

Rayat Shikshan Sanstha's
YASHAVANTRAO CHAVAN INSTITUTE OF SCIENCE,
SATARA

(AUTONOMOUS)

Lead college

of

Karmaveer Bhaurao Patil University, Satara

Syllabus For

Master of Science

Part - II

FORENSIC SCIENCE

Syllabus to be implemented w.e.f. June 2024

as Per NEP-2020

Preamble:

This syllabus is framed to give advanced knowledge of Forensic Science to Postgraduate students in the first year of two years of M.Sc. degree course. In order to keep pace with the advancement of forensic science and development of new investigative and analysis techniques, there has been a quantum jump in the demand for forensic personnel. The new syllabus is based on a basic and applied approach with vigor and depth. At the same time precaution is taken to make the syllabus comparable to the syllabi of other universities and the needs of forensic science laboratory and research. The syllabus is prepared after discussion at length with a number of faculty members of the subject and experts from industries and research fields. The units of the syllabus are well defined, taking into consideration the level and capacity of students.

Credit Framework for M.Sc. II

Structure of Course: M.Sc. – II

Semester – III

Level	Semester	Course Code	Course Title	No. of Lectures Per Week	Credits
		Discipline Specific Courses (Mandatory)			
6.5	III	MFST 531	Forensic Biology, Serology and DNA Profiling	4	4
		MFST 532	Forensic Toxicology and Pharmacology	4	4
		MFST 533	Forensic Medicine and Anthropology	4	4
		Discipline Specific Elective (Choose Any one among two)			
		MFST 534 E-I	E-I) Cyber Forensic and Cyber Security	2	2
		MFST 534 E-II	E-II) Forensic Chemistry and Toxicology		
		MFSP 535	Research Project	-	6
MFSP 536	LAB- III (based on MFST-531, 532 and 533)	4	2		
Total					22

Structure of Course: M.Sc. – II

Semester –IV

Level	Semester	Course Code	Course Title	No. of Lectures Per Week	Credits
		Discipline Specific Courses (Mandatory)			
6.5	IV	MFST 541	Forensic Physics and Ballistics	4	4
		MFST 542	Questioned Document and Fingerprint	4	4
		MFST 543	Forensic Serology	4	4
		Discipline Specific Elective (Choose Any one among two)			
		MFST 544 E-I	E-I) Cyber Cloud Security	4	4
		MFST 544 E-II	E-II) Forensic Toxicology and Extraction Methods		
		MFSP 545	On Job Training (OJT)	8	4
MFSP 546	LAB- IV (based on MFST-541, 542 and 543)	4	2		
Total					22

SEMESTER III**MFST 531: FORENSIC BIOLOGY, SEROLOGY AND DNA PROFILING****Course Objectives: student should be able to:**

1. Learn the scope of forensic biology
2. Understand the basic concepts of human genetics
3. Learn the Immuno-chemical Technique.
4. Understand the techniques in bioinformatics

Credits=4	MFST 531: FORENSIC BIOLOGY, SEROLOGY AND DNA PROFILING	No. of hours:60
UNIT I	BioMolecular Techniques	15
	<p>1.1 Fundamentals of biology- scope of forensic biology, structure and functions of cell, basic concepts of anatomy and physiology of the skeletal system.</p> <p>1.2 Centrifugation Techniques- Basic concepts of human genetics, DNA profiling structure, function and analysis- history of DNA fingerprinting, molecular biology of DNA, variations, polymorphism DNA typing system- RFLP analysis, PCR amplification, sequence polymorphism, Forensic significance of DNA profiling.</p> <p>1.3 Molecular Biology Techniques- Outline of Genetic Manipulations, Enzymes and in genetic manipulation, cloning procedures, isolation of specific nucleic acid sequences – complementary DNA, Gene libraries, colony hybridization, Nick translation, Oligonucleotide probes, Expression of genes.</p>	
UNIT II	Immunological Techniques	15

