCR
33. Preparation and transformation of competent E. Coli using calcium chloride
34. Perform a silver staining and fluorescence staining for the detection of DNA/protein
35. Estimation of hemoglobin percentage
36. Blood examination for diseases
37. Sperm counting by hemocytometer
38. Western blotting analysis
39. Extraction of mitochondrial DNA from forensic samples
40. Cultivation of forensically important microorganism.
41. Separation of polymorphic enzymes by electrophoresis
42. Cross over immune-electrophoresis
43. Examination of blood stains: physical and chemical tests; spectroscopic examination.
44. Examination of Menstrual blood by microscopic, spectroscopic, electrophoretic method
45. ABO blood grouping from other body fluids.



- 46 9 Molecular docking studies using Argus labs, software too
- 47 . Application of Raptor X, PEP-FOLD, QUARK
- 48 . Performe a BLAST of given protein / nucleic acid sequence
- 49 . Find out the restriction site by using bioinformatics tools
- 50 Perform a primer designing by using bioinformatics tools

### **MFS-407: Project Work (Specialization)**

**Hrs./week-10**

**Marks-100**

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, Anthropology, Entomology, etc.

### **SEMESTER IV**

#### **Specialization IV: Cyber Security and Cyber Forensic**

#### **MFS-402: Paper XXI (Special Paper I- Mobile & Cyber Forensics)**

**Hrs/week-4**

**Marks-75**

**Unit I: Mobile Forensic:** History, Professional Applications, Types of evidence, Internal memory, External memory, Service provider logs, Forensic process, Seizure, Acquisition, examination and analysis, Data acquisition types, Manual acquisition, Logical acquisition, File system acquisition Physical acquisition tools, Commercial Forensic Tools, Open Source Tools, Forensic desoldering, Chip re-balling, JTAG, Command Line Tools, System commands AT commands dd Non-Forensic Commercial Tools, Flasher tools, controversies.

**Unit II: Live Forensic :** live response, volatile memory analysis, volatility, PTFinder, the impact on investigated system, memory image analysis, recovering cached and internet artifacts , internet browsing artifacts, volatile data acquisition, volatile forensic method, runtime disk explorer, logical acquisition, memory dump analyzer, crash dump analyzer, cryptanalysis, MAC times, metadata issues, analyzing file time stamps.

**Unit III: Image Forensic:** Detecting traces of re-sampling, more images are spliced together, detect high quality and consistent image forgeries, detect geometric transformations such as scaling, rotation or skewing re-sampling and interpolation. Detecting near-duplicated image regions, common type of digital image forgery, copy-move forgery, Noise inconsistencies analysis to conceal traces of tampering altered image regions. Application of cyclostationarity analysis to image forensics, (cyslostationary signals) exhibit periodicity in their statistics. Find the traces of geometric transformation shows promising results. Double JPEG compression, CFA analysis, quantization tables analysis, etc.

**Unit IV: Network & Anti-Computer Forensics:** Ethernet analysis, Network interface card analysis, wireless forensic , attackers footprints , firewall logs, IDS/IPS, web proxies, traffic captures, DHCP log examination, sniffing traffic , analyzing proxy cache, tools like tcpdumps, Snort, ngrep, tcpextract, and wireshark. Email tracker pro, analyzing index.dat, input debugging, controlled flooding, ICMP traceback, packet marking techniques, honeypots and honeynets, source path isolation engine (SPIE). **Anti-Computer Forensic:** Definition, Sub-categories, Purpose and goals, Data hiding, Encryption, Steganography, Other forms of data hiding, Artifact wiping, Disk cleaning utilities, File wiping utilities, Disk degaussing / destruction techniques, Trail obfuscation, Attacks against computer forensics Physical, Effectiveness of anti-forensics

## SEMESTER IV

### **MFS-403: Paper XXII (Special Paper II- Ethical Hacking & Recovery Forensic)**

**Hrs/week-4**

**Marks-75**

**Unit I: Ethical Hacking:** Computer Image Verification and Authentication, understanding Malicious and hostile code including viruses, Trojan horses, worms, backdoors, trapdoors honeytrap forensics and spyware. Identification, Authentication and Authorization including passwords, smartcards and biometrics. Physical, environmental and organizational considerations for deploying forensic computing initiatives. Computer security and analyze security breaching attacks, Risk analysis, risk assessment and contingency planning for information security. Risk management. Impact and probability of threat.

**Unit II: System Hacking and prevention,** DoS Attacks and prevention, Session Hijacking and prevention, Hacking Web server and prevention, Hacking Web Application and prevention, SQL Injection and prevention, Social Engineering and prevention, Recognize the range of surveillance techniques and countermeasures. Investigate a range of security issues relating to operating systems, PC systems, threats vulnerabilities and security mechanisms.

**Unit III: Recovery Forensic :** Understanding the storage mechanism of devices like CD, DVD, USB, flash card, Harddisk, floppy disk etc, Data deletion concept, Breadth of Recovery software, limitations of recovery software, partition recovery(NTFS, FAT), recover data from CD, DVD, recover lost partition, Gpart recover data when sector 0 is damaged, data recovery form corrupted/formatted/repartitioned/deleted hard drive, backup of master boot record, restoration of firmware, Carving, recovering data from damaged storage devices.

**Unit IV: Winhex:** recovering digital evidence using winhex, creation and study of event logs in winhex, analysis of physical view and logical view, Disk cloning, disk imaging, RAM editor, Analyzing files, Analyzing files, wiping unused space, editing data structure, splitting files, viewing and manipulating files, hiding data and discovering hidden data, API, Cyber forensic application of Winhex.

