UNIVERSITY OF LADAKH

Faculty of Sciences

Department of Forensic Science

Certificate Course in "*Forensic Science*"

PG Diploma in "*Forensic Science*"

MSc in "*Forensic Science*"

M.Sc. Forensic Science (Semester System) Academic Session 2022-2023

Outlines of Tests, Syllabi and Courses of reading for

Choice Based Credit System (CBCS)

Choice Based Credit System (CBCS) is one of the important measures recommended by the University Grants Commission (UGC) to enhance academic standards and quality in higher education includes innovation and improvements in curriculum, teaching-learning process, and examination and evaluation systems. CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising Core, and Discipline Specific and Generic Elective courses. The performance of students in examinations will be evaluated following the Grading system, which provides uniformity in the evaluation and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations. The grading system will facilitate student mobility across institutions within and across countries and also enable potential employers to assess the performance of students.

1. Structure of Course:

The Master's programme is proposed in tune with National Education Policy 2020 with flexibility on different designs of Master's programme and exit policy:

Sl. No.	Entry Eligibility for Students completed	Course Offered
1	3-year Bachelor's Programme (BSc)	2-year Master's Programme with the second year devoted entirely to research
2	4-year Bachelor's Programme with Research	1-year Master's Programme

2. Course Structure and Entry/Exit Policy:

Sl. No.	Course	Entry	Exit	Outcome
1	Semester I (6 Months)	BSc (3 Years)	Certificate	To cater basic need of Forensic Science
2	Semester II (6 Months)	Certificate / Semester I	PG Diploma	Leading to MSc
3	Semester III & IV (12 Months)	BSc (4 Years)/ PG Diploma	MSc	Teaching/ Forensic Expertise/ Leading to Research

M.Sc. Forensic Science (Semester System)

Choice Based Credit System

Academic Session 2022-2023

M.Sc. Forensic Science is a two-year course divided into four-semesters with a total of 80 credits.

- A student is required to complete 80 credits for the completion of the course and the award of degree.
- In general, one-hour theory lecture per week equals 01 Credit, 2 hours practical class per Week equals 01 credit.

Courses/Papers offered in the M.Sc. are divided into three categories:

(i) **'Core Course'** means a course that is Compulsory for a particular programme and offered by the Department, where the student is admitted.

(ii) '**Discipline Specific Elective (DSE) Course'** means an optional course to be selected by a student out of such courses offered by the Department, where the student is admitted.

(iii) '**Generic Elective (GE)**' means an elective course which is taken by the students in the department other than where the student is admitted.

COURSE STRUCTURE

(Scheme)

SEMESTER I

(Credits = 20, Marks = 500)

Course	Paper	Credits	Marks	Teaching hrs/week
Compulsory Core Courses				
MFS-T1-C1	General Forensic and Fingerprint Science	4	100	4
MFS-T1-C2	Forensic Biology	4	100	4
MFS-T1-C3	Instrumentation	3	75	3
MFS-T1-C4	Criminology, Criminal Law & Forensic Psychology	3	75	3
MFS-P1-C1	General Forensic and Fingerprint Science (Pr)	1	25	2
MFS-P1-C2	Forensic Biology (Pr)	1	25	2
MFS-P1-C3	Instrumentation (Pr)	1	25	2
MFS-P1-C4	Crime file/Scrap File	1	25	2
MFS-T1-MP1	Minor Project	2	50	4
TOTAL		20	500	

SEMESTER II

(Credits = 20, Marks = 500)

Course	Paper	Credits	Marks	Teaching Hrs/week
Compulsory Core Courses				
MFS-T2-C1	Molecular Biology and Biochemistry	4	100	4
MFS-T2-C2	Forensic Chemistry	4	100	4
MFS-T2-C3	Forensic Physics	4	100	4
MFS-T2-C4	Quality Management	2	50	2
MFS-P2-C1	Molecular Biology and Biochemistry (Pr)	1	25	2
MFS-P2-C2	Forensic Chemistry (Pr)	1	25	2
MFS-P2-C3	Forensic Physics (Pr)	1	25	2
MFS-P2-C4	Quality Management (Pr)	1	25	2
MFS-T2-MP2	Minor Project	2	50	4
TOTAL		20	500	

Pr-Practical

SEMESTER III

(Credits = 20, Marks = 500)

Course	Paper	Credits	Marks	Teaching Hrs/week
Compulsory Core Courses				
MFS-T3-C1	Forensic Toxicology and Drugs of Abuse	3	75	3
MFS-T3-C2	Ballistics	3	75	3
MFS-T3-C3	Cytogenetics	3	75	3
MFS-T3-C4	Forensic Anthropology, Osteology and Odontology	3	75	3
MFS-P3-C1	Forensic Toxicology and Drugs of Abuse (Pr)	1	25	2
MFS-P3-C2	Ballistics (Pr)	1	25	2
MFS-P3-C3	Cytogenetics (Pr)	1	25	2
MFS-P3-C4	Forensic Anthropology, Osteology and Odontology (Pr)	1	25	2
Discipline Specific Elective Courses (Select any one Courses)@				
MFS-T3-TW1-P	Thesis Work-Part I (Physical Science)	2	50	4
MFS-T3-TW1-C	Thesis Work-Part I (Chemical Science)	2	50	4
MFS-T3-TW1-B	Thesis Work-Part I (Biological Science)	2	50	4
Generic Elective Courses (Select any one Course)				
MFS-GE1$		2	50	2
MFS-GE2$		2	50	2
MFS-MOOC1#	Statistics	2	50	2
MFS-MOOC2#		2	50	2
TOTAL		20	500	

Pr-Practical

@ Allotment will be on merit basis of the result of Semester II.

$ Student may opt for any **one** of the Generic Elective Courses studied in M.Sc. offered by the Science Departments (other than IFSC) of Panjab University. The course must be approved by the Academic Committee of the department followed by its approval by BOC.

A course under the code MFS-MOOC1-2 can be selected from the available on SWAYAM platform through UGC MOOCs Courses or through any other national coordinator. The course must be approved by the Academic Committee of the department followed by its approval by BOC. There shall be internal assessment to the extent of 20%.

SEMESTER IV

(Credits = 20, Marks = 500)

Course	Paper	Credits	Marks	Teaching Hrs/week
Compulsory Core Courses				
MFS-T4-C1	Questioned Documents	4	100	4
MFS-T4-C2	Computer Forensics	4	100	4
MFS-P4-C1	Questioned Documents (Pr)	1	25	2
MFS-P4-C2	Computer Forensics (Pr)	1	25	2
Discipline Specific Elective (Select any Two Courses)				
MFS-T4-TW2	Thesis Work-Part II**	5	125	5
MFS-T4-DES-P	Forensic Audio-Video Analysis* (Th)	4	100	4
MFS-P4-DES-P	Forensic Audio-Video Analysis* (Pr)	1	25	2
MFS-T4-DES-C	Forensic Explosives* (Th)	4	100	4
MFS-P4-DES-C	Forensic Explosives* (Pr)	1	25	2
MFS-T4-DES-B	DNA and Protein Methods* (Th)	4	100	4
MFS-P4-DES-B	DNA and Protein Methods* (Pr)	1	25	2
TOTAL		20	500	

Pr-Practical

** Compulsory and is the carry forward of Thesis Work-Part I

*Choose any one (Th and Pr make one course)

Thesis must be submitted by 30th May of every academic year, failing which it shall be counted as Re-appear.

Teaching and Evaluation

I. TEACHING:

The number of Lectures mentioned for each Course is 60 (45+15) hours, which includes 45 contact hours of teaching to be delivered exclusively by the Teacher as per the Scheduled time table and 15 contact hours are for interaction, discussion, assignments and seminars (attended/delivered) by the students.

II. EVALUATION

1. To qualify for the award of the Post–graduate degree of the Faculty of Science in Forensic Science & Criminology i.e. M.Sc (Forensic Science & Criminology) a candidate has to successfully complete the course and obtain at least 50% in aggregate (including the internal continuous assessment) & 40 % in each paper separately in theory (including the internal continuous assessment)and practical/Assignment. The students who fail to pass any paper(s) in first attempt will be allowed to take up immediately next two consecutive chances. In other words those failing to pass in the reappear chances or unable to avail of the chances will not be entitled for the award of the degree.
2. There shall be one Mid-Semester Examination of 20% Marks for Theory papers in each semester. End-semester examination will be of 80% of total marks.
3. Pattern of end-semester question paper

   i) Nine questions in all will be set with equal weightage. The candidate has to attempt five questions in total.
   ii) One Compulsory question (consisting of short answer type questions) covering whole syllabus will be there. The remaining eight questions will have Four Units comprising of two questions from each Unit.
   iii) Students will attempt one question from each unit and the compulsory question.

4. Evaluation of Courses based on Practicals –

   (i) The core courses involving practical examination will have internal assessment to the extent of 20% based on the Seminar, attendance and number of experiments performed by the candidate.
   (ii) There will be end-semester practical examination will be of 3 Hrs duration.

5. MFS-P1-C4: Crime file /Scrap file-

This includes the in depth understanding, collection and compilation of latest and /or relevant crime stories. Evaluation will be done on the basis of viva voce examination/presentation (50 marks).

6. MFS-P2-C4: Seminar/Journal Club-

This is a Seminar/Journal Club oriented paper. Evaluation will be done on the basis of presentation (50 marks). A student will be evaluated on the basis of content, clarity, presentation and question-answer.

7. Evaluation of Courses based on Thesis Work/Dissertation-

(i) In the third semester the evaluation (50 marks) of DSE paper MFS-T3-TW1-P/C/B will be done on the basis of Research Problem Identification, Review of Literature, Objectives and work done so far. The student needs to give a brief synopsis (20 marks) and a presentation (20 marks) in this regard. The Internal assessment (10 marks) will be based on attendance, regularity and daily performance.

(ii) In the fourth semester (MFS-T4-TW2) the evaluation (125 marks) will be done on the basis of the final thesis submission and viva-voice (conducted by the external expert duly approved by the Vice Chancellor).

M.Sc. Forensic Science

Syllabus-Semester I

MFS-T1-C1: General Forensic and Fingerprint Science
THEORY

Total Lectures: 45+15= 60 Hrs

Credits – 4

Marks – 100

Semester Exam- 80

Internal Assessment –20

Forensic science is the application of a broad spectrum of sciences to answer questions of interest to a legal system. This may be in relation to a crime or a civil action. The paper covers all general aspects of forensic science including definition, nature, needs and evaluation pertaining to forensic investigations. Fingerprint sections include history, development, classification and all the scientific aspects regarding preserving and examination.

Unit -1

1.	Nature, Need and Alternatives to forensic science
2.	Evidence: Types and relevance, Laws and Principles
3.	Problems of proof: General, Scientific evidence and proof, Investigative problems, Scientific aspects, Legal problems
4.	Expert Testimony: Expert, Report, Illustrations, Language, Prosecuting Counsel, Defense Counsel, Eye witness testimony, Memory recovery, Statement verification.
5.	Court: Fallacies about expert evidence
6.	Frye case & Daubert Standard

Unit -2

1.	Scene of Occurrence: Importance, Problems, Location. Evaluation: Sketching, Types of Search, Handling clues, Modern aids
2.	Scene Management Documentation: Scene Description, Photographic and Sketching Documentation, Evidence Recovery and Possession Log
3.	Criminal Profiling: Overview, Inductive and deduct method, Analysis and reconstruction, Offender charactrtistics
4.	Wound pattern analysis, Profiling of victim, Organized vs. disorganized crime, Offender characteristic, Investigating strategies,

Unit -3

1.	History and development of fingerprint Science, formation of ridges, pattern types, pattern areas, Fundamental Principles and levels of Fingerprints
2.	Classification of fingerprints – Henry system of ten digit classification, Extension of Henry system, search of fingerprints, Battley's Single digit classification, fingerprint Bureau, Poroscopy and Edgioscopy
3.	Composition of sweat, chance fingerprints: latent & visible fingerprints, plastic fingerprints,
4.	Development of latent fingerprints: conventional methods of development of fingerprints – fluorescent method, magnetic powder method, fuming method, chemical method. Latent fingerprint development using nanoparticles.

5.	Application of laser and other radiations to develop latent fingerprints, metal deposition method and development of latent prints on skin.

Unit -4

1.	Taking of finger prints from living and dead persons,
2.	Preserving and lifting of fingerprints, photography of fingerprints, Digital imaging and enhancement.
3.	Comparison of fingerprints, basis of comparison, class characteristic, individual characteristic, various types of ridge characteristics
4.	Automatic fingerprint identification system, Expert Opinion Writing
5.	Other prints: Lip print, palm print, foot print and Ear print- their applications.