	<p>2.1 Immuno-chemical Technique- Gel immuno-diffusion, Immunoelectrophoresis, complement fixation, Radioimmunoassay (RIA), ELISA, Fluorescence immuno assay. Enzyme Techniques- Enzyme kinetics, Purification and protein estimation, Enzyme assay technique, Visible & Ultraviolet Spectrophotometric methods, Luminescence method, Radio-isotope method,</p> <p>2.2 Immuno-chemical method, Automated enzyme analysis, Immobilized enzymes. Introduction to bioinformatics and its application in forensics. Integrated information retrieval. Major databases in bioinformatics. Sequence alignment, Phylogenetic analysis and related tools.</p> <p>2.3 Gene identification and prediction. FASTA and BLAST algorithm. Bioinformatics analysis of DNA Microarray, Bioinformatics tools of forensic applications Clustal family, BioEdit, MEGA, Arlequin, Protein structure prediction and visualization tools.</p> <p>2.4 Tools used in proteomics, In-silico simulation for molecular biology experiments. Basic theory of probability and statistics. Bayesian analysis. Likelihood ratio. Statistical evaluation of DNA profiles using Bioinformatics tools.</p>	
UNIT III	Body Fluids	15
	<p>3.1 Hairs and fibers- morphology and biochemistry of human and animal hair and its microscopic examination, determination of origin, race, site. Types of fibers- forensic aspects of fiber examination, fluorescent, optical properties, refractive index, birefringence, dye analysis etc. Identification and comparison of man-made and natural fibers.</p> <p>3.2 Composition and examination of body fluids - blood, semen, saliva, vaginal fluid, urine, sweat and menstrual blood and identification using current and emerging techniques..</p>	
UNIT IV	Forensic Botany and Wildlife Forensic	15

	<p>4.1 Forensic botany- various types of woods, timber varieties, seeds and leaves- their identification and matching. Diatoms- types, morphology, methods of isolation from different tissue and forensic importance of planktons- especially diatoms, forensic significance in drowning cases. Study and identification of pollen grains, starch grains, powder stains of spices etc. Paper and pulp identification, microscopic and biochemical examination of pulp material. Isolation, classification and identification of microbial organisms.</p> <p>4.2 Wildlife forensic- introduction and importance of wildlife, wildlife species identification and examination of physical evidence by conventional and modern methods, identification of pug marks of various animals, wildlife/ environment protection act.</p> <p>4.3 Forensic entomology- general entomology, significance of terrestrial and aquatic insects if forensic investigation and their role in crime detection, insect succession and its relationship to determine time since death. Impact of ecological factors on insects' developments.</p>	
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Course Outcomes: After completion of syllabus, student will be able to:

1. Understand the Fundamentals of biology, Basic concepts of human genetics
2. Understand the Immuno-chemical Technique, examination of body fluids, Hairs and fibers
3. Understand the Forensic botany and wildlife forensic
4. Apply knowledge of forensic biology to analyze biological evidence recovered at crime scenes.

References:

1. Goodwin, William; "An Introduction to Forensic Genetics", John Wiley & Sons Ltd., 2007.
2. Kapur, V; "Basic Human Genetics", Jaypee Brothers, 1991.
3. Kothari, Manu L; "Essentials of Human Genetics", University Press (India) Pvt. Ltd., 2009.
4. Singh B.D.; "Fundamentals of Genetics", Kalyani Publishers, 2006.
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7. Altenburg, Edgar; "Genetics", Oxford & IBH Publishing Co., 1970.
8. GJV Nossal; "Antigens, Lymphoid Cells and the Immune Response", Academic Press, 1971.
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10. Boorman, Kathleen E & Churchill; "Blood Group Serology", Livingstone, 1977.
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12. Sussan, Leon N & Charles Thomas; "Paternity Testing by Blood Grouping", 1968.
13. Prakash, M; "Physiology of Blood", Anmol Publications, 1998.
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15. Franklins Stahl; "The Mechanism of Inheritance", Prentice Hall, 1969.
16. Gell, P.G.H; "Clinical Aspects of Immunology", Blackwell Scientific, 1975.
17. Hosetti, B.B; "Concept in Wildlife Management", Daya Publishing House, 2005.
18. Lince, Adrian; "Forensic Science in Wildlife Investigation", CRC Press, Taylor & Francis, 2009.
19. Baalu, T.R.; "The Wildlife Protection Act, 1972", Nataraj Publication, 2001.
20. Universal Publication; "Wildlife (Protection Act, 1972)", Universal Publication, 2005.
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23. N. Clifford; "Timber Identification", Leonard Hill Ltd., 1957.
24. G. Erdtman; "Pollen Morphology & Plant Taxonomy: Angiosperms (an introduction to Palynology)", Hafner Publishing Co., 1971.
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26. Heather Miller Coyle; "Forensic Botany", CRC Press, 2005.
27. Herbert L. Edlin; "A manual of Wood Identification", Viking Press, 1976.
28. H.C. Long; "The Poisonous Plants", Asiatic Publishing House, 1994.
29. Katherine Paddock Hess; "Textile Fibres & their use", Oxford & IBH Publishing Co., 1974.
30. Simon Ball; "Environmental Law- The Law & Policy relating to Protection of Environment", Universal Law Publishing Co., Delhi, 1991.
31. B.P. Pandey; "Plant Anatomy", S. Chand & Co., New Delhi, 1998. 16.X-Ray Manual by WCCB, 2013.