## SEMESTER- IV

### MFS-404: Paper XXIII (Special Paper III- Digital Image Processing)

**Hrs/week-4**

**Marks-75**

**Unit I: Digital Image Processing:** Fundamental Steps in Image Processing, Elements of Digital Image Processing, Digital Image Fundamentals, Image Enhancement in the Spatial Domain, Image Enhancement in the Frequency Domain, Image Restoration. Image Compression: Fundamentals, Redundancies, Image compression models, Error free compression, Lossy compression, Image compression standards. Morphological Image Processing, Image Segmentation: Introduction to Dilation, Erosion, Opening, Closing, Hit-or-Miss transformation, Morphological algorithm operations on binary images, Morphological algorithm operations on gray-scale images. Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding, Region-Oriented Segmentation.

**Unit II: Pattern Recognition:** Introduction to Pattern Recognition, Bayesian decision theory: Classifiers, Discriminant functions, Decision surfaces, Normal density and Discriminant functions, discrete features, Principal Component Analysis (PCA), Expectation Maximization (EM), Hidden Markov models for sequential pattern classification, Non-parametric: Density estimation, Parzen window method, Probabilistic Neural Networks (PNNs), K-Nearest Neighbour, Estimation and rules, Nearest Neighbour and Fuzzy Classification. Linear Discriminant function based classifiers: Perceptron, Support Vector Machines (SVM).

**Unit III: Steganography & Steganalysis:** Information Hiding, Steganography, and Watermarking, History of Watermarking, History of Steganography, Importance of Digital Watermarking, Importance of Steganography Applications and Properties. **Steganography:** Information-Theoretic Foundations of Steganography, Steganographic Methods: Statistics Preserving Steganography, Model-Based Steganography, Masking Embedding as Natural

Processing, Minimizing the Embedding Impact. **Steganalysis:** Steganalysis Scenarios, Some Significant Steganalysis Algorithms

**Unit IV: Models of Watermarking:** Communication-Based Models of Watermarking, Geometric Models of Watermarking, Modeling Watermark Detection by Correlation, Robust Watermarking Approaches. **Watermark Security:** Security Requirements, Watermark Security and Cryptography, Some Significant Known Attacks, Content Authentication.

#### SEMESTER- IV

#### MFS-405: Paper XXIV (Special Paper IV- Biometrics)

**Hrs/week-4**

**Marks-75**

**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.

#### MFS-406: Practical XVI (Special: Cyber Security and Cyber Forensic)

**Hrs/week-12**

**Marks-100**

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

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, Steghide, Steganos, Pretty Good Envelop, Stegdetect,

### **MFS-407: Project Work (Specialization)**

**Hrs. /Week-09**

**Marks: 100**

Dissertation will be compulsory to all students. The format for dissertation report will be similar to the research thesis style; incorporating chapters on: Introduction, Materials and Methods, Results and Discussion and References / Bibliography. The dissertation will be submitted in a typewritten and bound form. Copy of each dissertation will be submitted to the respective department and the centre will store it permanently. Dissertation on forensically significant and need based problems in the area of Digital and Cyber Forensics.

### **MFS-408: Seminar-IV**

**2 h /week**

**Marks: 25**

Seminar of 30 minutes duration will be a part of internal assessment for 20 marks (1 credit).

Seminar should be delivered by the student under the guidance of concerned teacher on the topic allotted by the teacher. The topic will be related to the syllabus. Marks will be allotted by a group of teachers.

## REFERENCES: Semester III and Semester IV

### Specialization I: Questioned Documents & Fingerprint

1. H.C. Lee, R.E. Gaensslen "Advances in Fingerprint Technology", 2nd ed. NY: CRC Press, 2001.
2. S.A. Cole, Suspect Identities: A History of Fingerprint and Criminal Identification. Harvard Univ. Press, May 2001
3. Federal Bureau of Investigation. www.fbi.gov, 2002
4. A.K. Jain and S. Pankanti, Biometrics Systems: Anatomy of Performance,° IEICE Trans. Fundamentals, special issue on Biometrics,
5. D.A. Stoney and J.I. Thornton, °A Critical Analysis of Quantitative Fingerprint Individuality Models° J. Forensic Sciences, vol. 31, no. 4
6. B. Wentworth and H.H. Wilder, Personal Identification. Boston: R.G. Badger, 1918
7. H. Cummins and C. Midlo, Fingerprints, Palms and Soles. Philadelphia: Blakiston, 1943.
8. C. Champod and P.A. Margot, °Computer Assisted Analysis of Minutiae Occurrences on Fingerprints,° Proc. Int'l Symp. Finger-print Detection and Identification, J. Almog and E. Spinger
9. S.L. Sclove, The Occurrence of Fingerprint Characteristics as a Two Dimensional Process,° J. Am. Statistical Assoc., vol. 74.
10. D.A. Stoney, °Distribution of Epidermal Ridge Minutiae,° Am. J. Physical Anthropology
11. A.K. Jain, S. Prabhakar, L. Hong, and S. Pankanti, °Filterbank-Based Fingerprint Matching,° IEEE Trans. Image Processing,
12. A.K. Jain, S. Prabhakar, and S. Pankanti, °Twin Test: On Discriminability of Fingerprints,° Proc. Third Int'l Conf. Audio-and Video-Based Person Authentication
13. [Osborn, A.S.](#) (1929). Questioned Documents, 2nd ed. Albany, New York: Boyd Printing Company. Reprinted, Chicago: Nelson-Hall Co.
14. Harrison, W.R. (1958). Suspect Documents: Their Scientific Examination. New York: Praeger.
15. Conway, J.V.P. (1959). Evidential Documents. Illinois: Charles C Thomas.
16. Hilton, O. (1982). Scientific Examination of Questioned Documents. New York: Elsevier Science Publishing
17. Huber R.A. & Headrick A.M.(1999). Handwriting Identification:Facts n Fundamentals. Boca Raton: CRC Press.
18. Ellen, D. (2005). Scientific Examination of Documents: Methods and Techniques, Third Edition. Boca Raton: CRC Press.
19. Morris, R. (2000). Forensic Handwriting Identification: Fundamental Concepts and Principles. Academic Press.
20. Levinson, J. (2001). Questioned Documents: A Lawyer's Handbook. San Diego: Academic Press.
21. Koppenhaver, K. (2007) Forensic Document Examination, Principles and Practice Humana Press.
22. Joe Nickell (2005) *Detecting Forgery: Forensic Investigation Of Documents* University press of Tenkucty
23. [Daniel T. Ames.](#) - Ames on forgery: its detection and illustration, with numerous causes
24. [Joseph T. Wells](#) (2011 ) *Corporate Fraud Handbook: Prevention and Detection*
25. [Osborn, A.S.](#) (1929). Questioned Documents, 2nd ed. Albany, New York: Boyd Printing Company. Reprinted, Chicago: Nelson-Hall Co.
26. Harrison, W.R. (1958). Suspect Documents: Their Scientific Examination. New York: Praeger.
27. Conway, J.V.P. (1959). Evidential Documents. Illinois: Charles C Thomas.
28. Hilton, O. (1982). Scientific Examination of Questioned Documents. New York: Elsevier Science Publishing Co.