Recommended Books	
1.	Sharma, B.R 1990, Forensic Science in Criminal Investigation and Trial. Central Law Agency, Allahabad.
2.	Saferstein, R., 1976, Criminalistics : An Introduction to Forensic Science
3.	Saferstein, R., 1982, Forensic Science Hand Book, Printice Hall : N. Jersey
4.	Lundguist, F., 1962, Methods of Forensic Science, Vol. I & II. London
5.	Kirk, P.I, 1953, Crime in Investigation. Interscience Publishers : New York
6.	Franklin, C.A., (ed.), 1988, Modi's book of Medical Jursiprudence and Toxicology. N.M. Tripathi Pvt. Ltd. : Bombay.
7.	James, S.H., &Hardby, J., J., Forensic Science : An introduction to scientific and investigative techniques : C.R. C Publishers
8.	Houck, M.M., & Siegel, J.A., Fundamentals of Forensic Science: Academic Press.
9.	Saferstein, R., Forensic Science: From Crime Science to the crime lab : Prentice Hall.
10.	David R. Ashbaugh, Quantitative and Qualitative Friction Ridge Analysis, CRC Press (1990).
11.	E. Roland Menzel; Fingerprint Detection with Lasers, 2nd Ed. Marcel Dekker, Inc. USA (1999).
12.	James F, Cowger, Friction Ridge Skin, CRC Press London (1993).
13.	Mehta, M.K.; Identification of Thumb Impression & Cross Examination of Finger Prints, N.M. Tripathi Pub. Bombay (1980).
14.	Moenssens; Finger Prints Techniques, Chirton Book Co., Philadelphia, NY (1975).
15.	Chatterjee S.K.; Speculation in Finger Print Identification. Jantralekha Printing Works, Kolkata (1981)
16.	Cowger, James F; Friction ridge skin – Comparison and Identification of fingerprints, CRC Press, NY (1993)
17.	J.A. Seigel, R.J. Saukoo and G.C. Knupfer; Encyclopedia of Forensic Sciences Vol. I, II and III. Acad. Press (2000)
18.	Henry C. Lee & R.E. Ganesslen; Advances in Finger Print Technology, CRC Press, London (1991)
19.	Hardless, H.R.; Disputed documents examination and fingerprints Identification (with Illustrations, Sketches, Diagrams, Photos etc.) Law Book Co. Allahabad (1995)
20.	Menzel, E. Roland; Fingerprint detection with lasers. Marcel Dekker, NY (1990)
21.	Maltoni, Davide; Handbook of fingerprint recognition Springer Verlag. NY(2003)

MFS-P1-C1: General Forensic and Fingerprint Science (Pr)

PRACTICAL

Total Lectures: 30 Hrs **Total Marks – 25**
Credits – 1

1.	Study and evaluation of crime case histories on forensic aspects.
2.	Crime scene sketching: Blank, Indoor and Outdoor
3.	To take plain and rolled inked finger prints
4.	To study the palm prints
5.	To identify the finger print patterns
6.	To identify core and delta
7.	To perform ridge tracing and ridge counting
8.	To identify ridge characteristics
9.	Development of latent prints by mechanical methods, fuming and chemical methods on various surfaces
10.	Lifting of finger prints and photography
11.	Ten digit fingerprint classifications
12.	To compare the finger prints

MFS-T1-C2: Forensic Biology

THEORY

Total Lectures: 45+15= 60 Hrs **Credits – 4**

Marks – 100

Semester Exam- 80

Internal Assessment –20

Forensic biology is introduced with all its components i.e. forensic entomology, serology, botany, wildlife, limnology etc. It deals with forensic entomology, forensic wildlife, and forensic botany. This unit gives the students an insight into the life of other living organisms, which in turn will make them aware of the factors and features associated with the same thereby producing meaningful and substantial evidence. Forensic botany comprises of wood, leaves, pollen and diatoms and their usage as forensic evidence. It also covers often neglected but important evidences such as hair and fibers. It includes the study of various properties useful in forensic comparisons along with the collection procedures. It covers the most encountered body fluids at a crime scene along with their nature, forensic characterization and collection. The concepts useful in wild life crime and biodiversity conservation are also introduced. In the coming times wars will not be fought with guns and tanks, they will be fought will strategies involving microbes. Thus who better than a forensic science student can fight such crime against humanity?

Unit -1

1.	Forensic Biology: General Concept and Definitions, History and Nature, Classification of different biological evidences, Principals of collection and preservation of biological exhibits
2.	Animals, Plants and Microorganisms in Legal Investigation: Basic Principles,
	Tools and Techniques
3.	Forensic Entomology: General entomology and arthropod biology
4.	Insects of forensic importance
5.	Collection of entomological evidence during death investigations
6.	Insect succession on carrion and its relationship to determine time since death, its application to Forensic Entomology

Unit -2

1.	Forensic Paleontology: Pollen, Structure, function, methods of identification and comparison
2.	Microbial Forensics: Applications in Bioterrorism, Building a National capacity to investigate Bioterrorism, Database and Infectious microorganisms, Biocrimes and Physican.
3.	Diatoms: Nature, location structure, extraction from various body tissues, including bone marrow, preparation of slides, methods of identification and comparison, forensic significance

Unit -3

1.	Hair: Morphology of hair Cuticle cortex and medulla area of hair
2.	Three phases of hair growth
3.	Distinction between animal and human hair
4.	Hair features useful for microscopic comparison of human hair
5.	Wild Life Forensics: Introduction & importance
6	Introduction to conservation genetics
7	Species or subspecies? Resolving taxonomic uncertainty
8	Wild populations, captive populations and conservation management units
9	Genetics and Reproduction, Cloning, Genetic selection
10	Using molecular biology for species preservation

Unit -4

1.	Body Fluids: The nature of blood
2.	Chemical and Microscopic Analysis of Biological Stains
3.	Screening Evidence for Biological Stains in Forensic Casework
4.	Species of Origin and Serology Separation Techniques
5.	ABO Grouping and Secretor Status, List of ABO antigens and antibodies in blood
6.	Principles of heredity
7.	Biological Markers of Forensic Significance
8.	Forensic characterization of blood, Preservation of suspected blood
9.	The nature of semen Forensic characterization of semen, Semen stains for laboratory examination
10.	The nature of saliva, Forensic characterization of saliva

	Recommended Books
1	An Introduction to Forensic Science by Richard Saferstein (Prentice Hall College Div; 8th edition)
2	Essential Forensic Biology: Animals, Plants and Microorganisms in Legal Investigation by Allen Gunn
3	The biochemistry of semen and male reproductive tract Thaddeus Mann Methuen &Co. Ltd. London 1964
4	Biology methods Manula Metropolitan Police Forensic Science Laboratory London
5	Mathew's textile fibres their physical, microscopic and chemical properties Herbert R. Mauersberger John Wiley New York 1954
6	Plant Anatomy B.P. Pandey
7	Forensic Examination of Hair (Taylor & Francis Forensic Science Series) by James R. Robertson (Editor)
8	Forensic entomology: the utility of arthropods in legal investigations By Jason H. Byrd, James L. Castner Published by CRC Press, 2001
9	Forensic botany: principles and applications to criminal casework By Heather Miller Coyle Published by CRC Press, 2004
10	Protein Engineering and Design Sheldon J. Park, Jennifer R. Cochran 2009 by CRC Press
11	DNA Barcodes Methods and Protocols Editors: Lopez, Ida, Erickson, David L. (Eds.) 2012 Humana Press
12	Nucleic Acid and Peptide Aptamers Methods and Protocols Editors: Mayer, Günter (Ed.) 2009 Humana Press

MFS-P1-C2: Forensic Biology (Pr)

PRACTICAL

Total Lectures: 30 Hrs **Total Marks – 25**

Credits – 1

1.	Sample preparation of hairs, human and animal hair morphology, measurements (diameter, medullary ratio)
2.	Human hair comparison, colour, treatment, pigment shape and distribution, damage, disease, medulla, root, tip – Animal hair diameter, medulla, color banding, scale casts
3.	Vegetable fiber characterization
4.	Tests for saliva
5.	Presumptive/confirmatory tests for blood and semen
6.	RT PCR based identificatiuon of human tissue
7.	DNA-barcoding based identification of plant species from trace sample
8.	DNA isolation from hair and bone

MFS-T1-C3 - Instrumentation

THEORY

Total Lectures: 34+11= 45 Hrs **Credits – 3**

Marks – 75

Semester Exam- 60

Internal Assessment –15

This paper includes all the various types of instrumental techniques which can be employed in forensic examination. It comprises of various microscopic techniques, spectroscopic techniques like UV-Vis, FTIR spectrophotometer, Raman Spectroscopy AAS, Atomic Emission Spectroscopy, XRD, XRF, Chromatographic techniques like TLC, GC, LC, HPTLC etc.

Unit -1

1.	Principle of Microscopy, Abbe's Equation and its significance, working of compound microscope, stereomicroscope, polarized microscope and comparison microscope. Forensic applications and limitations.
2.	Electron microscopy: Principle and working of scanning electron microscopy (SEM), field emission scanning electron microscope (FE-SEM), transmission electron microscopy (TEM), Advantages/disadvantages as compared to optical microscopy and their forensic applications.

Unit-2

1.	Introduction to spectroscopy, electromagnetic spectrum, Method of Calibration and sample preparation, Atomic and Molecular Spectroscopy, Optical system used in spectroscopy, Limit of detection and Quantification.
2	UV-Vis spectroscopy, Fourier transforms infrared spectroscopy (FTIR), and Raman Spectroscopy: Their instrumentation, Analytical and Forensic applications, Near-Mid-Far ranges of spectroscopy, spectra of some common Organic molecules
3.	Atomic Spectroscopy: Atomic Absorption Spectrometry (AAS) and Atomic Emission Spectrometry (AES): Instrumentation, Atomization process, Analytical and Forensic applications.

Unit-3

1.	X-Ray Spectroscopy: X-ray Diffraction, X-ray Fluorescence; Origin of X-ray spectra, Instrumentation, differences between soft and hard X-rays, Analytical and Forensic Applications
2.	Nuclear Magnetic Resonance (NMR): Basic principle, theory of Chemical Shifting, instrumentation, and Forensic applications
3.	Basic principles, Working and Instrumentation of Neutron activation analysis (NAA). Thermogravimetry analysis (TGA): Instrumentation, Working and Applications

Unit-4

1.	Chromatography: Principle, Working and Instrumentation of Thin-layer Chromatography (TLC), HPTLC, Paper and Column chromatography, and Electrophoresis. Applications and limitations
2.	Ion Chromatography (IC): Working and instrumentation, Applications. High performance liquid chromatography and Gas chromatography: Principle, Instrumentation and Forensic Applications
3.	Mass Spectroscopy: Basic Principle, Instrumentation, applications, Ionization techniques i.e. Time of flight (ToF), Matrix-assisted laser desorption/ionization MALDI, Inductive coupled plasma (ICP).

Recommended Books	
1.	Undergraduate Instrumental Analysis, 6th Edition, James W. Robinson, Eileen M.S. Frame, GM Frame II. (2005)
2.	Instrumental Analysis- Skoog, Holler & Crouch, Cengage Lear
3.	Instrumentation Methods of Analysis – Willard Merritt & Dean Settle
4.	Forensic Science Hand book- R. Saferstain
5.	Introduction to spectroscopy, Donald L Pavia, Gary M. Lampman, and George S. Kriz, Cengage Learning-2015
6.	Chapmen JR; Practical Organic Mass Spectrometry- A Guide for Chemical and Biochemical Analysis, Wiley & sons, NY(1993)
7.	Instrumental Methods Of Chemical Analysis, G.R. Chatwal, S.K. Anand, Himalya Publishing House-2011

MFS-P1-C3: Instrumentation (Pr)

PRACTICAL

Total Lectures: 30 Hrs **Total Marks – 25**

Credits – 1

1.	To measure the various physical parameters of fiber samples using microscope
2.	To find out the unknown concentration of the given sample using UV/Vis Spectrophotometer
3.	To study the Beer's Lambert's law.
4.	To study the Hypsochromic and Bathochromic shift using UV/Vis Spectrophotometer
5.	To study the TLC of different inks of the writing pen.
6.	To analyze the given compound using FTIR spectra
7.	To analyze the XRD of given powder sample by using XRD software.
8.	To perform TLC of phenolphthalein
9.	To identify petroleum products by using UV-Vis spectroscopy
10.	Identification of different synthetic and man-made fibres
11	Quantitative and qualitative analysis of soils from different source of origin
12.	Differentiation of various toxic textile dyes using FTIR analysis

MFS-T1-C4- Criminology, Criminal Law and Forensic Psychology

THEORY

Total Lectures: 34+11= 45 Hrs **Credits – 3**

Marks – 75

Semester Exam- 60

Internal Assessment –15

The realm of criminology takes up its scope and development, causes, control, criminal behavior and its theories. In criminal law the detailed description is provided regarding Indian penal code, criminal procedure code and the Indian evidence act.
Forensic psychology includes the ethical issues, profile typing, psychological assessment, aspects of polygraph, brain signature profiling, hypnosis and related legal and ethical aspects. The evolutionary paradigm of psychology will be also studied in this paper.

Unit -1

1.	Criminology: Nature and Scope
2.	Schools of criminology: Pre-classical, Classical, Neo-classical, Positive School
3.	Causes of Crime: Biological, Psychological, Sociological, Geographic and Economic.