MFST 532: FORENSIC TOXICOLOGY AND PHARMACOLOGY**Course Objectives: student should be able to:**

1. Make the student aware about Forensic Pharmacology.
2. Enhance the knowledge of Extraction of poisons and Drugs.
3. Enhance the knowledge of Toxicology.
4. Make the student aware about Quality Management and Forensic Statistics.

Credits=4	MFST 532: FORENSIC TOXICOLOGY AND PHARMACOLOGY	No. of hours: 60
UNIT I	Forensic Toxicology	15
	<p>1.1 Forensic toxicology: introduction and concepts of forensic toxicological examination and its significance. Law relating to poisons.</p> <p>1.2 Poison: classification, mode of action and factors modifying the action of poisoning, medico-legal procedures in poisoning, antidotes, signs and symptoms of poisoning, collection and preservation of viscera in fatal and survival cases. Submission of samples to the laboratory, and postmortem examination report/findings studies, specific analysis plan/ approach to toxicology examination of poisoning samples.</p>	
UNIT II	Extraction Techniques	15
	<p>2.1 Extraction, isolation and clear up procedure using conventional as well as modern techniques such as solid-phase micro extraction techniques, separation of poison and drugs using chromatographic and electrophoretic techniques,</p> <p>2.2 identification and estimation of poison and drugs using chromatographic, spectrophotometric, and other instrumental methods, ingestion of drugs and their metabolism in the body, the significance of analytical studies with respect to forensic examination.</p>	
UNIT III	Poison Analysis	15

	<p>3.1 Examination of metallic poison, Plant poison, volatile poisons, snake venom, insects bites poisons involving animal poisons cases and their examination,</p> <p>3.2 interpretation of toxicological findings and preparation of reports, limitation of methods and troubleshooting in toxicological examinations, disposal of analyzed samples, some interesting cases of common and specific poisons and their importance in view of the specific scientific approach in examinations.</p>	
UNIT IV	Fornesic Pharmacology	15
	<p>4.1 Forensic pharmacology- forensic pharmacological studies, absorption, distribution, metabolism, pathways of drug metabolism,</p> <p>4.2 drug metabolism and drug toxicity, excretion of drugs and poisons, detection of poison on the basis of their metabolic studies, interpretation of analytical data and formation of opinion.</p>	

Course Outcomes: After completion of syllabus, student will be able to:

1. Understand the concepts of forensic toxicological examination
2. Apply the knowledge of Extraction and isolation of poisons for analysis of forensic evidences
3. Analyze forensic samples related to metallic poison, Plant poison, volatile poisons and animal poisons
4. Understand the concepts of Forensic pharmacology and its application in forensic evidence examination

References:

1. Curry A.S; "Analytical Methods in Human Toxicology: Part II", CRC Press Ohio, 1986.
2. Curry, A.S; "Poison Detection in Human Organs", C Thomas Springfield
CRC Press, 1976. Page 96
3. Clarke G.C; "Isolation and Identification of drugs", Vol.1 and Vol.2, Academic Press, 1986
4. Niesink R.J.M; "Toxicology- Principle and Application", CRC Press, 1996.
5. Sunshine I; "Handbook of Analytical Toxicology", CRC Press, 1969.
6. Parikh C.K; "Text Book of Medical Jurisprudence, Forensic Medicine and Toxicology", CBS Publ. New Delhi, 1999.