29. Huber R.A. & Headrick A.M. (1999). Handwriting Identification: Facts and Fundamentals. Boca Raton: CRC Press.
30. Ellen, D. (2005). Scientific Examination of Documents: Methods and Techniques, Third Edition. Boca Raton: CRC Press.
31. Morris, R. (2000). Forensic Handwriting Identification: Fundamental Concepts and Principles. Academic Press.
32. Levinson, J. (2001). Questioned Documents: A Lawyer's Handbook. San Diego: Academic Press.
33. Koppenhaver, K. (2007) Forensic Document Examination, Principles and Practice Humana Press.
34. Gerald R. McMenamin (2002) : *Forensic Linguistics: Advances in Forensic Stylistics*.
35. John Gibbons, Maria Teresa Turell (2008): *Dimensions of forensic linguistics*
36. Gerald R. McMenamin – 1993: *Forensic stylistics*
37. John Olsson - 2004 *Forensic Linguistics: An Introduction to Language, Crime and the Law*
38. Malcom Coulthard - 2007 *An introduction to forensic linguistics: language in evidence*
39. Alan Davies - 2007 *An introduction to applied linguistics: from practice to theory*.
40. Henry G. Widdowson, Guy Cook, Barbara Seidlhofer - 1995 *Principle and Practice in Applied Linguistics: Studies in Honour*
41. Lawrence M. Solan, Peter M. Tiersma - 2010 *Speaking of Crime: The Language of Criminal Justice*
42. Huber, A. R. and Headrick, A.M. (1999) : Handwriting identification : facts and fundamental CRC LLC
43. Ellen, D (1997) : The scientific examination of Documents, Methods and techniques. 2nd ed., Taylor & Francis
44. Morris (2000) : Forensic Handwriting Identification (fundamental concepts and Principals)
45. Harrison, W.R. : Suspect Documents & their Scientific Examination, 1966, Sweet & Maxwell Ltd., London.
46. Hilton, O : The Scientific Examination of Questioned Document, 1982, Elsevier North Holland Inc., N York.
47. Sulner, H.F. : Disputed Document, 1966 Oceana Publications Inc., New York.
48. Saxena's : Saxena's Law & Techniques Relating to Finger Prints, Foot Prints & Detection of Forgery, Central Law Agency, Allahabd (Ed. A.K. Singla).
49. Quirke, A.J. : Forged, Anonymous & Suspet Documents, 1930, Reorge Rontledge & Sons Ltd., London.
50. Osborn, A. S. : Questioned Documents 1929, Boyd Printing Co., Chicago.
51. Levinson, J: Questioned Documents, 2000, Academic Press, Tokyo.
52. Kelly,J.S and Lindblom, B.S: Scientific Examination of Questioned Documents, 2006, Taylor & Francis, NY.
53. Brunelle, R.L. & Reed, R.W: Forensic Examination of Ink and Paper, 1984, Charles C Thomas Publisher, USA
54. Baker, J.N: Law of Disputed and Forged Documents, 1955, The Michie Company, Virginia.
55. David R. Ashbaugh; Quantitative and Qualtative Friction Ridge Analysis, CRC Press, 1999.
56. E. Roland Menzel; Fingerprint Detection with Loseres; Second edition; Marcel Dekker, Inc. 1999.
57. James F. cowger; Friction Ridge skin CRC Press London, 1993.
58. Cummins & Midlo : Finger Prints, Palms and Soles, 1943, The Blakiston office London.
59. Cherril, F.R. : The Finger Prints. System at Scotland Yard, 1954; Her Majestuy's office, London.