Unit- 2

1.	**I. Indian Penal Code** *(i) Actus non facit reum nisi mens site rea* Elements of crime: *Actus reus & mensrea* (ii) Definitions: Dishonestly (S. 24), Fraudulently (S. 25), Good Faith (S. 52), Inquiry (S. 44), Voluntarily (S. 39), Reason to believe (S. 26) Criminal Liability : Joint liability (S. 34, 149) General Exceptions : Mistake of fact (S. 76, 79), Accident (S. 80) Unsoundness of mind (S. 84), Compulsion (S. 94) Private defense (S. 96,97)
2.	**II. The criminal procedure code 1973** (i) Definations: Bailable and non-bailable offence (S. 2(a)) Cognizable offence 2(c), Complaint 2(d), Inquiry 2(g) Investigation 2(h), Non Cognizable offence 2(l), Summon case 2(w), Warrant case 2(x) (ii) Information in cognizable case : FIR (S. 154) (iii) Arrest of person without warrant and rights of arrested person (S.41 to 60 A) (iv) Process to compel appearance: (a) Summons (Section- 61,62,64,65,69) (b) Warrant of arrest (Section-70 to 81) (v) Search and seizure (Sections- 93,100,101,102,165,167) (vi) Evidence of officers of Mint and Scientific Experts (Sections-292,293)
3.	**III. The Indian Evidence Act 1872** (i) Definition: Section (3), Facts in issue, Evidence Proved, Disproved, Not proved May presume, Shall presume, Conclusive proof (ii) Examination of witness: Sections-135, 137, 141, 142, 143 (iii) Confession by accused: Sections-24, 25, 26, 30
	(iv) Expert Evidence : Sections-45, 45-A, 46, 47, 47-A

Unit-3

1	Forensic Psychology and the Law
2	Ethical Issues in Forensic Psychology
3	Assessing mental competency
4	Psychological Assessment
5	Genetics and Crime
6	Introduction to Evolutionary Psychology
7	Social Organization, Aggression, and Mating in primates/Apes

8	Biological Constraints on Human Social Organization and Mating
9	Behavioral similarity and differences between human and apes
10	Examples of evolutionary adaptations in human behavior

Unit-4

1	Detection of deception, Various methods for detection of deception
2	Non-verbal detection, voice stress analyzer, thermal imaging, functional magnetic resonance study
3	Current research in detection of deception/truth finding mechanisms
4	Principles of polygraph Lie detection/ truth verification
5	Psycho physiological aspects, operational aspects
6	Question formulation techniques, Interviewing technique procedure
7	Chart recording
8	The Art-Polygraph: Legal and Ethical aspects, Human rights of individual
9	Principles of Brain Signature profiling, Nero psychological aspects, operational aspects, probe preparation, EEG-ER recording, analysis methodology and interpretation skills
10	Legal and Ethical aspects, Human rights of individual
11	Theory and validity of Hypnosis in forensic science
12	Narco analysis, General Procedure, Legal and Ethical aspects, Human rights of individual

Recommended Books:	
1.	Forensic Science in Criminal Investigation & Trials, B.R.Sharma
2.	The Hand Book of Forensic Psychology, Weiner Hass
3.	Hand Book of Forensic Psychology, O' Donohue Levensky
4.	Brain Experience – C.R.Mukundan
5.	Criminal Profilling – B.Turvey
6.	Investigative Forensic Hypnosis – J. Niehans
7.	Art & Science of the Polygraph Techniques – J.A.Matte
8.	Hand Book of Polygraph Testing – M.Kloinen
9.	Detecting Lies & Deceit – A.Vrij
10.	Pinker, S. (2011). The Better Angels of our Nature . New York, NY: Viking
11.	Pinker, S. (2007). The Stuff of Thought : Language as a Window Into Human Nature . New York, NY: Viking.
12.	The Adapted Mind: Evolutionary Psychology and the Generation of Culture, Jerome H. Barkow, Leda Cosmides, John Tooby (1992) Oxford University Press
13.	The Selfish Gene, Richard Dawkins (1976) Oxford University Press
14.	The Moral Animal: Why We Are the Way We Are: The New Science of Evolutionary Psychology, Robert Wright (1994) Vintage Books

MFS-P1-C4: Crime File/Scrap File (Pr)

PRACTICAL

Total Lectures: 30 Hrs **Total Marks – 25**
Credits – 1

Crime file/Scrap file includes the collection recent and important forensically relevant cases published in newspapers/magazines/research journals. The collection should highlight the associated procedure of investigation, physical evidences and their forensic examination helpful in the case.

Visit to the Police Station: To learn the technical investigation procedures and crime file management system.

MFS-T1-MP1: Minor Project

PRACTICAL

Total Lectures: 60 Hrs **Total Marks – 50**
Credits – 2

M.Sc. Forensic Science
Syllabus – Semester - II

MFS-T2-C1: Molecular Biology and Biochemistry

THEORY

Total Lectures: 45+15= 60 Hr

Credits: 4
Marks:100
Semester Exam 80
Internal Assessment 20

This paper will be a melting pot of knowledge just like forensic science. It will bring together all the main streams of biology that hold a place of their own now. The knowledge imparted by these individual sciences will lead to a wholesome view of the biomolecules and their basic units along with an insight into forensic microbiology. In the coming times wars will not be fought with guns and tanks, they will be fought will strategies involving microbes.

UNIT-I

1	Chemistry of Nucleotides, Structure of DNA/RNA
2	DNA Replication: Eukaryotic and Prokaryotic
	Helicases, Topoisomerases and other DNA replicating Enzymes
3	DNA Denaturation, Cot-Rot curves,
4	DNA Repair mechanisms
5	DNA Epigenetics
6	Eukaryotic and Prokaryotic Transcription.
7	RNA Processing and Editing
8	Protein synthesis and Gene Regulation

UNIT-II

1	Humoral and Cellular Immunology
2	Structure and Functional Properties of Antibodies
3	Production of Antibodies
4	Diversity, Assembly, Switching and Maturation
5	Complement System, Activation and Regulation
6	Immune Response Disorders

UNIT-III

1	Amino Acids, Proteins, Carbohydrates and Lipids: Structure and Functions
2	Metabolism of essential Amino Acids and Urea Cycle, Denovo and Salvage pathway for Nucleotide Synthesis
3	Bioenergetics, Glycolysis, Citric Acid Cycle, Oxidative Phosphorylation,
4	Oxidation of Fatty acids,
5	Gluconeogenesis
6	Hormonal Regulation

UNIT-IV

1	Introduction to Microbiolgy
2	Bacteria Structure and Function
3	Viruses and Prions
4	Eukaryotic pathogens

5	Fungi and Parasites
6	Microbial growth and Metabolism
7	Microbial genetics

8	Immunization, sterilization and disinfection
9	Fighting infections
10	Microbial Forensics: Applications in Bioterrorism, Building a national capacity to investigate Bioterrorism, Database for infectious microorganisms
11	Biocrimes, Microbial Forensics, and the Physician

Recommended Books	
1.	Molecular Biology of the Cell by Bruce Albert*set. al*. (Garland Science; 2nd edition)
2.	GENES VII by Benjamin Lewin (Published by Jones and Bartlett Publishers)
3.	Principles of Genetics by D. Peter Snustad, Michael J. Simmons, John B. Jenkins (Published by John Wiley & Sons)
4.	Physical Biochemistry by David Freifelder (Published by W. H. Freeman and Company)
5.	Molecular Biology by David Freifelder (Published by Jones & Bartlett Pub)
6.	Lehringer's Principles of Biochemistry by David L. Nelson, Michael M. Cox (Published by W. H. Freeman; 4th edition)
7.	Biochemistry by LubertStryer (Published by W. H. Freeman and Company)
8.	Basic Principles in Nucleic Acid Chemistry Vol I and II by Paul OPO Tso (Publishedby Academic Press)
9.	Population Genetics by John H Gillespie (Published by The Johns Hopkins University Press)
10.	Progress in Forensic Genetics 9: Proceedings from the 19th International ISFG Congress Held in Munster, Germany by Bernd Brinkmann and Angel (Published by Elsievers Health Sciences)
11.	Human and Molecular Genetics by Peter Sudbery (Published by Pearson Education Limited)
12.	An Introduction to Forensic Genetics by William Goodwin, Adrian Linacre, SibteHadi (Published by Wiley)
13.	Human Variations by Stephen Molnar (Published by Prentice Hall)
14.	Genomic Diversity: Applications in Human Population Genetics bySurinder Singh Papiha, RanjanDeka, Ranajit (Published by Springer)
15	Basic ImmunologyAuthor: Abul K. Abbas, Andrew H. Lichtman Publisher: WB Saunders; 2nd edition
16	Cellular and Molecular ImmunologyAuthor: Abul K. Abbas, Andrew H. LichtmanPublisher: W.B. Saunders Company; 5th edition
17	Sourcebook in Forensic Serology, Immunology, and Biochemistry Author: R. E. Gaensslen Publisher: NatlInst of Justice/Ncjrs

Suggested Reading	
1	Forensic Science International; Forensic Science International: Reports - Elsevier
2.	Science & Justice – Elsevier
3.	Journal of Forensic and legal Medicine: Elsevier
4.	Australian Journal of Forensic Sciences - Taylor & Francis
5.	Journal of Forensic Science- Wiley Online Library

MFS-P2-C1: Molecular Biology and Biochemistry (Pr)

PRACTICAL

Total Lectures: 30Hrs **Credits: 1**

Marks:25

1.	Detection, Isolation and Staining methods for different microorganisms of forensic application
2.	Isolation of Plasmid DNA, Restriction enzyme digestion – ligation of plasmid DNA
3.	Study (observation) of some pathogenic Fungi and bacteria, (permanent slides)
4.	Microbiological examination of water (Coli form test Microbiological examination of milk
5.	Study of general Morphology and cultural characteristics of staphylococeusStreptococcus, Darmatophytes etc.
6.	Study of normal flora of human body
7.	Observation some spoiled food materials
8.	Biochemical test for the identification of Soli bacteria (**IMVIC** test)
9.	Amino acid detections paper chromatography
10.	Comparative evaluation of different methods of protein analysis, Lowry, Biuret, Kjeldahl,UV
11.	Specific reactions for carbohydrates and estimation
12.	Isolation of amino acids and proteins
13.	Estimation of DNA and RNA

MFS-T2-C2: Forensic Chemstry

THEORY

Total Lectures: 45+15= 60 Hrs **Credits – 4**

Marks – 100

Semester Exam- 80

Internal Assessment –20

This paper includes the basic concepts of forensic chemistry which are helpful in exploring the minute of the subject. It takes up the detective dyes, restoration of erased numbers, alcohols and it all related aspects, fire and arson, Indian standard specifications for the analysis of petroleum products. Analytical chemistry includes the basics of sampling and the analysis procedure

UNIT-I

1	Analysis of corrosive chemicals- acids and alkalies.
2	Examination of contact traces: Detective dyes: Bribery-definition under Indian penal code, Motives, Chemistry of detective dyes, Analysis
3	Restoration of erased numbers – Importance of numbers, Theory, Methods of marking of numbers on different surfaces
4.	Obliteration and restoration of erased numbers on different surfaces

UNIT-II

1	Alcohol- Forensic significance, problems of prohibition, nature, production of different types of alcohols including wines, liquors, IMFS, rectified sprit and

	absolute alcohol
2	Proof spirit, Analysis of alcohol: Percentage of alcohol by specific gravity method, acidity, Methanol poisoning Breath-alcohol instrumentation, Interpretation and presentation of alcohol: Retrograde exploration or back calculation of alcohol concentration, Widmark's equation
3	Identifying the alcohol-impaired driver: Tests of impairment, Alcohol measurement (using blood, breath, urine, saliva and oral fluid)

UNIT-III

1	Arson – Definition under IPC, Nature of fire, Progress, Control, Burnt bodies, Seat and time of fire, Natural causes of fires, suspected arson, motives, person responsible
2	Search and collection of evidence, Isolation and extraction of accelerants, analysis by GC/GC-MS method.
3	Petroleum products-production, Classification and properties
4	ISI of Gasoline, Kerosene and Diesel (HSD & LDO)
5	Analysis of Gasoline, Kerosene and Diesel (HSD & LDO), Forensic relevance

UNIT-IV

1	Analytical Chemistry: Overview, Sample collection, Preservation and Preparation
2	Analysis: Ionic equilibrium, pH scale, hydrolysis, solubility and ionic product.
3	Disposition: Absorption, Distribution, Excretion and Influencing Factors
4	Detection of drugs in alternative specimens: Hair, Oral fluids, Sweat

Recommended Books

1.	Vogel's Qualitative Inorganic Analysis (7th Edition) revised by G.Svehia (2nd Impression-2006).
2.	Petroleum Laws and Essential Commodities Act (E.C. Act) 1955
3.	IS:3752; 2005 Indian Standard Alcoholic Drinks – Methods of Test, Second Revision (2005)
4.	The ISI Specification for Kerosene (IS: 1459/1974), Second Revision (2006)
5.	The ISI Specification for Motor Gasoline (IS: 2796/2008), Fourth Revision
6.	The ISI Specification for Diesel (IS: 1460/2005), Fifth Revision
7.	The Indian Standard Methods of Test for Petroleum Products IS:1448[P:2]:2007 Second Revision
8.	An Introduction to Forensic Science by Saferstein, R., (8th edition 2003)
9.	Forensic Science Hand Book, by Saferstein, R., Printice Hall : N. Jersey, 3rd edition 2020
10.	Kirk's Fire Investigation. Pearson 2017 (8th edition).
11.	Forensic Issues in Alcohol Testing By Steven B. Karch, Edition: Illustrated, Published by CRC Press (2007)
12.	Clark, E.G.C. : Isolation and identification Drugs, Vol. I and Vol.II, (1986).
13.	Karch, S. B. (Ed.). (2019). Drug abuse handbook. CRC press.
14.	Kintz, P. (Ed.). (2006). Analytical and practical aspects of drug testing in hair. CRC Press.
15.	The Essentials of Forensic Medicine and Toxicology - 34th Edition by KSN Reddy and OP Murty (2017)
16.	Skoog, D. A., Holler, F. J., & Crouch, S. R. (2007). Instrumental analysis (Vol. 47).