7. "Laboratory Procedure Manual, Forensic Toxicology", Directorate of Forensic Science MHA Govt ,2005.
8. Steward and Stolman; "Toxicology", Vol.1 and Vol. 2
9. Michel J Detal; "Handbook of toxicology", CRC Press Publication, USA 1995.
10. Casarett ,LJ and Doul John; "Toxicology: The Basic Science of Poison", Macmillan Publishing Co. New York, 1975.
11. Carvey R.H & Baselt R.C; "Introduction to Forensic Toxicology and Biochemicals", Publ. Davis C.A, 1981.
12. Chadha PV; "Handbook of Forensic Medicine and Toxicology", J.P Brothers New Delhi, 2004.
13. Modi Jaisingh P; "Textbook of Medical Jurisprudence and Toxicology" M.M. Tripathy Publications, 2001.
14. The Poisonous Spectrum: Understanding Toxicity by Mr. G.A. Varade (Author), Capt. Prof. Dr. S.T. Gaikwad (Editor), Dr. S.R. Bankar (Editor), Mr. R.K. Manjul (Editor), Mr. A.R. Pagare (Editor), Prof. Dr. D.M. Suryawanshi (Editor), Mr. S.M. Gage (Editor), Mr. D.N. Gaikwad (Editor) , 2024
15. A Concise in Forensic Toxicology by by Mr. G.A. Varade (Author), Capt. Prof. Dr. S.T. Gaikwad (Author), Mr. D.N. Gaikwad (Author), Dr. S.B. Kamble (Author), Prof. Dr. D.M. Suryawanshi (Author), 2023

MFST 533: FORENSIC MEDICINE AND ANTHROPOLOGY**Course Objectives: student should be able to:**

1. Study the science of forensic medicine.
2. Study the basics of Forensic Medicine and its forensic significance.
3. Study the basics of anthropology.
4. Study the medico legal aspects.

Credits=4	MFST 533: FORENSIC MEDICINE AND ANTHROPOLOGY	No. of hours: 60
UNIT I	Forensic Anthropology	15
	1.1 Forensic anthropometry and osteometry somatoscopy including determination of race. 1.2 Portrait parley and its use in crime investigation. Reconstructions of mutilated faces- identikit and photo fit reconstruction.	
UNIT II	Anthropometric Techniques	15
	2.1 Bone: Identification of bones- morphological, anatomical and chemical characteristics. Determination of site, age, sex, race and species origin from bones. 2.2 Determination of stature from long bones. Personal identification: By photographic superimposition technique. Video superimposition. Roentgenographic cephalometry. 2.3 Comparison of measurements on photograph and roengenograph of deceased. From bodily tattoo marks, mole etc.	
UNIT III	Medical Jurisprudence	15
	3.1 Medical jurisprudence: introduction, identification of mutilated bodies, fragmentary remains and bones. Medico legal autopsy (post mortem examination, rules for pm examination, disposal of dead body, pm examination report and opinion), exhumation. 3.2 Medico legal aspects of death Death from asphyxia- (hanging, strangulation, throttling, suffocation and drowning) Death from starvation, cold, heat, electricity etc. Infanticide. Forensic odontology- dentition pattern,	

	types and structure of teeth, age determination, identity of person, role in mass disaster, disease of teeth and their significance in personal identification	
UNIT IV	Wounds and Forensic Psychology	15
	<p>4.1 General and medico legal aspects of injuries- (abrasions, bruises, lacerations, incised wounds, stab wounds , firearm injuries, defense wounds, and fabricated injuries) Regional injuries, traffic accidents, thermal injuries.</p> <p>4.2 Medico legal aspects of sexual offenses. Forensic psychology and investigation techniques: forensic psychiatry (insanity), criminal profiling, polygraph (lie detector), narco analysis, brain fingerprinting, forensic hypnosis, voice stress analysis and speaker profiling.</p>	

Course Outcomes: After completion of syllabus, student will be able to:

1. Understand the concept of anthropometry, osteometry and somatoscopy
2. Apply the knowledge of forensic anthropology for determination of age, race and sex for personal identification of skeletal remain.
3. Understand various aspects of Medical jurisprudence
4. Understand and apply the medicolegal aspects of injuries, burns, PM, sexual offenses and Forensic psychology.