60. Wentworth & Wilder : Personal Identification, 1948. R. G. Badger. Boston.
61. Mehta, M. K. : Identification of Thumb Impression & Cross Examination of Finger Prints, 1980 N. M. Tripathi (P) Ltd. Bombay.
62. Moenssens : Finger Prints Techniques, 1975, Chitton Book Co., Philadelphia, New York.
63. Allison : Personal Identification.
64. Chatterjee S.K. and Hagne R.V. (1988) : Finger Print or Dactyloscopy and Ridgeoscopy.
65. David R. Ashbaugh; Quantitative and Qualitative Friction Ridge Analysis, CRC Press, 1999.
66. E. Roland Menzel; Fingerprint Detection with Lasers; Second edition; Marcel Dekker, Inc99.
67. James F. Cowger; Friction Ridge skin CRC Press London, 1993.
68. Cummins & Midlo : Finger Prints, Palms and Soles, 1943, The Blakiston office London.
69. Cherril, F.R.: The Finger Prints. System at Scotland Yard, 1954; Her Majesty's office, Lon
70. Wentworth & Wilder : Personal Identification, 1948. R. G. Badger. Boston.
71. Mehta, M. K. : Identification of Thumb Impression & Cross Examination of Finger Prints, 1980 N. M. Tripathi (P) Ltd. Bombay.
72. Moenssens : Finger Prints Techniques, 1975, Chitton Book Co., Philadelphia, New York.
- Allison : Personal Identification.
73. Chatterjee S.K. and Hagne R.V. (1988) : Finger Print or Dactyloscopy and Ridgeoscopy.
74. Tommie W. Singleton, Aaron J. Singleton – 2010 *Fraud Auditing and Forensic Accounting*.
75. Mark Nigrini - 2011 *Forensic Analytics: Methods and Techniques for Forensic Accounting*.
76. Joseph Petrucelli 2013 *Detecting Fraud in Organizations: Techniques, Tools, and Resources*.
77. Mary-Jo Kranacher, Richard Riley, Joseph T.Wells 2010. *Forensic Accounting & Fraud Examination*
78. Steven L. Skalak, Thomas W. Golden, Mona M. Clayton.2011 *A Guide to Forensic Accounting Investigation*
79. Larry E. Rittenberg, Karla M. Johnstone, Audrey A. Gramling, *Auditing: A Business Risk Approach*
80. George A. Manning, 2010 *Financial Investigation & Forensic Accounting*
81. Saurav K. Dutta – 2013 *Statistical Techniques for Forensic Accounting*
82. K. H. Spencer Pickett – 2010 *The Internal Auditing Handbook*
83. Joseph T. Wells – 2007 *Corporate Fraud Handbook: Prevention and Detection*
84. Walter J. Pagano, Thomas A *Expert Witnessing in Forensic Accounting*
85. Jack Bologna, Robert J. Lindquist - 1995 *Fraud auditing and forensic accounting: new tools and techniques*
86. Xenia Ley Parker, Lynford Graham – 2007 *Information Technology Audits*

## **Specialization II: Forensic Chemistry & Toxicology**

### **Suggested Readings for Theory:**

1. B. R. Sharma: Forensic Science in Criminal Investigation and Trials, Fourth Edition, Universal Law Publishing
2. Modi's: Medical Jurisprudence & Toxicology, M. M. Trirathi Press Ltd. Allahabad, 1988.
3. S. N. Tiwari: Analytical Toxicology, Govt. of India Publications, New Delhi, 1987.
4. Curry: Analytical Methods in Human Toxicology, Part II, 1986.



5. Arena Poisoning: Chemistry, Symptoms and Treatment.
6. H. H. Wouldard, et al : Instrumental Methods of Analysis, 1974.
7. A.A. Moonesens et al : Scientific Evidence in Criminal Cases, 1973.
8. Lundquist and Curry: Methods of Forensic Science, 1963.
9. Lee and Gaensslen: Advances in Forensic Science, (Vol. 2) Instrumental Analysis.
10. Borrow: Molecular Spectroscopy, 1980.
11. Spectroscopy of Organic compounds by P. S. Kalsi.
12. W. Kemp, Organic Spectroscopy, 2<sup>nd</sup> Ed., Macmillan Pub., 1987.
13. D.L. Pavia, G. M. Lampman and G.S. Kriz: Introduction to Spectroscopy, 2008
14. F.A. Settle: Handbook of Instrumental Techniques for Analytical Chemistry, Prentice Hall, 1997.
15. Lurie and Witturer : High Performance Liquid chromatography in Forensic Chemistry, 1983.
16. P.R. Brown and E. Bruksha: Advances in Chromatography, Vol. 42, 2003.
17. Howard: Forensic Analysis by Gas Chromatography
18. D. Grahm: The use of X-ray Techniques in Forensic Investigation, 1973.
19. B.K. Sharma: Industrial Chemistry, Goel Publishing House, Meerut.
20. R.A. Day and A.L. Underwood, Quantitative Analysis, 6th Ed., Prentice Hall of India Pvt. Ltd (1993).
21. G.D. Christian, Analytical Chemistry, 6<sup>th</sup> Ed., John Wiley & Sons (2001).
22. Basic Concepts of Analytical Chemistry by S.M. Khopkar.
23. B. Levine: Principles of Forensic Toxicology, 3<sup>rd</sup> Ed., AACC Press, 2010.
24. K.N. Rao: Forensic Toxicology, CRC Press, 2012.
25. M.G. Carlin and J.R. Dean: Forensic applications of Gas Chromatography, CRC Press, 2013.
26. S. Bayne and M. Carlin: Forensic applications of High Performance Liquid chromatography, CRC Press, 2010.
27. Curry: Analytical Methods in Human Toxicology, Part II, 1986.
28. C.D. Klaassan: Casarett & Doull's Toxicology: The Basic Science of Poisons, 7<sup>th</sup> Ed. McGraw Hill.
29. A.S. Curry: Poison Detection in Human Organs, 1976.
30. Arena Poisoning: Chemistry, Symptoms and Treatment.
31. B. R. Sharma: Forensic Science in Criminal Investigation & Trials, 2003.
32. G. B. Clark: Systematic Quality Management, Practical Laboratory Management Series, 1995.
33. Turner : Drugs & Poisons.
34. Samford : Poisons Their Isolation Identification.
35. Dubois and Celling: Textbook of Toxicology.
36. R. C. Froede: The Laboratory Management of the Medico-Legal, Specimen Analytical Chemical Laboratory Sciences.
37. Gurudip R. Chatwal, Sham K. Anand: Instrumental Methods of Chemical Analysis, First Edition Reprint 2010, Himalaya Publication.
38. Skoog, Holler, Crouch: Instrumental Analysis, India Edition, 2009.
39. Willard, Merritt, Dean, Settle: Instrumental Method of Analysis, Seventh Edition.
40. M. N. Gleason and et. Al.: Clinical Toxicology of Commercial products.