17.	A Handbook on Drug and Alcohol Abuse: The Biomedical Aspects (4th edn). By G. Winger, JH Woods and FG HofmannOxford University Press, Inc.: New York. 2004.
18.	Explosives & Arson Investigation (Solving Crimes with Science: Forensics) by Jean Ford, 2014
19.	Clarke's Analysis of Drugs and Poisons, 2013(3rd edition)

Suggested Reading	
1.	Forensic Chemistry – Elsevier
2.	Science & Justice – Elsevier
3.	Forensic Science International- Elsevier
4.	Australian Journal of Forensic Sciences - Taylor & Francis
5.	Analytical letters - Taylor & Francis
6.	New journal of chemistry- Royal Society of Chemistry
7.	Drug Testing and Analysis- Wiley

MFS-P2-C2: Forensic Chemistry (Pr)

PRACTICAL

Total Lectures: 30Hrs	**Credits: 1** **Marks:25**
1	Acids: (a) Analysis of individual acids (HCl, H_2SO_4 and HNO_3) (b) Mixture of acids (c) Effect on fabric and analysis
2	Chemical test and TLC of Phenolphthalein, Anthracene, Alta, Rhodamine B, Carbonate, Bicarbonate, Bleaching powder
3	Study of effect of different concentration of Sod. Carbonate, Sod. Bicarbonate, NaOH, Bleaching powder on Phenolphthalein
4	Collection of different bribery samples and extraction of Phenolphthalein (ether method)
5	Minimum detection limit of Phenolphthalein using TLC and UV method
6	Restoration of erased numbers of different surfaces
7	Identification of alcohol (ethanol, methanol) in given (a) known sample (b) unknown sample
8	Chemical analysis of alcohol for the presence or absence of all possible impurities
9	Analysis of various accelerants by GC (a) in pure form (b) after extraction from burnt cloth or soil
10	Determine the % proof of ethyl alcohol in (a) lab. Fabricated sample (b) alcoholic beverages
11	Preparation of calibration curve for any drug/chemical and determination of concentration of unknown sample
12	Analysis of Petroleum products: Gasoline, Kerosene and Diesel (a) individually (b) in mixture, using TLC, UV-vis or GC

MFS-T2-C3: Forensic Physics
THEORY

MFS-T2-C2: Forensic Chemstry
THEORY

Total Lectures: 45+15= 60 Hrs

Credits – 4

Marks – 100

Semester Exam- 80

Internal Assessment –20

This paper includes basic principles of physics based techniques which can be appliedto solve the various forensically relevant cases. It comprises of analysis of foot/footwear/Type impression, Tool marks, Paint Instrumental technique like IR, Py- GCMS, XRD etc., Fiber and Paint analysis, papers examination, soil and cement analysis, analysis of glass.

UNIT-I

1.	Foot/Footwear/Tyre Impression: Collection, Tracing, Lifting, Casting of impressions, Enhancement of Footwear Impression, Analysis & comparison of foot impressions, Moulds, Identification characteristics.
2.	Tool Marks: Compression marks, Striated marks, Combination of compression and striated marks, Repetitive marks, Comparison of tool marks. Features: Class characteristics, Sub class characteristics, Individual characteristics, development of tool marks.
3.	Paint: Microscopic examination, Micro chemical tests, Differential solubility and TLC, Infra-red spectroscopy, Pyrolysis Gas Chromatography, Mass Spectrometer, Elemental analysis of the pigments

UNIT-II

1.	Fiber: Fiber as Physical Evidence, fiber recovery, FiberIdentification: Physical matching, Microscopic Examination, solubility test, Chromatographic and Spectroscopic analysis (UV-Vis & FTIR) of Fibre.
2.	Paper: Physical examination, Watermark Examination, Chemical Analysis,
	Analysis by FTIR.

UNIT-III

1.	Soil: Sample preparation, Removal of contamination, Microscopic Examination, Particle Size Distribution, Ignition Test, Density distribution, pH Measurement, UV and TGA Analysis of soil.
2.	Cement: Bromoform Test, Fineness Test, Loss on Ignition Test, Physical method: Determination of compressive Strength, Setting Times, Initial and final Setting Time, Standard Consistency, Preparation of Cube
3.	X-Ray Powder Diffraction: Identification of adulterated cement and adulterant,
4.	Mortar and Concrete: Analysis of mortar and concrete.

UNIT-IV

1.	Glass: Types of Glass-Soda lime glass, Borosilicate glass, Safety glass, Laminated, Light sensitive glass, Tampered/toughened glass, Wire glass, Coloured glass.
2.	Physical parameters of glass: Fluorescence under UV radiation, Density or Specific gravity, Density measurements for bigger fragments of glass, Density comparison by flotation and density gradient tubes.

3.	Refractive Index Measurement (RI): Glass refractive index measurement (GRIM), Immersion method, Becke line concept, RI using the mixture of miscible liquids and hot stage microscope, Elemental analysis, Glass fracture identification.

	Recommended Books
1.	Forensic science hand book by Richard Saferstein, Prentice Hall, volume 1 3rd edition.
2.	Forensic examination of glass and paint, Brian Caddy, Taylor & Francis-2001. 1st edition
3.	Forensic Science Progress, A. Maehly et all, Vol.1 to 5.
4.	Forensic Science Hand Book, Vol.-III Chapter-3 (1993), R Saferstein, Prentice Hall International, London.
5.	Methods of Chemical Analysis of Hydraulic Cement, Bureau of Indian Standards,IS: 4032-1985.
6.	Elements of X-ray Diffraction, B.D. Cullity, Addision- Weseley Publ. Comp. Inc. 3rd edition
7.	ASTM standards, Vol.15-09. 2020
8.	Forensic examination of fibres, James R. Robertson, Claude Roux, Ken Wiggins, Michael Grieve, CRC Press-1999, 3rd edition
9.	The chemistry of cement and concrete, Lea, F.M.1971, Chemical Publication. Comp.Inc. New York (USA), 3rd edition

Suggested Reading	
1	Forensic Science International; Forensic Science International: Reports - Elsevier
2.	Science & Justice – Elsevier
3.	Journal of Forensic and legal Medicine: Elsevier
4.	Australian Journal of Forensic Sciences - Taylor & Francis
5.	Journal of Forensic Science- Wiley Online Library
6.	Forensic Chemistry: Elsevier

MFS-P2-C3: Forensic Physics (Pr)PRACTICAL

Total Lectures: 30 Hrs		**Credits: 1** **Marks:25**
1.	Analysis of Radial, Concentric cracks in Glass fracture	
2.	Measurement of physical parameters (colour, density, refractive index) on glass samples	
3.	Development of footwear impressions.	
4.	Comparison of paint chips under microscope	
5.	FTIR analysis of paint samples	
6.	Microscopic examination of various fibres	
7.	Measurements of physical parameters of fibers (Number of strands, Diameter of strand, Dye marks, Twist, Colour, thickness)	
8.	Soil comparison using density gradient tubes	
9.	UV-Vis examination of dyes in fiber/fabric	
10.	Identification and comparison of fiber in the fabric material using FTIR	
11.	Development and comparison of compression, striated and combination of both marks.	
14.	Identification of the best solvent for fiberexamination	
15.	Lifting of Footwear impressions by photographic film	
16.	Development of tool marks by using china clay/M-seal	

17.	Examination of glass by using vernier calliper and spherometer
18.	Discrimination of soil samples by using FTIR
19.	Characterization and discrimination of paper samples using FTIR
20.	Characterization of glass samples by FTIR

Perform any 12 Practical

MFS-T2-C4: Quality Management
THEORY

Total Lectures: 23+7= 30 Hrs

Credits – 2

Marks – 50

Semester Exam- 40

Internal Assessment –10

Quality management can be considered to have three main components: quality control, quality assurance and quality improvement. The paper covers up the scope and management of quality control and assurance, document control, internal audits and its technical requirements, sampling, role of assessor, assessor assignment procedure and processes of on site assessment.

UNIT-I

1.	Scope, Quality, Quality Assurance, Quality Control
2.	Management Requirements- organization, management system
3.	Document control, Review of requests, Tenders and contracts
4.	Subcontracting of tests and calibrations, Purchasing of services and supplies
5.	Service to customer, Complaints and Improvement
6.	Corrective action, Preventive action Control of records: Method of corrections in document
7.	Management Review – Objectives, organization of management review, planning, implementation, records
8.	Technical requirements – General, Personnel
9.	Accommodation and environmental conditions, Tests and calibration methods and

	Analytical method validation
10.	Equipment, Measurement traceability, Sampling, Sampling plan, Handling of test and calibration items
11.	Assuring the quality of test and calibration results, Reporting the results
12.	Good laboratory practices (GLP): Fundamental points, Resources, Raw data and data collection, SPOs
13.	Good documentation
14.	Lab safety

UNIT-II

1.	Internal Audits, Terminology, Objectives, Organization of internal audits
2.	Planning of audit, Implementation of internal audits, Follow up of corrective action
3.	Records and reports of internal audits, Additional unscheduled audits
4.	Assessor guide -Assessor's role, Assessor assignment procedure
5.	Procedure of assessment of new applicant laboratories, Pre-assessment visit
6.	Guide of assessors to formulate recommendations for NABL

7.	Procedure for conducting closing meeting

Recommended Books	
1.	NABL-113, Issue No.01 Issue Dt : 8.6.1998
2.	IS/ISO/IEC 17025: 2005 General Requirements for the competence of testing and calibration laboratories
3.	NABL -161, Guide for Internal audit and Management Review for Laboratories
4.	NABL-210, Assessor Guide Issue No.3, 1.5.2002
5.	NABL-141, Guidelines for Estimation and Expression of Uncertainty in Measurement
6.	Juran's Quality Control Handbook, Fourth Edition, J.M. Juran, Frank M. Gryna, McGraw-Hill International Editions, Industrial Engineering Series (1988)
7.	Total Quality Control Essentials - Key Elements Methodologies and Managing for Success, Sarv Singh Soni, Gryna, McGraw-Hill International Editions, Industrial Engineering Series (1993)

Suggested Reading	
1.	Forensic Science International; Forensic Science International: Reports - Elsevier
2.	Accreditation and Quality Assurance: Springer
3.	Science & Justice – Elsevier
4.	Journal of Forensic and legal Medicine: Elsevier
5.	Australian Journal of Forensic Sciences - Taylor & Francis
6.	Journal of Forensic Science- Wiley Online Library
7.	Forensic Chemistry: Elsevier
8.	Analytical Chemistry: American Chemical Society

MFS-P2-C4: Quality Management (Pr)
PRACTICAL

Total Lectures: 30Hrs	**Credits: 1** **Marks:25**
1.	**SPSS/R** practical's on computer: To cover those techniques of data preparation needed prior to data analyses, practical implementation of statistical analyses methods
2.	Practical's on ISO/IEC/17025: 205

MFS-P2-C5: Minor Project

Lectures: 60

Credit: 2
Marks: 50

Note: Evaluation of Minor Project will be the average of evaluation by experts

M.Sc. Forensic Science
Syllabus-Semester III

MFS-T3-C1: Forensic Toxicology and Drugs of Abuse
THEORY

Total Lectures: 45+15= 60 Hrs

Credits – 4

Marks – 100

Semester Exam- 80

Internal Assessment –20

Toxicology is the study of the adverse effects of chemicals precisely the poisons on living organisms. The paper comprises of characteristics and spectrum of exposure, metabolism of poison and the drugs, extraction viz. solvent extraction, solid phase extraction and isolation and analysis of various poisons. Drug of abuse refers to a maladaptive pattern of use of a drug that is not considered dependent. The paper includes the definitions i.e. tolerance and addiction and effects of narcotics. Various drugs of abuse viz. opium, barbiturates, benzodiazepines, amphetamines and cannabis have been discussed including their characteristics and analysis.