References:

1. Review of Forensic Medicine and Toxicology- Book by Gautam Biswas, 2008.
2. Principles of Forensic Medicine and Toxicology – Book by Rajesh Bardale..2002
3. Textbook of Forensic Medicine and Toxicology, Nagesh kumar G Rao, Jaypee Publishers, 1999.
4. Textbook of Forensic Medicine and Toxicology, Anil Aggrawal, Avichal Publishing Company, 2014.
5. International Standard on General requirements for the competence of testing and calibration laboratories, 1st Ed., 1999-12 15, ISO/IEC 17025:1999(E).
6. Fundamentals of Forensic Science, Max M. Houck, Jay A. Siegel, Academic Press Publishers, 2010.
7. Introduction to Forensic Anthropology, Steven N. Byers, Pearson

- /Allynand Bacon,2011.
8. Forensic Anthropology Laboratory Manual, Steven N. Byers, Pearson Education,USA,2011.
 9. Forensic Anthropology: Current Methods and Practice,Angi M.Christensen, Nicholas V.Passalacqua and Eric J.Bartelink, Academic Press,USA,2014.
 10. Parikh's Textbook of Medical Jurisprudence, Forensic Medicine and Toxicology: C.K.Parikh, CBS Publishers & Distributors Pvt.Ltd.,India,1999
 11. Forensic Medicine: Guharaj,P.V., ChandranM.R, 2ndEd., Universities Press (India) Pvt.Ltd., Hyderabad,2006
 12. Fundamental of Forensic Anthropology, Linda L.Klepinger, Ajohn Wiley and Sons Inc.Publishers,USA,2006.

MFST 534 E I: CYBER FORENSIC AND CYBER SECURITY**Course Objectives: student should be able to:**

1. Understand the Metasploit framework.
2. Study the Bitcoin & Block chain concept.
3. Understand the application of hash function
4. Study the types of Classical cipher

Credits=2	MFST 534 E I: CYBER FORENSIC AND CYBER SECURITY	No. of hours: 30
UNIT I	Fundamentals of Metasploit framework	
	1.1 Fundamentals of Metasploit framework 1.2 Metasploit History, Metasploit Architecture, Hardware Prerequisites, Metasploitable. 1.3 Metasploit Exploits, Metasploit Payloads.	7
UNIT II	Classical Ciphers	
	2.1 Classical Ciphers 2.2 Caesar Cipher, Vigenere Cipher, Rail fence Cipher, Row Transposition Cipher. 2.3 Confidentiality, Integrity, Availability, Non-Repudiation. 2.4 Advanced Encryption Standard (AES).	8
UNIT III	Bitcoins & Blockchain	
	3.1 Bitcoins & Blockchain 3.2 Bitcoin introduction, working, 3.3 blockchain, bitcoin wallets, bitcoin mining.	7
UNIT IV	Message authentication code and Hash Functions	
	4.1 Message authentication code and Hash Functions 4.2 Message authentication code. MD5 Secure Hash Algorithm	8

Course Outcomes: After completion of syllabus, student will be able to:

1. Learn Metasploit framework process
2. Understand the Bitcoin & Blockchain Process
3. Utilize Hash function in Cyber case investigation

4. Use types of hashes for security purpose

References:

1. Introduction to Cryptography: Principles and Applications. Springer-Verlag Berlin and Heidelberg GmbH & Co.-Delfs,H. & Knebl,H.,2002
2. Cryptography and network security: Principles and practice Boston: Prentice Hall -Stallings,W.,2004
3. The Handbook of Applied Cryptography. CRC Press.- Menezes, A.J.,Oorschot,P,2005.
4. Applied cryptography, Protocols, algorithms and source code inC. NewYork:John Wiley & Sons.–Schneier2003

MFST 534 E II: FORENSIC CHEMISTRY AND TOXICOLOGY**Course Objectives: student should be able to:**

1. Make the student aware about Forensic Chemistry, drugs and drug abuse.
2. Understand about the knowledge of beverages, trace evidences.
3. Enhance the knowledge of pigments, fibers etc.
4. Learn and about the Fertilizers, Pesticides and Other Chemicals.