41. DFS –Working Procedure Manual Chemistry, Explosives and Narcotics.
42. Feigl: Spot Test in Organic Analysis, Elsevier Pub., New Delhi (2005)
43. Jehuda Yinon: Forensic and Environmental Detection of Explosives
44. Yinon Jitrin: Modern Methods & Application in Analysis of Explosives, John Wiley & Sons England (1993)
45. M. M. Houck & J.A. Siegel: Fundamentals of Forensic Science, Academic Press, London, 2006.
46. N.C. Asthana and Nirmal Anjali: The Ultimate Book Of Explosives, Bombs and I E Ds, Pointer Publishers (2008).
47. T. Suceska: Test Methods for Explosives, Springer (1995).
48. D. K. Molina: Handbook of Forensic Toxicology for Medical Examiners, CRC Press, 2009.
49. T. Altug: Introduction of Toxicology and Food, CRC Press, 2012.
50. Clarke's Analytical Forensic Toxicology by A. Negrusz and G. Cooper, 2<sup>nd</sup> Ed., Pharmaceutical Press, 2013.

### **Suggested Readings for Practical:**

1. Illustrated guide to home forensic science experiments by Rober B. Thompson and Barbara F. Thompson
2. Laboratory Procedure Manual, Forensic Toxicology, 2005.
3. Spot test in Organic Chemistry by Feigl.
4. M D Cole: The Analysis Of Drugs Of Abuse: An Instruct ion Manual
5. Curry A.S: Analytical Methods in Human Toxicology, Part II, CRC Press Ohio (1986).
6. E. Stahl: Thin Layer Chromatography: A Laboratory Handbook.
7. Clerk's Analysis of Drugs & Poisons VOL.-I & II by Clerke
8. Marie P. Kautsky: Steroid analysis by HPLC
9. Ballantyne B: General and Applied Toxicology Vol-1-3 2<sup>nd</sup> Ed., Macmillan, NY (2000)
10. C.E. Meloen, R.E. James, R. Saferstein, Criminalistics: An Introduction to Forensic Science, Lab Manual, Seventh Edition, Prentice-Hall, Upper Saddle River, 2001.
11. Laboratory Procedure Manual of Forensic Toxicology, 2005.
12. Clerke: Clerk's Analysis of Drugs & Poisons, Vol.-I & II
13. A. Keith Furr: CRC Handbook of Laboratory Safety, 5<sup>th</sup> Ed.
14. R. Meyer, J. Kohler and A. Homburg: Explosive, 4<sup>th</sup> Ed., Wiley-VCH pub.
15. J. J. Lentini: Scientific protocols for fire investigation
16. H. Jork, W. Funk, W. Fischer and H. Wimmer: Thin layer chromatography reagents and detection methods, Vol. 1-3, VCH Publication.
17. Vogel's Text Book of Practical Organic Chemistry by A.I. Vogel, A.R. Tatchell, B.S. Furniss, A.J. Hannaford, P.W.G. Smith, 5<sup>th</sup> Ed.

### **Specialization III: Forensic Biology & Serology**

#### **Suggested Reading:**

1. Instrumental Methods of Analysis 6<sup>th</sup> Edition. (1986): H.H. Willard, L.L. Merritt Jr. and others. CBS Publishers and Distributors.
2. Instrumental Methods of Chemical Analysis. (1989): Chatwal G and Anand, S. Himalaya Publishing House, Mumbai.

3. A Biologists Guide to Principles and Techniques of Practical Biochemistry. (1975): Williams, B.L. and Wilson, K.
4. Spectroscopy. (Vol. 1): Edited by B.B. Straughan and S. Walker. Chapman and Hall Ltd.
5. Gel Electrophoresis of Proteins- A Practical Approach: Hanes.
6. Chromatography: Concepts and Contrasts- 1988 by James Miller. John Wiley and Sons. Inc., New York.
7. Analytical Biochemistry: Holme.
8. Introduction to High Performance Liquid Chromatography: R. J. Hamilton and P. A.Sewell.
9. Spectroscopy: B.P. Straughan and S. Walker.
10. Practical aspects of Gas Chromatography and Mass Spectrometry (1984) by Gordon M.Message, John Wiley and Sons, NY.
11. Gel Chromatography by Tibor Kremmery.
12. Principles and Techniques of Biochemistry and Molecular Biology: Edt. Keith Wilson, John Walker
13. Statistics in biology, (1967) Vol. 1: Bliss, C.I.K. McGraw Hill, New York.
14. Practical Statistics for experimental biologist (1985): Wardlaw, A.C.
15. Statistical Methods in Biology (2000): Bailey, N.T. J. English Univ. Press.
16. Biostatistics - 7th Edition : Daniel
17. Fundamental of Biostatistics : Khan
18. Bio-statistical Methods : Lachin
19. Statistics for Biologist (1974):Campbell R.C. Cambridge
20. Research Methodology Tools And Techniques : H.C Purohit
21. Research Methodology: An Introduction : Wayne Dean Goddard, Stuart Melville
22. Research Methodology in the Medical and Biological Sciences: PetterLaake (Author) Haakon Breien Benestad (Author) Bjorn Reino Olsen (Editor)
23. Research Methodology For Biological Science : Gurumani N Gurumani
24. Research Methodology- G.R. Basotia and K.K. Sharma.
25. Research Methodology- C.H. Chaudhary, RBSA Publication
26. Research Methodology: An Introduction - Wayne Goddard & Stuart Melville
27. Research Methodology - Ranjit Kumar
28. Research Methodology: Methods & Techniques - Kothari, C.R.
29. Lucy D., Introduction to statistics for forensic scientists, page 7-14, 17-27, 29-42, 55-69, 155-159,161-176
30. Forensic Science -2008, Embar-Seddon, A and Pass A (Ed), Volumes 1-3 (page 365, 366,
31. An Introduction to Forensic Genetics: William Goodwin, Adrian Linacre, SibteHadi
32. Forensic DNA Typing : Biology, Technology, and Genetics behind STR Markers by John M. Butler
33. An Introduction to Forensic Genetics, (2007): Goodwin William, John Wiley & Sons Ltd,
34. Basic human genetics (1991) :Kapur V, Jaypee Brothers
35. Essentials of Human Genetics (2009): Kothari, Manu L, Universities Press (India) Pvt .Ltd.
36. Fundamentals of Genetics,(2006) :Singh, B.D., Kalyani Publishers