UNIT-I

1	Toxicology-Concept and scope, Classification of poisons, Characteristics of exposure: Acute and chronic, Route, Site, Duration and Frequency
2	Spectrum of Toxic Effects, Dose-Response Relationship, Lethal dose: Methods,
3	Conflict Poisoning-Warfare Agents of Mass destruction
4	Extraction, Isolation and Identification of Poisons: Solvent Extraction – Stas Otto method, Ammonium sulphate method, Solid Phase Extraction, Clean-up Prodedures, Metallic poisons: Identification and toxicology

UNIT-II

1	Pharmacokinetics and Metabolism: Types of Metabolic reactions
2	Drug Metabolism: phase I and II (Analgesics, Tranquilizers, Barbiturates and Benzodiazepines)
3	Pesticide Metabolism (intricacies): Herbicides, organophosphate insecticides, carbamates, Factors influencing Metabolism
4	Drug Analysis: Screening and detection, Extraction pathway for basic, acidic and neutral molecules

UNIT-III

1	Definition- Tolerance, Addiction, Use of Drugs, Withdrawal Symptoms.
2	Classification and Effects of Drugs, Synonyms, Diluents and Adulterants

3	NDPS Act, Drugs and Crime, Identification of Addict.
4	Opiates: Production of opium, Isolation of Morphine, Production of Heroin, Alkaloidal constituents of opium and heroin
5	Depressants (Barbiturates, Benzodiazepines, Methaqualone): Description of compounds, Production, Physical and chemical characteristics of derivatives, Analysis

UNIT-IV

1	Stimulants (Amphetamines, Cocaine): Description of compounds, Production, Physical and chemical characteristics of derivatives; Analysis
2	Hallucinogens (Cannabis, Ergot-LSD): Production, Description, Physical characteristics, Extraction, Chemical constituents.
3	Drugs of Abuse in sports: Prohibited substances, Analytical approach; Drug facilitated sexual assault: Drugs, Metabolism
4	Separation of bound and unbound drug, Techniques of separation (Immunoassay), Forensic Application

Recommended Books	
1.	Toxicology- The Basic Science of Poisons by Louis J.Casarett & John Doull, Macmillan Publishing Co., Inc., New York-1975
2.	Clark, E.G.C. : Isolation and identification Drugs, Vol. I and Vol.II, (1986).
3.	Sunshine, I : Guidelines for Analytical Toxicology Programme, Vol. I,CRC Press, (1950).
4.	Mule, S.J. et.al. : Immunoassays for Drugs, CRC Press,(1974).
5.	Curry, A.S.: Poison Detection in Human Organs, C. Thomas Springfield, Illinois USA, (1963).
6.	Connors. : A textbook of Pharmaceuticals analysis, Interscience, New York, (1975).
7.	Gleason, M.N. et.al : Clinical Toxicology of Commercial products, Williams and Williams, Baltimore, USA,(1969)
8.	Modi, Jaisingh P: Textbook of Medical jurisprudence & Toxicology, M.M. Tripathi Pub. (2001).
9.	Cravey, R.H., Baelt, R.C. : Introduction to Forensic Toxicology, Biochemical publications, Davis C A (1981).
10.	A. Stolmen : Progress in Chemical Toxicology : Acad, Press, New York (1963).
11.	Working Procedure Manual – Toxicology, DFS Publications (2005)
12.	Forensic Science in Criminal Investigation & Trials by Dr. B.R. Sharma, Universal Law Publishing Co. Pvt. Ltd., Delhi (4^{th} edition 2005).
13.	Rapid testing methods for testing Drugs of Abuse, United Nations Office on Drugs and Crime, (UNODC), Vienna, Austria.
14.	Clark, E.G.C. : Isolation and identification Drugs, Vol. I and Vol.II, (1986)
15.	Vogel's Qualitative Inorganic Analysis (7^{th} Edition) revised by G. Svehia (2^{nd} Impression-2006)
16.	Analytical Methods in Forensic Chemistry by Mat H.Ho Ellis Horwood Limited, England (1990)

17.	March's Advanced Organic Chemistry by Michael B. Smith and Jerry March, Willey – Interscience – A John Wiley & sons, INC; Publication, New Jersy (6th edition 2007)
18.	Vogel's Textbook of Quantitative Chemical Analysis, by J Mendham, RC Denney, JD Barnes, MJK Thomas, Pearson Education,– Dorling Kindersley (India) Pvt. Ltd., Delhi 6th edition 2007

MFS-P3-C1: Forensic Toxicology and Drugs of Abuse (Pr)

PRACTICAL

Total Lectures: 30 Hrs **Total Marks – 25**
Credits – 1

1	Colour Tests (a) Drugs (Benzodiazepines, Barbiturates: Phenobarbital, Secobarbital, Paracetamol, Diazepam, Lorazepam, Aplrazolam etc.) (b) Pesticides (OPs Insecticides, Pesticides and Carbamates: (i) Malathion, chlorpyrifos, monochrotophos, dimethoate (ii) Lindane, DDT (iii) Propoxure, Seven) (c) Plant Poisons (Cannabis, Opiates, Calotropis, Dhatura, Ricimus etc.)
2.	TLC (a) Drugs (Benzodiazepines, Barbiturates: Phenobarbital, Secobarbital, Paracetamol, Diazepam, Lorazepam, Aplrazolam etc.) (b) Pesticides (OPs Insecticides, Pesticides and Carbamates: (i) Malathion, chlorpyrifos, monochrotophos, dimethoate (ii) Lindane, DDT (iii) Propoxure, Seven) (c) Plant Poisons (Cannabis, Opiates, Calotropis, Dhatura, Ricimus etc.)
3.	Extraction of non-volatile organic poison from viscera by Solid-phase extraction (SPE) method
4.	Reinsch test for Metallic Poisons (Arsenic, Mercury, Antimony, and Bismuth)
5.	Microscopic identification Cannabis and analysis of alkaloids by Colour test (Dequenois Levine), TLC and UV-Visible Spectroscopy
6.	Detecting presence of Aluminum/Zinc phosphide in given exhibit
7.	Determination of Salicylate by visual colorimatery
8.	Analysis of plant poison plants (any of Datura, Calotropis, Ricimus) alkaloids by UV-Visible Spectroscopy
9.	Determining the quantity of OPs (any of Chlorpyrifos, Monochrotophos, Dimethoate) in unknown/suspect samples using UV-Visible technique
10.	Quantitative analysis of drugs (phenobarbital, paracetamol, Alprazolam, lorazepam) in unknown/suspect sample using UV-Visible technique

MFS-T3-C2: Ballistics
THEORY

Total Lectures: 34+11= 45 Hrs

Credits – 3

Marks – 75

Semester Exam- 60

Internal Assessment –15

Ballistics is the science of mechanics that deals with the flight, behavior, and effects of projectiles, especially bullets, gravity bombs, rockets etc. It also deals with the art of designing and accelerating projectiles so as to achieve a desired performance. This paper includes history of fire arms, ammunition, internal and external ballistics, terminal ballistics, fire arm examination, gunshot residue analysis and fire arm injuries.

UNIT-I

1	History of Firearms, classification and characteristics of firearms, components of small arm firearms, smooth bore and rifled firearm, bore and caliber, choke, different systems and their functions, Arms Act
2	Purpose of rifling, types of rifling and methods of producing rifling, trigger and firing mechanism, Theory of recoil, identification of origin, improvised/ country-made/ imitative firearms and their constructional features
3	Ammunition and their components, classification and constructional features of different types of cartridges, head stamp markings, various types of bullets and compositional aspects, latest trends in their manufacturing and design.
4	Types of primers and priming composition, propellants and their compositions, Velocity and pressure characteristics under different conditions, Explosives Act

UNIT-II

1	Internal Ballistics: Definition, ignition of propellants, shape and size of propellants, manner of burning, various factors affecting the internal ballistics: lock time, ignition time, barrel time, erosion, corrosion and gas cutting
2	External Ballistics: Vacuum trajectory, effect of air resistance on trajectory, base drag, drop, drift, yaw, shape of projectile and stability, trajectory computation, ballistics coefficient and limiting velocity,
3	Measurements of trajectory parameters, introduction to automated system of trajectory computation and automated management of ballistic data
4	Terminal Ballistics: Effect of projectile on hitting the target: function of bullet shape, striking velocity, striking angle and nature of target, Tumbling of bullets, effect of instability of bullet, effect of intermediate targets, influence of range, Ricochet and its effects, stopping power

UNIT-III

1	Principles of identification of firearms, different types of marks produced during firing process on cartridge-firing pin marks, breech face marks, chamber marks, extractor and ejector marks
2	Different types of marks produced during firing process on bullet, number of lands and grooves, direction of twist, depth of grooves and width of land/grooves, class and individual characteristics
3	Techniques for obtaining test material from various types of weapons, basic methodology used in comparison microscopy, linkage of fired bullets/cartridge cases with firearms
4	Automated examination and comparison of fired bullets/cartridge cases and ballistics imaging database of the markings of fired bullets/cartridge cases
5	Determination of range of fire/ bullet hole identification: Burning, scorching, blackening, tattooing and metal fouling, shots dispersion and GSR distribution, bullet hole identification, bullet penetration and trajectory through glass

UNIT-IV

1	Analysis of Gunshot Residues: Mechanism of formation of GSR, source and collection, spot test, chemical test, identification of shooter and instrumental methods of GSR Analysis, Management and reconstruction of crime scene; suicide, murder and accidental and self-defense cases
2	Firearm injuries: Threshold velocity for penetration of skin/flesh/bones, cavitations – temporary and permanent cavities, nature of wounds of entry, exit, bullet track with various ranges and velocities with various types of projectiles, explosive wounds
3	Evaluation of injuries caused due to shot-gun, rifle, handguns and country made firearms, methods of measurements of wound ballistics parameters, preparation
	of gel block penetration of projectiles in gel block and other targets, post-mortem and anti-mortem firearm injuries

Recommended Books	
1.	Arms Act, 1959. and Arms Rule, 1962.
2.	Bhattacharyya C.N., (2000) Particle Analysis for Detection of Gunshot Residues – A State-of-the-Art Technique, The Indian Police Journal, BPR&D, Vol.XLVII, No. 4, pp. 113-127
3.	Burrad, G., (1951) The Identification of Firearm and Forensic Ballistics, Herbert Jenkins, London.
4.	Cordell G. Brown, (Oct, 1981), Non-Destructive Rust Removal From Ferrous Objects, AFTE Journal, Vol 13, no. 4; pp. 85-89.
5.	Cowgill, J.P., (1975) The Newest Look of Handgun Ballistics, The American Rifleman, Vol. 123, No. 10.
6.	Davis, J.E., (1958) An Introduction to Toolmarks, Firearms and the Striagraph, Charles C Thomas, Springfield, Illinois, USA.
7.	DiMaio, J.M., (1985) Gunshot Wounds, Elseveir, USA.
8.	Feigl, F., (1962) Spot Tests in Inorganic Analysis, Elsevier Publishing Co., Netherlands.

9.	Hatcher, J.S., Jury, F.J. & Weller, J., (1957) Firearms Investigation, Identification and Evidence, The Stackpole Co., Harrisburg, Pennsylvania, USA.
10.	J.S. Bates, (Feb, 1973) Cleaning of Rusted Firearms, AFTE Journal, Vol 5, no. 1, p.11.
11.	Jauhari, M., (1980) Identification of Firearms, Ammunition and Firearm Injuries, Bureau of Police Research and Development, Govt. of India, New Delhi, India.
12.	Kumar, K., (1987) Forensic Ballistics in Criminal Justice, Eastern Book Co., Lucknow, India.
13.	Maiti, P.C., (1973) Powder Pattern around Bullet Hole in Blood Stained Articles, Journal of Forensic Science Society, p 147.
14.	Saferstein, R., (1995) Criminalistics – An Introduction to Forensic Science, Prentice Hall, Englewood Cliffs, NJ 07632, USA.

MFS-P3-C2: Ballistics (Pr)

PRACTICAL

Total Lectures: 30 Hrs **Total Marks – 25**
Credits – 1

1.	Gun shot residue analysis: (i) Barrel wash (ii) Hand swab
2.	Examination for serviceability/working condition of firearm
3.	Identification of Firearm for Type, Make and Model
4.	Identification of Ammunition/Parts: Type, Make and Calibre
5.	Bullet/Pellets/Wads whether Fired or Not
6.	Identification of bullet marks and its Comparison.
7.	Identification of catridge case and its comparison.
8.	Identification of Firearm Injuries.
9.	Report writing in forensic ballistic cases
10.	Examination of gun shot residue (GSR) samples using (i) SEM-EDS (ii) XRF

MFS-T3-C3: Cytogenetics

THEORY

Total Lectures: 34+11= 45 Hrs **Credits – 3**
Marks – 75
Semester Exam- 60
Internal Assessment –15

This paper consists of basic genetics-blood grouping of various types, serum protein polymorphisms, Mendelian inheritance, mutations, genetic drift etc, human cytogenetics, mitosis, meiosis, DNA databanking, conservation genetics and statistics of forensic

importance. A study of this paper will be helpful in knowing the basics involved in the biology of DNA, proteins and blood (biological markers) along with their usage to arrive at forensically relevant information. This information is the key to the value attributed to the biological evidence when it is presented in the court of law. 4th unit is a summarization of bioinformatics, it touches upon phylogenetics, and human genetic disorders too.