Credits=2	MFST 534 E II: FORENSIC CHEMISTRY AND TOXICOLOGY	No. of hours: 30
UNIT I	Forensic Chemistry	
	1.1 Forensic chemistry: introduction, types of case/exhibits, 1.2 preliminary Vs screening, presumptive test (color and spot test).	7
UNIT II	Analysis of Beverages	
	2.1 Analysis of beverages: alcoholic and nonalcoholic, country madeliquor, 2.2 illicit liquor and medicinal preparations containing alcohol and drugs as constituents. 2.3 forensic analysis of organic and inorganic fertilizers.	8
UNIT III	Drugs of Abuse	
	3.1 Drugs of abuse; introduction, classification of drugs of abuse, drugs of abuse in sports, 3.2 narcotic drugs and psychotropic substances, designer drugs and their forensic examination, 3.3 drugs and cosmetic act, excise act, NDPS act and detective dye added.	7
UNIT IV	Trace Evidence	
	4.1 Analysis of trace evidence, cosmetics, dyes, trap related evidence material, paint, pigment, fibers, oil, fats, greases, industrial dusts chemicals and plants materials.	8

Course Outcomes: After completion of syllabus, student will be able to:

1. Understand Forensic chemistry, types of exhibits in chemistry.
2. Utilize the knowledge about Drugs, types of drugs and related Acts.
3. Apply Nanotechnology and basics of nonmaterials in crime detection techniques.
4. Analysis of beverages, trace evidence, dye, pigments etc.

References:

1. "Laboratory Procedure Manual :Petroleum Products", Directorate of Forensic Science,MHA,Govt.of India,2005.
2. "Working Procedure Manual on Chemistry",Directorate of Forensic Science MHA Govt.of India.
3. Bureau of Indian Standard Specifications related to Alcohols and Petroleum Products.Page|93
4. Welcher Frank; "Standard Methods of Chemical Analysis",6thEdition, Van Nostrand Reinhold,1969.
5. Watson C.A ; "Official and Standardized Methods of Analysis",Royal Society of Chemistry,UK,1994.
6. "Laboratory Procedure Manual Forensic Toxicology",Directorate of ForensicScience,MHA,Govt.of India,2005.
7. Narayanan,T.V; "Modern Techniques of Bomb Detection and Disposal", R.A.Security system,1995.
8. Jacqueline Akhavan; "The chemistry of explosives",Royal Society of Chemistry,UK,1998.
9. PearsonD;"Chemical Analysis of Food",Chemical Publ. Co.NewYork,1971
10. Somani SM;"Chemical Warfare Agent",CRC Press,2000.
- 11.SunYin and Kwok Yong; "Detection Technologies for Chemical Warfare Agent and Toxic Vapours",CRC Press,Washington DC,2004.
12. Yinon,J.andZitrin,S; "The Analysis of Explosives", Oxford, Pergamon,1981.
- 13.Beveridge,A; "Forensic Investigation of Explosives",Taylor & Francis,2000.

MFSP 535: Research Project (6 Credits)

Students will undertake research in specific area of his Major/Core with an advisory supported by a teacher/Faculty member. Students are required to take 6 credit Research Project for semester III under the guidance of faculty members.

Practicals: 20 (2 Credits)

Credits=2	MFSP 536 LAB- III (based on MFST-531, 532 and 533)	No. of hours: 30
	<ol style="list-style-type: none"> 1. Identification of Fibers-man-made and natural fibers. 2. To study the isolation and methods of Diatoms analysis. 3. Identification of Pugmarks by various animals. 4. Microscopic examination of Human and Animal hair. 5. To study the Microscopic analysis of pollengrains. 6. To study the PCR techniques and DNA amplifications methods. 7. To study the BLAST and FASTA techniques. 8. Determination of methanol and ethanol in alcoholic liquors.(wetest,GC,TLC) 9. Analysis of gasoline as per BIS specifications. 10. Analysis of alcoholic liquor as per BIS specifications. 11. Estimation of ethyl alcohol in blood sample by wet test, TLC, GC-HS. 12. Analysis of explosion residues (Preliminary analysis,GC,GC-MS,ion chromatography.(2Nos.) 13. Systematic analysis of pharmaceutical products as per IPC specification by using HPLC 14. To identify types of human bones. 15. To determine the origin of skeletal remains (human/animal). 16. To determine the number of individuals from skeletal remains. 17. To estimate stature from long bones. 18. To determine sex from skull and pelvis 19. To determine age from skull and teeth 20. To study the features of Bite marks. 	