37. Genes IX,(2008): Lewin, Benjamin Jones and Bartlett Publishers
38. Genetic influences on neural and behavioral functions. (2000): Pfaff, Donald W CRC Press
39. Genetic Markers in Human Blood,(1969): Giblett, Eloise R. Blackwell Scientific Publications
40. Genetics, (2003): Winter, P.C; Viva Books Pvt. Ltd.,
41. Genetics Altenburg, (1970): Edgar, Oxford& IBH Publishing Co.
42. Genetics Strickberger, (2005): Monroe, Prentice Hall of India Ltd
43. Genetics, (1998): Hartl, Daniel L Jones and Bartlett Publishers
44. Genetics of populations,(2005):Hedrick, Philip W Jones and Bartlett publishers,
45. Genomic Imprinting, (1995): Ohlsson, R.; Cambridge University Press
46. Human Genetics, (1987): Vogel, Friedrich; Springer –Verlag Berlin Heidelberg,
47. Human Genome methods, (1998): Adolph, Kennetth W CRC Press,
48. Human population genetics in India,(1974): Sanghvi, L.D; Orient Longman Ltd,
49. Concepts of Genetics: Klug W.S. & Cummings M.R., Prentice-Hall
50. An Introduction to Genetic Analysis, Griffith A.F. et al., Freeman
51. Statistical Methods in Human Population Genetics, (1998): K.C. Malhotra Indian Statistical Institute, Calcutta
52. Understanding enzymes 3<sup>rd</sup> ed. (1991): Trevor Palmer, Prentice Hall
53. Kuby Immunology: Kindt, Goldsey, Osborne.
54. Immunology: Roitt, Brostoff, male.
55. The elements of Immunology: Fahim Halim Khan
56. Fundamental immunology William E. Paul
57. Microbial Forensics : Roger G Breeze, Bruce Budowle, Steven E Schutzer
58. Handbook of computational molecular biology: Edt by SrinivasAluru
59. S.C. Rastogi, N. Mendiratta & P. Rastogi; Bio-informatics- Methods & Applications, PHI learning pvt. Ltd., (2009)
60. Dr. Westhead, J.H. Parish & R.M. Twyman, Bio-informatics, Viva Books Pvt Ltd., (2003)
61. Introduction to bioinformatics : Lesk
62. Blood biochemistry : Nicholas J Russell
63. Human blood groups-Chemical and biochemical basis of antigen specificity (Second edition): Helmut Schenkel –Brunner, Springer Wein New York
64. Blood: Principles and practice of hematology (2003): Robert L Handin, Samuel Lux, Thomas Stossel
65. Medical laboratory techniques: Godkar and Godkar
66. Blood group typing: Danford and bowly.
67. Blood grouping on man: R.R. Race and Sanger.
68. Blood grouping techniques: Boorman, Dodd. B, Lincoln. PB
69. Typing of blood stains: Callifird, Bryan
70. Bioinformatics - A Practical Guide to the Analysis of Genes and Proteins. 2nd Edition by Baxevanis.
71. Bioinformatics: Sequence, structure and Data Bank: A Practical Approach by Higgis.
72. Bioinformatic methods and protocols: Misener.
73. Introduction to Bioinformatics by Altwood.

74. Bioinformatics sequence and genome analysis 2<sup>nd</sup> ed.: David Mount.
75. Concept in wildlife Management, Hosetti, B.B Daya publishing 103House
76. Forensic science in wild life investigation, Lincarce, Adrian CRC Press, Taylor & Francis
77. The wild life (protection) act, Baalu, T.R.1972, Nataraj Publication
78. Wild life (Protection act, 1972), Universal Publication
79. Wildlife protection act, 1972; Natraj Publishers
80. Timber Identification, N. Clifford; Leonard Hill ltd.,
81. A manual of wood identification, Herbert L. Edlin Viking Press,
82. Man-made fibres, R.W. Moncrieff Newness butter worth
83. Identification of vegetable fibres., Dorothy catling & John Grayson Chapman & hall ltd
84. Pollen morphology & Plant taxonomy: angiosperms (an introduction to palynology), Erdtman, G Hafner Publishing Co.,
85. Forensic botany, Coyle, Heather Miller CRC Press,
86. College botany, Gangulee, Hirendra Chandra New Central Book Agency,
87. Plant anatomy, Esau, Katherine Wiley Eastern Ltd,
88. Plant anatomy, Chandurkar, P J Oxford & IBH Publishing Co,
89. Systematic botany for degree students, Singh, Jagjit S Chand & Co.,
90. The poisonous plants, H.C. Long Asiatic Publishing House,
91. Plant Anatomy, B.P. Pandey S. Chand& Co., New Delhi, (1998)
92. Environmental Law- The Law & policy relating to protection of environment, Ball Simon Universal Law Pub Co, Delhi,
93. Environmental Forensic Principles and Applications, Morrison Robert D, CRC Press, NY
94. Forensic Entomology: Jason H Byrd & James L Castner
95. Insect Biology : Hovard Evan
96. Fundamentals of Entomology, Richard J. Flzinga Prentice hall of India pvt ltd, (1978)
97. Entomology & death- A procedural guide, Catts E.P & Haskell NH; Joyce's print shop (1990)
98. A manual of Forensic Entomology Smith DGV; Ithaca NY Camstock Univ. Press, USA (1986)
99. General text book of Entomology, O.W. Richards & R.G. Davis; Chapman & hall ltd, (1973)
100. Microbial Forensics : Roger G Breeze, Bruce Budowle, Steven E Schutzer
101. Microbial Forensics : Bruce Budowle, Steven E Schutzer, Roger G Breeze, Paul S Keim, Stephen A Morse
102. Chemical and Physical Signatures for Microbial Forensics: Cliff, J.B, Kreuzer, H.W, Ehrhardt C.J, Wunschel, D.S
103. Practical Approaches to Method Validation and Essential Instrument Qualification: Chung Chow Chan , Herman Lam , Xue-Ming Zhang.
104. Guidelines for Forensic Science Laboratories International Laboratory Accreditation Cooperation(ILAC)
105. DNA Technology in Forensic Science By Committee on DNA Technology in Forensic Science, National Research Council
106. The laboratory Quality Assurance system: A manual of Quality Procedures and forms. Thomas