UNIT-I

1.	Mendelian Inheritance
2.	The concept of Genetics polymorphism
3.	Blood groups: ABO, MN and Rh systems, ABH saliva secretion
4.	Haemoglobin
5.	Serum Proteins: Hptoglobin
6.	Inborn errors of metabolism: Albinism, Phenylketonuria and Alkaptonuria PTC taste sensitivity and Glucose
7.	Hardy-Weinberg Law
8.	Mutations and Genetic Drift
9.	Evolution, Molecular basis of Evolution
10.	Natural Selection, Mutation
11.	Genetic Segregation
12.	Genetic Distance
13.	Effects of Migration,
14.	Marriages and Consanguinity

UNIT-II

1.	General introduction Human Cytogenetics, Nomenclature Standardization in Human Cytogenetics
2.	Mitosis Meiosis in Males, Meiosis in Females
3.	Chromosome structure and cell division
4.	Human somatic chromosomes, Morphological variability of human chromosomes
5.	Heterochromatin and genetic inactivation: Heterochromatin, the sex chromatin, correlation between the number of chromatin masses and the number of X chromosomes.
6.	Chromosome mutations in Man Numerical and structural changes

UNIT-III

1.	Human Genome Project: Introduction, History, Goals

2.	Benefits, Social, Ethical and Legal Issues
3.	DNA Forensic Databases, Ethical, Legal, and Social Issues Associated with DNA Databanking, Potential Benefits of DNA Databanking
4.	Human Genome Diversity Project: Introduction, History, Goals, Benefits
5.	Genetic Discrimination, Behavioral genetics, Genetics and Violence

UNIT-IV

1.	Eukaryotic genome structure and concepts of genomic analysis
2.	Public sequence databases: DNA, RNA, proteins, whole genomes
3.	Data mining for homologous sequences
4.	Multiple sequence alignment algorithms
5.	Phylogenetic trees and molecular evolution
6	Microarrays and transcriptome analysis
7	The proteome, metabolome, glycome, lipidome, and interactome
8	Human genes and genetic disorders
9	Ethics in human bioinformatics and genomics
10	Y Chromosome testing
11	Non-Human, medical, and research applications

Recommended Books	
1	Population Genetics by John H Gillespie (Published by The Johns Hopkins University Press)
2	Progress in Forensic Genetics 9: Proceedings from the 19th International ISFG Congress Held in Munster, Germany by Bernd Brinkmann and Angel (Published by Elsievers Health Sciences)
3	Human and Molecular Genetics by Peter Sudbery (Published by Pearson Education Limited)
4	An Introductin to Forensic Genetics by William Goodwin, Adrian Linacre, Sibte Hadi (Published by Wiley)
5	Human Variations by Stephen Molnar (Published by Prentice Hall)
6	Genomic Diversity: Applications in Human Population Genetics by Surinder Singh Papiha, Ranjan Deka, Ranajit (Published by Springer)
7	Statistics at Square one by TDV Swinscow, Campbell, Kenneth L. Bontrager
	(Published by Hammicks BMA Medical Bookshop)
8	Forensic DNA Evidence Interpretation by John S. Buckleton, Simon J. Walsh (Published by CRC Press)
9	Statistics and the Evaluation of Evidence for Forensic Scientists by C. G. G. Aitken, Franco Taroni (Published by John Wiley and Sons)
10	Expert Evidence and Criminal Justice by Mike Redmayne (Published by Oxford University Press)
11	Interpreting DNA Evidence: Statistical Genetics for Forensic Scientists by Ian W. Evett, Bruce S. Weir (Published by Sinauer Associates
12	Laboratory procedures in Human Genetics Vol. I Chromosome methodology

	Sharma, A. and Talukder, G.
13	Laboratory procedures in Human Genetics, Vol. 11 : Biochemical Methodology Sharma, A., Talukder, G. and Mukherjee, S.K., 1976, The Nucleus, Calcutta.
14	Practical Cytology, applied Genetics and Biostatistics Goswami, H.K.
15	The Principles of Human Biochemical Genetics Harris, H.
16	Genetics and medicine Thompson and Thompson.
17	Blood groups serology Boorman, Dodd and Lincoln
18	Human Genetics Mckusick, V.A
19	Principles of Genetics Stern, C.
20	Human Cytogenetics, Vol. I General Cytogenetics Hamerton, U.J
21	Baxevanis, A. D., & Ouellette, B. F. F. (2004). Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. 3rd ed. New York; Chichester: Wiley.
22	Barnes, M. R. (2007). Bioinformatics for Geneticists: A Bioinformatics Primer for the Analysis of Genetic Data. 2nd ed. New York; Chichester: Wiley.
23	Bergeron, B. (2002). Bioinformatics Computing. 1st ed. Upper Saddle River, NJ: Prentice Hall/Professional Technical Reference
24	Campbell, A. M., & Heyer, L. J. (2006). Discovering Genomics, Proteomics and Bioinformatics. 2nd ed. San Francisco, CA: CSHL Press: Pearson/Benjamin Cummings
25	Gibson, G., & Muse, S. V. (2004). A Primer of Genome Science. 2nd ed. Sunderland, MA: Sinauer Associates
26	Higgins, D., & Taylor, W. (2000). Bioinformatics: Sequence, Structure and Databanks:A Practical Approach. 1st ed. Oxford; New York: Oxford University Press, USA.
27	Kohane, I. S., Kho, A., & Butte, A. J. (2005). Microarrays for an Integrative Genomics. 1st ed. Cambridge, MA; The MIT Press
28	Lesk, A. (2008). Introduction to Bioinformatics. 3rd ed. Oxford; New York: Oxford University Press
29	Letovsky, S. I. (1999). Bioinformatics: Databases and Systems. 1st ed. Boston, MA: Kluwer Academic Publishers.
30	Pevsner, J. (2003). Bioinformatics and Functional Genomics. 1st ed. Hoboken, NJ: Wiley-Liss, Inc.

MFS-P3-C3: Cytogenetics (Pr)

PRACTICAL

Total Lectures: 30 Hrs **Total Marks – 25**
Credits – 1

1.	Analysis of Interphase Nuclei Introductory remarks
2.	Buccal smears and blood smears obtaining the material, fixation, staining and scoring
3.	Chromosome painting/Florescent in situ hybridisation (FISH)
4.	Slide test for sickle cell

5.	Hb typing on paper electrophoresis
6.	Test for G6PD enzyme deficiency
7.	Starch agarose gel electrophoresis for Hb and G6PD systems
8.	Genetic Ratios : Segregation Ratios
9.	Identification of gender by amilogenin gene PCR
10.	Test for PTC taste sensitivity

MFS-T3-C4: Forensic Anthropology, Osteology and Odontology

THEORY

Total Lectures: 45+15= 60 Hrs

Credits – 4

Marks – 100

Semester Exam- 80

Internal Assessment –20

This paper includes forensic anthropology, osteology and dentistry. It gives the students the strength of forming a picture with the information that they can retrieved from the bones- demography, race, sex, age etc. It also teaches them complete facial reconstruction and restoration. The facial superimposition and forensic art forms an intrinsic part of this science and of the syllabus here. This will ensure that the students of this paper will be of great help to the society and science as they will have hands on experience in the field. Ancient DNA typing along with procedures involved for optimization of these techniques is also a part of this paper.

UNIT-I

1	Introduction to subject, Forensic anthropology, History, Scope and methods, Introduction to forensic Archaeology
2	Investigation of death, determination of time since death and age of the dead. Injuries: classification and type of injuries, nature of injuries – ante mortem/postmortem.
3	Burn injuries due to fire, acid, crackers& electricity. Mechanical Violence, fire arm injuries, blast & projectile injuries, injuries in sexual offence, suicide & homicide.
4	Field and laboratory management of skeletal remains
5	Dental anatomy and forensic dentistry

UNIT-II

1	Introduction to subject of human osteology, its over-view, ethics and handling of bones. Anthropometric and osteometric variation in human population
2	Biological profiling of skeletal remains: Demography, sex, age, stature and race estimation. Bio-distances and divergences
3	Trauma and Paleopathology as means of personal identity
4	Micro-skeletal markers of activity and life history
5	Body modifications and identification in living person
6	Chemistry of bones
7	Time elapsed since death. Decomposition stages and forensic entomology and Thanatology
8	Non metric skeletal variation

UNIT-III

1	Forensic facial reconstruction Human facial anatomy including bones and muscles, anatomy of the facial features, facial tissue thicknesses with MRI and other methods, three dimensional method of facial reconstruction with clay method as well as with computerized technique.
2	Facial restoration
3	Facial superimposition : Anthropological study of skull, Photography of the skull in the same pose as the antemortem photography, enlargement of the antemortem photograph, comparison of the facial features of the human skull and the antemortem photograph. Still photographic method and computerized technique of superimposition.
4	Forensic art: 2D facial reconstruction by drawing method from the facial features, 'rule of the thumb' principles for facial reconstruction, age progression on the face, relation.

UNIT-IV

1	Forensic anthropologists and mass disasters
2	Forensic Archaeology Introduction, Recovery of Forensic Evidence from individual graves, Forensic Geophysical survey, Legal matters.
3	Molecular Anthropology: Progress and Perspectives
4	Genetic Anthropology, Human migrations, modern human ancestry, Benefits and Controversies of Genetic Anthropology
5	Ancient DNA Typing: Introduction, Methods, strategies and applications, Ancient DNA markers, CCR5, ΔF508, Ancient DNA extraction: comparision of extraction methods, ancient DNA yield, ancient DNA preservation, ancient DNA degradation patterns, the age of ancient DNA, Fragment lengths of ancient DNA, storage of ancient DNA extracts.

Recommended Books	
1.	Forensic Anthropology Laboratory manual Steven Byers and Susan, Myster. Allyn and Bacon Publishers
2.	Human osteology: A laboratory and field manual William M. bass : Missouri Archaeological Society
3.	The human bone manual Tim White and Pieter Folkens Academic press
4.	Forensic Archaeology: Advances in Theory and Practice by John Hunter, Margaret Cox (Routledge Taylor and Francis Group)
5.	Ancient DNA Typing: Methods, Strategies, and Applications by Susanne Hummel (Published by Springer)
6.	Human Osteology in Archaeology and Forensic Science: In Archaeology and Forensic Science Margaret Cox, Simon Mays Cambridge University Press, 2000
7.	Anthropometry Singh, I.P. and Bhasin, M.K

MFS-P3-C4: Forensic Anthropology, Osteology and Odontology (Pr)

PRACTICAL

Total Lectures: 30 Hrs **Total Marks – 25**
Credits – 1

1.	Osteology: Human skeleton Axial and appendicular skeleton; Descriptive terminology used in osteology; Different classes of bones and their functions, features of bones; Bone identification, anatomical layout and skeletal recording
2.	Visit to crematorium: Demonstration of bone injuries
3.	Demonstration of bone and dental pathology
4.	The Skull, Clavicle scapula and ribs, Vertebral column, Humerus radius ulna, Carpals metacarpals and phalanges, Pelvis, Femur tibia, fibula, patella, Tarsals, metatarsals, phalanges
5.	Human and non-human bones case study
6.	Age and sex determination of Human skeleton
7.	Osteometry, Scapula Measurements, angles, indices Humerus Measurements, Angles and indices Humerus and femur Torsion angles, Craniometry : Measurements on cranium and face
8.	Somatometry : Landmarks on body; projective height measurements of the body in standing position measurements in sittingpositic linear and breadth measurements of upper and lower extremities, Measurements of head and face; Indices.
9.	Somatoscopy: Morphological observations of different body characters

M.Sc. Forensic Science
Syllabus-Semester IV

MFS-T4-C1: Questioned Documents

THEORY

Total Lectures: 45+15= 60 Hrs

Credits: 4
Marks:100
Semester Exam 80
Internal Assessment 20

Questioned document examination is the forensic science discipline pertaining to documents that are (or may be) in dispute in a court of law. The primary purpose of questioned/forensic document examination is to answer question about a disputed document using a variety of scientific processes and methods. The most common type of examination involves handwriting wherein the examiner tries to address concerns about potential authorship. This paper includes Nature and problems of document examination, basis of handwriting identification, identification of type writing, printing of security documents, and determination of age of document, e-document, digital signatures and opinion writing.

UNIT-I

1.	Nature and problems of document examination, classification of documents, procurement of standard admitted/specimen writings, handling and marking of documents, preliminary examination of documents.
2.	Basis of handwriting identification – individuality of handwriting, natural variation, process of comparison,
3.	Various types of documents – genuine and forged documents, holographic documents.
4.	Various writing features and their estimation, general characteristics of handwriting, individual characteristic of handwriting.
5.	Basic tools needed for forensic documents examination and their uses.

UNIT-II

1.	Disguised writing and anonymous letters
2.	Identification of a writer, Examination of signatures – characteristics of genuine and forged signature,
3.	Examination of alteration, erasers, overwriting, additions and obliterations,
4.	Various types of inks and paper, their chemical compositions, characterization and elemental analysis
5.	Decipherment of secret, indented and charred documents
6.	Examination of seal impression and the mechanical impressions.

UNIT-III

1.	Examination of black & white Xeroxed copies and colour Xeroxed copies, carbon copies, fax messages
2.	Various types of forgeries and their detection
3.	Examination built up documents – determination of sequence of strokes by microscopic examination.
4.	Physical matching of documents
5.	Identification of type writings – Identification of typist, Identification of printed matter
6.	Various types of printing of security documents, printing of currency notes, latest security feature of new Indian currency note of Rs 500 & Rs 2000, examination

	of counterfeit currency notes, passports, visa, stamp papers, postal stamps.

UNIT-IV

1.	Determination of age of documents by examination of signatures – paper ink and writing/signatures etc., by spectroscopic and chromatographic methods and statistical technique.
2.	Examination of computer print-out, identification of dot-matrix, ink-jet and laser printers, electronic typewriter, e-documents, digital signatures

Recommended Books	
1.	Rev. ED: Ordway Hilton, Scientific Examination of Questioned Documents, Elsevier, New York(1982)
2.	Albert S. Osborn, Questioned Documents, Second Ed. Universal Law Publishing, Delhi (1998).
3.	Charles C. Thomas, I.S.Q.D., Identification System for Questioned Documents, Billy Prior Bates, Springfield, Illinois (1971).
4.	Wilson R. Harrison, Suspect Documents – Their Scientific Examination, Universal Law Publishing (1997).
5.	Hard Less, H.R., Disputed Documents, Handwriting and Thumbs – Print Identification. Profusely Illustrated, Low Book Co., Allahabad (1988).
6.	Morris, Ron, N. Forensic Handwriting Identification, Acad. Press, London (2001).
7.	Lerinson Jay, Questioned Documents, Acad. Press, London (2001).
8.	Kurtz Sheila Grapholypes, A **N**ew Plan on Handwriting Analysis, Crown sPublishers Inc. (1983).

Suggested Reading	
1	Forensic Science International; Forensic Science International: Reports – Elsevier
2.	Science & Justice – Elsevier
3.	Australian Journal of Forensic Sciences - Taylor & Francis
4.	Journal of Forensic Science- Wiley Online Library

MFS-P4-C1: Questioned Documents (Pr)

PRACTICAL

Total Lectures: 30 Hrs	**Credits: 1** **Marks:25**

1.	Sequence of different colour strokes
2.	Ink Differentiation by UV-Vis & FTIR spectrophotometer
3.	Identification of individual and class characteristics of a writer from five writings
4.	Display of characteristic features of forgery in a document
5.	Identification of movements, speed, form of letters in a piece of writing
6.	Dating of Ink by using FTIR analysis
7.	Display of type writings with its elements of analysis i.e. letter design, vertical and horizontal alignments, wear and tear marks
8.	Identification of alteration, addition, and subtraction in a piece of writing

9.	Analysis of Paper fibres.
10.	Examination of counterfeit currency by using microscopy and UV light
11.	Decipherment and detection of indentations in a document.
12.	Decipherment of secret writing in a piece of writing.
13.	Decipherment and identification of invisible pen writing ink in a piece of writing
14	To analyse handwriting and its applications towards the identification of writer
15	To study the identifying features of a typist
16	Dating of typewriters
17	To study the characters of documents printed by different printers

Perform any 12 practical

MFS-T4-C2: Computer Forensics

THEORY

Total Lectures: 45+15= 60 Hrs

Credits: 4
Marks:100
Semester Exam 80
Internal Assessment 20

Computer forensics is a branch of forensic science pertaining to legal evidence found in computers and digital storage media. Computer forensics is also known as digital forensics. Computer Forensic includes Principles of Computer, methods of scoring data, Hardware Passwords and encryption techniques, seizure of computers, investigation on various imaging methods, forensic examination procedure for storage media, Cyber Crimes, overview of several operating systems, registries and Linux basics.

UNIT-I

1.	Principles of Computer: Memory and processor, address and data buses, stored program concept. Basic electrical safety, Motherboards, Start of boot sequence, Power on Self Test (POST), BIOS and CMOS, MSDOS, Windows 95/98/ME, Windows NT/2000/XP and Mac operating systems.
2.	Methods of storing data: number systems, character codes, record structures, file formats and file signatures. Word processing and graphic file formats.
3.	Hardware: Development of the hard disk, Physical construction, CHS and LBA addressing, Encoding methods and formats, IDE and ATA specifications, overcoming the 528 MB, 8 GB and 127 GB limitations, Dynamic drive overlays. Boot sector, partition table, slack space and free space, Disk mapping.

UNIT-II

1.	The logical structures of the Microsoft operating system FAT file system. The DOS and Windows boot process. How to recover deleted files. The significance and determination of the creation date and time. Passwords and encryption techniques: Importance of keeping a log, Explanation of passwords keys and hashes,

2.	Seizure of computers: Preparations to be made before seizure, Actions at the scene, Treatment of exhibits. How to make bitstream (exact copies) of the original media.
3.	Investigation: Investigating on various imaging methods. Lay down the image provided onto a hard disk and provide a disk map of the suspect drive. Extraction of all relevant information from a hard disk.
4.	Instruction on the acquisition, collection and seizure of magnetic media. How to best acquire, collect or seize the various operating systems. Legal and privacy
	issues.
5.	Forensic examination procedures. Preparing and verifying forensically sterile storage media.

UNIT-III

1.	Definition and types of Cyber crimes
2.	HTML and other Internet protocols, Internet History and Topology, Internet Services and Access, Internet Protocols and Addressing, E-Mail and Header Interpretation, E-Mail Attachments, FTP, Telnet and IRC, Internet Chat, HTTP.
3..	Outlook Express, Virus and Trojan infection, Different types of attacks, Internet Research & Investigative Tools.

UNIT-IV

1.	Overview of several operating systems including: Windows NT/2000/XP, Linux, DOS, Windows 95/98
2.	Registries: Use of registry viewers, use of Regedit and WinHex; Typed URLs; understanding of User Assist; Mounted Devices, Event Log; extracting USB related artifacts; understanding and examination of protected storage.
3.	Linux Basics: File system layout, system management and security concepts. Accessing devices, partitions, and file systems. Using a desktop (GUI) environment, and introducing common desktop applications. The shell and common command-line utilities, Understanding Linux Kernels, distributions, graphical environments and available options, Installing and configuring Linux and Linux applications.

S.No.	**Recommended Books**
1.	Hand book of computer crime investigation, Eoghan Casey, Elsevier.2001
2.	Computer crime-A crime fighter's hand book, David Icove, K. Seger and W.Vonstorch, O'reily&Alseriates, Inc.1995
3.	Digital evidence and computer crime-Forensic science, computers and the internet, Casey, Academic press.3rd Ed. 2011
4.	Computer forensics-Computer crime scene investigation, John R. Vacca, Firewall Media, New Delhi.1st Ed. 2015
5.	Computer evidence-Collection and preservation, Christopher L.T. Brown, FireWall Media, New Delhi.2005
6.	Cyber forensics-A field manual for collecting, examining and preserving of computer crimes, A.J. Marcella, Robert S. Greenfield, Auerbach publications.1st Ed.2012
7.	Cybercrime, Doughless Thomas and Brian D.Loader.
8.	Cybercrime, Doughless Thomas and Brian D.Loader.1st Ed. 2013
9.	A practical guide to LINUX, Sober.3rd Ed. 2012
10.	Computer forensics-Incident response essentials, Warren G.KruseIIand Jay G.Heiser., Addison Wesley, 2001

11.	Cybercrime investigation field guide, Bruce Middleton, Auerbach publications.1st Ed.2001

Suggested Reading	
1.	Forensic Science International; Forensic Science International: Reports; Forensic Science International: Digital Investigation- Elsevier

2.	Digital Investigation: Elsevier
3.	Journal of Digital Forensic Practice: Taylor &francis
4.	Science & Justice - Elsevier
5.	Australian Journal of Forensic Sciences - Taylor & Francis

MFS-P4-C2: Computer Forensics (Pr)

PRACTICAL

Total Lectures: 30 Hrs		**Credits: 1** **Marks:25**
1.	Detailed analysis of FAT 12, FAT 16, FAT 32 and NTFS file systems.	
2.	Practical exercises in dismantling and re-building PCs.	
3.	Practical recovery of such data using methods to preserve its integrity. Methods of recovering deleted files. Copying and imaging	
4.	Methods of hiding data on hard and floppy disks	
5.	A series of practical lab exercises designed to demonstrate how to access forensic artifacts within hard disk drives and to develop the student's skills in forensic analysis.	
6.	Finding and documenting data and files in unallocated space.	

MFS-T4-DES-P: Forensic Audio-Video Analysis

THEORY

Total Lectures: 45+15= 60 Hrs

Credits: 4
Marks:100
Semester Exam 80
Internal Assessment 20

Forensic Audio Video analysis is the scientific examination, comparison and /or evaluation of audio-video in legal matters. This paper includes Audio Level measurement; noise characteristics sound recording play back devices, authentication of recorded audio, introduction to video technology component of Digital Image processing, Image enhancement, restoration, Forensic analysis of audio/Video in Video recording Basic Factors of sound in speech, Acoustic speech production, Phonetic aspects of speech speaker identification etc.

UNIT-I

1.	Audio Level Measurement: Voltage, Decibels, Audio line levels, Frequency measurements, range, Spectrum Analysis, Basic Electric Circuits
2.	Noise Characteristics: Noise Model, Properties of Noise, Additive Noise, Convolution Noise, Acoustic Characteristics of Environments, Conventional Filters, Digital Filters, Adaptive noise cancellation, Audio- enhancement
3.	Sound Recording/Playback Devices: Analog Tape recorders, Digital recorder, Microphone Types & Advantages/disadvantages, Digital audio formats.
4.	Authentication of recorded audio: Type of alterations, Auditory Examination by Critical Listening. Waveform analysis, speech Spectrographic analysis. Magnetic developing, Optical Method.

UNIT-II

1.	Introduction to Video technology: Video standards, Recording formats- Analog and Digital, Introduction to Video devices, Linear and Non-linear Editing, Concept of

	Video film Production, Graphics and animation technique.
2.	Introduction to component of Digital Image Processing: Introduction to Image processing & Computer Graphic, Image perception, Colour space & representation, Storage, Image Processing Application.
3.	Introduction to Image enhancement, Image restoration, Integrity of Images, Concept of Digital Water marking, Facial Image Recognition, Image Compression.
4.	Forensic Analysis of Audio/Video in Video recording: Falsification in Video Recording, Visual Examination technique on Video frame sequence, Instrumental Method-Waveform-Vectroscope, Cross-pulse Monitor, Videogrametry and Photogrametry technique, Video image analysis-Object, costumes, Facial Image recognition from video frame image.

UNIT-III

1.	Basic Factors of Sound in Speech: Physics of Sound, Components of speech sound, Speech Signal- Analogue & Digital, Fourier Analysis, Fourier transforms.
2.	Acoustic Speech Production: Speech Anatomy- Animal Vs Human, Organs of speech-Respiratory System, Phonatory System, Articulatory System, Mechanism of speech Production-Vibration Mechanism of Vocal Folds, Acoustic Properties of Vocal Tract,
3.	Phonetic Aspects of Speech: Articulators-Active/Passive, Articulation- Manner & Place of Articulation, Phonemes, Segmental & Supra-segmental, Sound of speech-Vowel, Consonant and Glides, IPA (The International Phonetic Alphabets) Forensic Phonetics, Phonetics in Speaker Identification, Co-articulation, Effect of context,Supra segmental (Prosodic features)-Stress, Tone, Intonation, Duration, Syllables, Nasalisation, Accent features, Psychological Stress.
4.	Speaker Recognition: Principles of speaker recognition/ identification, Methods on Speaker Recognition, Aural, Sound Spectrographic, Automatic Method, Various approaches in Forensic Speaker Identification, Interpretation of result, Statistics interpretation of probability scale, Objective/Subjective methods, Concept of test and error in Speaker Identification, Present Scenario.

UNIT-IV

1.	Introduction to Digital Signal Processing: Digital/Analog signals, Signal Processing, Types of processing, Signal Processing Applications, Signal Processing Systems,
2.	A/D Signal Processing Model, Computer Representation of Speech, A to D Conversion- Sampling, Quantization, Digital Audio Formats, Pulse Code

	Modulation, Coding and Decoding.
3.	Introduction to Pattern recognition Application in Automatic Speaker Identification and Verification System.
4.	Legal status in India and Abroad: Historical Background on Speaker Identification in USA, European countries and India. Judgment of Supreme Court of India on report of Speaker Identification. Court presentation of report based on speaker Identification. Ear witness-Speaker Profiling, Speaker Line-up.

Recommended Books	
1.	Forensic Voice Identification, Harry Hollien, Academic Press, London. 1st edition, 2001
2.	The Physics of Speech, D.B. Fry, Cambridge University Press.1979
3.	The Acoustics of Crime- The New Science of Forensic Phonetics, Harry Hollien, Plenum Press, New York and London, 1990
4.	Speech Sounds, Patricia Ashby, Routledge, London and New York 2nd edition.
5.	The Complete Book of Video Techniques Subjects Equipment, David Cheshire, Dorling Kindersley, London,1990
6.	Digital Audio Restoration, Simon J. Godsill and Peter J.W. Rayner, Springer, 1998
7.	Illustrated Dictionary of Moving Image Technology, 4th Edition, Martin Uren, Focal Press, Daystar Publications, 3/4, Raisina Road, New Delhi 2013
8.	A Laboratory Manual on Bilogical Anthropology and Anthropometry, Indera P. Singh and M.K. Bhasin, Kamla-Raj Enterprises, 2273, Delhi,1989
9.	Forensic Uses of Digital Imaging, John C. Russ, CRC Press,2nd Ed. 2016
10	A Simplified Approach to Image Processing, Randy Crane, Prentice Hall PTR New Jersey,1996

Suggested Reading	
1.	Forensic Science International; Forensic Science International: Reports - Elsevier
2.	Int. Journal Multimedia and Image Processing: Springer
3.	Science & Justice - Elsevier
4.	Australian Journal of Forensic Sciences - Taylor & Francis
5.	Journal of Forensic Science- Wiley Online Library

MFS-P4-DES-P: Forensic Audio-Video Analysis (Pr)

PRACTICAL

Total Lectures: 30 Hrs	**Credits: 1** **Marks:25**
1.	Recording the voice of a speaker using a tape recorder and measures for keeping it in the safe custody.
2.	Making a working copy of the recording in appropriate format in analog mode.
3.	Recording the speech sample of a speaker using digital audio tape recorder.
4.	Measures to be taken care during recording the specimen speech sample of a suspect.
5.	Digitization of analog speech sample.
6.	Segregation of speech sample.
7.	Transcription of speech sample using IPA symbols.
8.	Selection of verbatim for speaker identification.
9.	Extraction of audio from a video recording.