107. A Ratliff. 2003 3rd ed. John Wiley & Sons ISBN. 0-471 26918-2 Systematic Quality Management Gary B Clark. 1995 Practical Laboratory Management Series.
108. Quality assessment of chemical Measurements John K. Taylor. CRC Press 1987. 087371-097-5.
109. Quality in the analytical chemistry laboratory E. Prichard. 1995 John Wiley ISBN 0471 955418
110. IS/ISO/IEC 17025 : 2005 General Requirements for the competence of testing and calibration laboratories
111. Juran's Quality Control Handbook, Fourth Edition, J.M. Juran, Frank M. Gryna, McGraw-Hill
112. International Editions, Industrial Engineering Series (1988)
113. Total Quality Control Essentials - Key Elements Methodologies and Managing for Success,
114. Quality Control & Application, Bertrand L. Hansen, Prabhakar M. Ghare, Prentice-Hall of India Pvt. Ltd., New Delhi-110001 (1993)
115. Application areas of anthropology, Anil Mahajan & Surinder Nath Reliance Publishing house,
116. Dental Anthropology, V.Rami Reddy Inter-India Publication,
117. A manual of biological Anthropology, Indra P. Singh & M.K. Bhasin Kamla Raj Enterprises,
118. Anthropology, Fred Plog, Clifford J. Jolly & Danial G. Bates Alfred A. Knopf New York,
119. Anthropology, Kroeber Oxford & IBH Publishing Co.,
120. The use of Forensic Anthropology, Robert Pickering & David Bachman CRC Press,
121. Physical Anthropology, B.R.K. Shukla & Sudha Rastogi Palaka Prakashan,
122. Forensic examination of hair, Robertson, James Taylor & Francis, (1999)
123. Introduction to forensic examination, Selective Scientific Books, (2008) Goutam, Shubhra
124. The Forensic Anthropology Laboratory, Michael W. Warren, Heather A. Haney & Laurel E. Freas; CRC Press, (2008)
125. Forensic recovery of human remains: Dopras, Schultz, Whirler, Williams
126. Advances in Forensic Taphonomy, Method theory and Archaeological perspective
127. An Introduction to Forensic DNA Analysis, Rudin, Norah CRC Leviw Publishers, (2002)
128. An Introduction to Forensic DNA Analysis, Inman, Keith CRC Press, (1997)
129. Ancient DNA, Herrmann, Bernd Springer Publishing Co., (1994)
130. Basics of DNA and Evidentiary Issues, Vij, Krishan Jaypee Brothers, (2004)
131. DNA, forensic and legal applications Kobilnsky, Lawrence John Wiley & Sons, (2005)
132. DNA Cloning 4: Mammalian systems, Glover, D.M.; IRL Press, (1995)
133. DNA Damage and repair, Nickoloff, Jac A Humana Press, (1998)
134. DNA Evidence and Forensic Science, Newton, David E. Viva books private limited, (2010)
135. DNA fingerprinting, Kirby, Lorne W H Freeman and Co, (1992)
136. DNA Fingerprinting: Approaches and applications. T. Burke, Terry Birkhauser Verlage, (1991)

137. DNA in forensic science, Robertson, J Ellis Horwood Ltd., (1990)
138. DNA profiling Eastal, Simon, Harwood academic Publishers,(1993)
139. DNA profiling and DNA fingerprinting, Epplen, Jorg T Birkhauser Verlage,(1999)
140. DNA technology, Alcamo, I Edward Harcourt Academic Press,(1999)
141. DNA tests in Criminal Investigation Trial & Paternity Disputes Singh, Yashpal, Alia Law Agency,(2006)
142. Forensic DNA typing, J.M. Butler Elsevier Academic press,(2005)
143. Forensic DNA technology, Mark A. Farley & James J. Harrington CRC Press,(1991)
144. Forensic DNA analysis, J. Thomas McClintock Lewis Publications, (2008)
145. Forensic DNA typing protocol: Carracedo
146. Rudin N. and Inman K, Introduction to Forensic DNA Analysis, page 97-131, 139-150, 183-195.
147. Progress in Forensic Genetics 10, Proceedings of the 20<sup>th</sup> International ISFG Congress held in Arachon, France, September 2003.
148. Forensic Science -2008, Embar-Seddon, A and Pass A (Ed), Volumes 1-3 (page 424, 754, 832).