10.	Anthropometric measurements in facial recognition from a still image/ photograph.

MFS-T4-DES-C: Forensic Explosives
THEORY

Total Lectures: 45+15= 60 Hrs

Credits: 4
Marks:100
Semester Exam 80
Internal Assessment 20

An explosive is a substance that contains a great amount of stored energy that can produce a sudden expansion of the material after initiation, usually accompanied by the production of light, heat, sound, and pressure. This paper covers up all the essentials of different explosive material and further includes the explosive devices, assessment of properties, effects of explosives, assessment of damage, explosive detection and laboratory examination of post blast debris.

UNIT-I

1.	History of Explosives (Milestones)
2.	Explosive and explosion: Definition, Components, Theory of explosion: deflagration, detonation, mechanism
3.	Classification: Inorganic and Organic, Condensed and Dispersed, Deflagrating and Detonating, Low and High (Chemistry and synthesis, illustrated), Primary and Secondary
4.	Composite explosive: Intensive and novel explosives, Non-military explosives, Liquid and foam explosives Nuclear explosions: Introduction
5.	Non-explosive explosions: Mechanical, Thermal, Electrical, Aerosol
6.	Explosive Devices: Initiation, Safety fuses, Detonators, Detonating Cord, Shock tubes, Explosive train

UNIT-II

1.	Pyrotechniques: Basics and chemistry Improvised Explosive devices (IEDs): Basics, Initiation, Mechanism, Types
2.	Properties of explosives: Strength or power of explosives, Brisance, Sensitivity or specificity of explosives, Relative effectiveness factor, Stability, Density, Volatility, Hygroscopicity, Oxygen balance, Toxicity, Melt cast
3.	Shock wave/blast wave: Generation of the shock wave, Characteristic, Effect of mach reflections, Effect of confinement, Channelling of blast wave
4.	Explosion effects-types: Blast pressure: Positive and Negative, Thermal, Fragmentation, Ancillary
5.	Physics of explosion hazards; Thermo-chemistry of explosives, The Explosion process, Types of hazard

UNIT-III

1.	Blast injuries: Primary- (Direct) blast wave exposure Secondary- Blast energized bomb fragments and other debris (shrapnel) Tertiary- Abrupt deceleration of the body- indirect blast wave effect Quaternary- Collapse of building
2.	Assessment of Damage: Importance, Value to be attached to damage observations, Importance of the Site of the Explosion centre, Significance of Pressures, Fragmentation: Information from fragments

	Explosion site – Location; Scene of explosion - Planning

3.	Laboratory examination of Post Blast Debris: Physical examination, Microscopic, Search and Sorting, Extraction Scheme
4.	Comprehensive laboratory examination of Explosive Substances: Recovery and clean-up, Chemical tests: Acidic and basic radicals, Color tests and TLC
5.	Crime investigation related to explosions: Laboratory capabilities, Reading the Bomber's signatures (case study)

UNIT-IV

1.	Explosive Detection : Issues, Threats and Problems (i) Trace/Vapor Detection: Trained Animals, GC-ECD (adsorption and pre-concentartion) Ion mobility spectrometry (IMS), Bio/Chemiluminescence
2.	(ii) Bulk Detection: X-ray imaging, Backscatter imaging Detection with energetic protons, Thermal neutron activation (TNA), Fast neutron analysis (FNA)
3.	Taggants-Tagging of Explosives
4.	Analysis and detection of explosives by Mass Spectrometry: RDX TNT

Recommended Books:	
1.	Yinon, J., &Zitrin, S. (1996). Modern methods and applications in analysis of explosives. John Wiley & Sons.
2.	Thurman, J. T. (2016). Practical bomb scene investigation.
3.	Marshall, M., & Oxley, J. C. (Eds.). (2011). Aspects of explosives detection. Elsevier.
4.	Meyer, R., Köhler, J., & Homburg, A. (2016). Explosives. John Wiley & Sons.
5.	Svehla, G. (2008). Vogel's Qualitative Inorganic Analysis, 7/e. Pearson Education India.
6.	J Mendham, R C. Denney, J D. Barnes, & M Thomas. (2000). Vogel's textbook of quantitative chemical analysis. prentice hall.
7.	Spectrometric Identification of organic Compounds (8^{th} Edition), by Robert M. Silverstein and Francis X. Webster, published John Wiley & Sons, Inc. New York.2014.
8.	Instrumental Methods of Analysis(7^{th} Edition) by Hobart H. Willard, Lynne L. Merritt, Jr., John A. Dean and , Frank A. Settle, Jr., CBS Publishers & Distributors, Delhi.(Ist Indian Edition-1988).
9.	Yallop, H. J. (1980). Explosion investigation. Forensic Science Society.
10.	McLafferty, F. W., Tureček, F., &Turecek, F. (1993). Interpretation of mass spectra. University science books.
11.	Beveridge, A. (Ed.). (2011). Forensic investigation of explosions.
12.	Elsayed, N. M., & Atkins, J. L. (2010). Explosion and blast-related injuries: effects of explosion and blast from military operations and acts of terrorism.
13.	Yinon, J. (Ed.). (2020). Forensic Applications of Mass Spectrometry. CRC Press.
14.	Watson, J. T., & Sparkman, O. D. (2013). Introduction to Mass Spectrometry: Instrumentation, Applications, and Strategies for Data Interpretation. John Wiley & Sons.

Suggested Reading	
1.	Science & Justice - Elsevier
2.	Talanta - Elsevier
3.	Journal of Forensic Sciences- American Academy of Forensic Sciences
4.	Forensic science International - Elsevier
5.	Analytical letters - Taylor & Francis
6.	Journal of Energetic Materials - Taylor & Francis

MFS-P4-DES-C: Forensic Explosives (Pr)

PRACTICAL

Total Lectures: 30 Hrs		**Credits: 1** **Marks:25**
1.	Ion analysis of (i) Standard radicals and (ii) Radicals from explosive debris	
2.	Analysis of lab fabricated explosive samples	
3.	Chemical tests for mixtures of anions	
5.	Analysis and color test for Nitrate explosives and Black powder	
6.	TLC of RDX, TNT, NG and PETN	
7.	Analysis of Pyrotechnique mixtures	
8.	Analysis of components of crackers	

MFS-T4-DES-B: Forensic Genomics and Proteomics

THEORY

Total Lectures: 45+15= 60 Hrs

Credits: 4
Marks:100
Semester Exam 80
Internal Assessment 20

This Paper will consist of details of biomacromolecules used in forensic identification and the techniques thereof. Protein and DNA are the biomacromolecules that are extensively used in forensic identification at species level as well a individualization. In DNA forensics, you will learn DNA fingerprinting for individual level identification as well as DNA barcoding for species level identification. You will also learn about upcoming trends/developments in field like Next Generation Sequencing techniques of DNA and their applications in forensics. Automation and miniaturization in the field of DNA forensics will also be discussed. Protein Biomarkers for identification of biological fluids will be discussed, specifically their serological techniques like immunochromatography. The basics of serological techniques like antigen-antibody reaction as well as the upcoming replacements of antibodies like aptamers and affibody will also be discussed in detail. These DNA based techniques and immunochromatography based techniques are upcoming as a more convenient and robust techniques in

replacement of conventional techniques like microscopic and morphological identifications.

UNIT-I

1.	Introduction, Methods, strategies and applications DNA markers
2.	Mitochondrial, DNA the hypervariable regions and control regionV
3.	Biology of STRs, Forensic Issues
4.	Chromosomal DNA Amelogenin, Autosomal STRs, Y Chromosomal STRs, X chromosomal STRs
5.	Variable Number Tandem Repeat (VNTR's) and RFLP
6.	Single Nucleotide Polymorphism (SNP's)

UNIT-II

1.	DNA Extraction, Organic and Inorganic extraction, Comparison of Extraction methods, Commercial kits
2.	DNA Quantitation, Importance of quantitation, Spectrophotometric analysis, Agarose Gel Electrophoresis, Slot Blot Hybridization, Real Time PCR
3.	Polymerase Chain Reaction
4.	Basic PCR mechanism, Real time PCR, Primer designing
5.	Primer dimmer and Hairpins, Mismatch primers
6.	Software's packages, Multiplex PCR, PCR failures
7.	DNA degradation, Inhibition, DNA overload and Cycling

UNIT-III

1.	DNA barcoding for Species identification
2.	DNA barcoding of Plant, fungi and animals
3.	Challenges in DNA barcoding of forensic samples and their solution
4.	Databases of DNA barcodes
5.	International missions/facilities/projects on DNA barcoding
6.	Applications of DNA barcoding in forensics: drug adulteration, wild life crime, associative evindence at crime scene (wood leaf, pollen, spores, diatoms)
7.	Aptamers and affibody: forensic applications
8.	Protein engineering and invitro evolution for making proteins for forensic application
9.	Concept of antigen- antibody reaction and application to species identification
10.	Monoclonal and polyclonal antibodies

UNIT-IV

1.	NGS (next generation sequencing techniques of DNA): principles
2.	Protocols in NGS
3.	Application of NGS in forensics
4.	Automation in DNA profilling: robotics
5.	Miniaturisation in DNA profilling: microfluidics
6.	Recent developments in DNA profilling and databases

	Recommended Books
1	Fundamentals of Forensic DNA Typing John M. Butler · 2009
2	Inman, K. & N. Rudin. 1998. Introduction to Forensic DNA Analysis. CRC Press
3	Boca Raton.Griffith, H. & M. Annette, eds. 1994. PCR Technology: Current Innovations. CRC Press, Boca Raton.

4	Kirby, L.T. 1990. DNA Fingerprinting: An Introduction. W.H. Freeman, New York.
5	Krawczak, M. & J. Schmidtke. 1994. DNA Fingerprinting. Bios Scientific Publishers, Oxford.
6	Landweber, L.F. & A.P. Dobson. 1999. Genetics and the Extinction of Species: DNA and the Conservation of Biodiversity
7	Walls, H.J. 1968. Forensic science: An Introduction to the Science of Crime Investigation. Praeger, New York
8	Barker, K. 1998. At the bench: A laboratory navigator. Cold Spring Harbor Laboratory Press, New York.
9	Butler, John M. 2001. Forensic DNA Typing. Academic Press, San Diego. ISBN 0-12-147951-X. 322 pages.
10	Forensic DNA Typing Protocols
11	Baxevanis, A. D., & Ouellette, B. F. F. (2004). Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. 3rd ed. New York; Chichester: Wiley.
12	Protein Engineering and Design Sheldon J. Park, Jennifer R. Cochran 2009 by CRC Press
13	DNA Barcodes Methods and Protocols Editors: Lopez, Ida, Erickson, David L. (Eds.) 2012 Humana Press
14	Nucleic Acid and Peptide Aptamers Methods and Protocols Editors: Mayer, Günter (Ed.) 2009 Humana Press
15	Essential Forensic Biology: Animals, Plants and Microrganisms in Legal Investigation by Allen Gunn
16	Forensic Biology by Jane Schober, Richard Li, and Sue Norman

Suggested Reading	
1.	Forensic Science International; Forensic Science International: Reports - Elsevier
2.	Forensic Science International: Genetics
3.	Science & Justice - Elsevier
4.	Australian Journal of Forensic Sciences - Taylor & Francis
5.	Journal of Forensic Science- Wiley Online Library

MFS-T4-DES-B: Forensic Genomics and Proteomics (Pr)

PRACTICAL

Total Lectures: 30 Hrs

Credits: 1
Marks:25

1.	DNA Isolation, STR PCR
2.	Searching Barcode database for identification of insects
3.	Differencial extraxtion of DNA from bull semen and vaginal epithelial cells
4.	STR Analysis, Genescan, Genotyper, Genemapper
5.	Mt DNA: Sample collection, extraction
6.	Polymerase Chain Reaction, Contamination Control
7.	Gel purification of PCR Product
8.	Big Dye Sequencing PCR
9.	PCR cleanup, Set up, Sample loading Sequencing on Genetic Analyzer
10.	Sequence analysis, BLAST Search, troubleshooting
11.	Independent sequencing projects, practice on analysis of STR profiles of mixed sample degraded sample and identification of STR artifacts