#### **Specialization-IV: Cyber Security and Cyber Forensic**

##### **Suggested Reading:**

1. Walrand.J. Varaiya, High Performance Communication Network, Morgan Kauffman - Harcourt Asia Pvt Ltd, 2nd Edition, 2000.
2. William Stallings, ISDN & Broadband ISDN with frame Relay & ATM, PHI 4th Edition 2000.
3. Uyles Black, Emerging Communications Technologies 2/e Prentice Hall 1997.
4. Bates & Donald W. Gregory, Voice & Data Communications Handbook, Mc-Graw Hill, Edition, 3<sup>rd</sup> edition 2000.
5. Behrouz A Forouzan and Firouz Mosharraf, Computer Network (A Top-Down Approach), TMH.
6. Andrew S. Tanenbaum, Computer Network, 4<sup>th</sup> Edition, Pearson Prentice Hall.
7. Optical Networking Best Practices Handbook by John R. Vacca
8. R.C.Gonsales R.E.Woods, "Digital Image Processing", Second Edition, Pearson Education.
9. Anil K. Jain, "Fundamentals of Image Processing", PHI William Pratt, "Digital Image Processing", John Wiley
10. R.O.Duda, P.E.Hart and D.G.Stork, "Pattern Classification 2nd Edition", John Wiley, 2007
11. Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis, and Machine Vision" Thomson Learning
12. B. Chanda, D. Dutta Majumder, "Digital Image Processing and Analysis", PHI
13. E. Gose, R. Johansonbargh, "Pattern Recognition and Image Analysis", PHI
14. Harvey M. Deitel, "Operating Systems", Second Edition, Pearson Education Pvt. Ltd, 2002.
15. Andrew S. Tanenbaum, "Modern Operating Systems", Prentice Hall of India Pvt. Ltd, 2003.

16. William Stallings, "Operating System", Prentice Hall of India, 4th Edition, 2003.
17. Pramod Chandra P. Bhatt – "An Introduction to Operating Systems, Concepts and Practice", PHI, 2003.
18. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", Sixth Edition, John Wiley & Sons (ASIA) Pvt. Ltd, 2003.
19. Web security and commerce by simson garfinkel
20. Foundations of security by neil daswani, anita kesavan
21. Hacking Exposed Web Applications, Second Edition by Joel Scambray, Mike Shema, Caleb Sima Professional Pen Testing for Web Applications by Andres Andreu
22. Preventing Web Attacks with Apache by Ryan C. Barnett
23. Innocent Code : A Security Wake-Up Call for Web Programmers by Sverre H. Huseby
24. HackNotes(tm) Web Security Pocket Suggestive readings by Mike Shema
25. Testing Web Security: Assessing the Security of Web Sites and Applications by Steven Splaine
26. Improving Web Application Security: Threats and Countermeasures by Microsoft Corporation
27. Hacking the Code: ASP.NET Web Application Security by Mark Burnett
28. How to Break Software Security by James A. Whittaker and Herbert H. Thompson
29. Exploiting Software : How to Break Code by Greg Hoglund and Gary McGraw
30. Advances in digital forensic VI by kam pui chow, sujeet shenoi
31. Malware forensic by Cameron malin
32. Windows registry forensic by Harlan carvey,
33. Digital forensic for network internet and cloud computing clint garrison
34. Wireless crime and forensic investigation by Gregory kipper
35. Digital image forensic by husrev taha, nasir memon
36. Computer forensic investigating data and image files by Ec-council
37. Network forensic tracking hackers by sherri Davidoff
38. Mastering windows network forensic by steven anson
39. Anti computer forensic by Gred numitor
40. Computer forensic Nathan Clarke
41. Guide to Biometrics (Springer Professional Computing) by R. Bolle, J. Connell, S. Pankanti, N. Ratha, Springer Press, 2003, ISBN0387400893
42. Biometrics Personal Identification in Networked Society, Jain, Bolle, Pankanti 1999
43. Handbook of Fingerprint Recognition, Maltoni, Maio, Jain, Prabhakar, 2005
44. Biometric Systems, Wayman, Jain, Maltoni and Maio 2004
45. Fundamentals of Speech Recognition, L. Rabiner and B. Juang, , Pearson Education.
46. Speech and Audio Signal Processing, B. Gold and N. Morgan, John Wiley.
47. Spoken Language Processing, Huang, Acero & Hon, Prentice Hall, 2001.
48. Speech and Language Processing: An Intro to NLP, CL, and Speech Recognition (2nd Edition) Jurafsky & Martin, Prentice Hall, 2000.
49. Statistical Methods for Speech Recognition. Jelinek. MIT Press,
50. Fundamentals of Speech Recognition, Rabiner & Juang, Prentice-Hall
51. Ingemar Cox, Matthew Miller, Jeffrey Bloom, and Jessica Fridrich . Digital Watermarking and Steganography, 2nd Ed, (The Morgan Kaufmann Series in Multimedia Information and Systems). (Hardcover - Nov 16, 2007)
52. Frank Y. Shih. Digital Watermarking and Steganography: Fundamentals and Techniques, CRC Press.g



53. Stefan Katzenbeisser, Fabien, and A.P. Petitcolas. Information Hiding Techniques for Steganography and Digital Watermarking, Artech House.
54. Neil F. Johnson; Zoran Duric; Sushil Jajodia. Information Hiding: Steganography and Watermarking - Attacks and Countermeasures, Springer.
55. Gregory Kipper. Investigator's Guide to Steganography, Auerbach Publications.
56. Wireshark 101 essential skills for network analysis by laura chapel
57. Internet safety by leo notenboom
58. Guide to secure intranet and extranet server by Verisign
59. Intrusion detection with Snort by by rafeeq ur rehman
60. Improving web application security by Microsoft press
61. Open source security tools by tony howlett
62. Understanding OSI by john larmouth
63. Network security Roberta bragg
64. Wireless security model randall Nichols
65. Mobile application security by himanshu dwivedi
66. Fundamental security by MAIWALD
67. Web application security by bryan Sullivan
68. Securing the clicks network security in the age of social media by bahadur
69. Data recovery e-book V 1.5
70. The secret of hacking
71. The art of human hacking , Kevin mitnik
72. Gray hat hacking, the ethical hackers handbook-Allen Harper,Shon Harris,Jonthan
73. Hardware hacking by Kelvin D. Mitnick
74. Cataloging for Mac OS- khriss karr
75. Linux kernel development , paperback
76. Beginning linux, paperback
77. Linux command line and shell script , paperback