Semester IV**MFST 541: FORENSIC PHYSICS AND BALLISTICS****Course Objectives: student should be able to:**

- 1) Understand about the Vehicular accidents crime scene investigation
- 2) Learn about the Forensic Speaker Identification
- 3) Understand different types of Microscope used in Forensic Analysis
- 4) Learn about the Forensic Ballistic

Credits=4	MFST 541: FORENSIC PHYSICS AND BALLISTICS	No. of hours: 60
UNIT I	Vehicular Accident Investigation	15
	1.1 Introduction, Analytical tools used, Converting Scene data into an event sequence, Basic energy methods, Basic momentum methods, 1.2 Accident analysis; Post crash movements, Collision model and Accident reconstruction calculations, Skid marks and evaluation of speed, 1.3 Occupant kinematics, Biomechanics of injuries, Tips and solution strategies. Hit and Run cases and investigation: 1.4 Nature and causes, Collection of evidence; paint, automobile window glass, Headlight- tail light, scratch marks, bulb filament, fibre and rubber, chassis and engine number, RTO registration number and related documentary clues.	
UNIT II	Forensic Speaker Identification	15
	2.1 voice production theory- vocal anatomy, speech signal processing and pattern recognition- basic factors of sound in speech acoustic characteristics of speech signal, 2.2 Fourier analysis, frequency and time domain representation of speech signal, analogue to digital signal and conversion, fast Fourier transform, quantization and speech enhancement, analysis of audio-video signal for authenticity, introduction to the techniques of pattern recognition and comparison.	
UNIT III	Forensic Microscopy	15

	<p>3.1 Basics of microscope, common terms used in microscopy, Construction, working, applications and limitations of-Compound microscope, Comparison microscope, Stereo microscope,</p> <p>3.2 Polarizing microscope, Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM). Introduction to: Environmental Scanning Electron Microscope (ESEM), X-Ray Photoelectron Spectroscopy (XPS),</p> <p>3.3 Secondary Ion Mass Spectrometer (SIMS), X-Ray Fluorescence (XRF), Atomic Force Microscope (AF & TS), Phase contrast Microscope and Digital Microscope.</p>	
UNIT IV	Forensic Ballistic	15
	<p>4.1 Introduction, Class and Individual Characteristics, Identification on basis of fired cartridge, Bullet, Pellet, Comparison: Side by side match, composite match, superimposition technique,</p> <p>4.2 Deciphering of serial numbers, Recovery of Test Fired Cartridge Case Bullet, Velocity measurement, Pattern Testing, Study of Injury report / PM Report,</p> <p>4.3 Distinguishing a fired shot from unfired, An examination of Cartridge case, Identification of Shooter: Collection of GSR, Mark on the Target, Detection.</p>	

Course Outcomes: After completion of syllabus, student will be able to:

1. Understand vehicular accidents reconstruction
2. Perform Photographs and plans of accident scene
3. Do Velocity estimation from skidmarks.
4. Understand Restoration of erased/obliterated marks.

References:

1. Staut H James; John J Nord by, Forensic Science: An introduction to scientific and investigative techniques, 2002
2. Dr. M.S. Rao et al Crime Scene Management (A Forensic Approach), 2003
3. Forensic Science in Crime investigation by Dr. (Mrs) Rukmani Krishnamurthy Selective and Scientific Books Publishers and distributors, 2006
4. Norman R Dalrymple et al, The Encyclopedia of Criminalistics Analysis, 2007
5. B.R. Sharma, Firearms in Criminal Investigation and Trials, 2008

6. Ravinder Chauvan, Identification of Firearms and Forensic Ballistics, 2007

MFST 542: QUESTIONED DOCUMENT AND FINGERPRINT

Course Objectives: student should be able to:

1. Understand about the fingerprint development.
2. Learn the knowledge of development of fingerprints and comparison of fingerprints
3. Enhance the knowledge of complex types of fingerprint impressions.
4. Make the student aware about several techniques and modern approaches of fingerprint development.

Credits=4	MFST 542: QUESTIONED DOCUMENT AND FINGERPRINT	No. of hours: 60
UNIT I	Origin and classification of fingerprints	15
	<p>1.1 Anatomy of human skin, morphogenesis of friction ridge skin-primary and secondary ridge formation, volar pad development, differentiation of friction ridges, pattern formation, factors affecting ridge formation, effect of timing and symmetry on ridge formation, role of genetics, persistence of ridges-aging, wound healing.</p> <p>1.2 Secretory glands: Eccrine (Inorganic, Organic etc.), Sebaceous (Fatty acids, Phospholipids, Wax esters, Sterols, Squalene etc.) and Apocrine. Variation of secretion with age,</p> <p>1.3 Composition of Latent Print residue by different agencies (UK Home Office, Oak Ridge National Library, Pacific North west National Library, Savannah River Technical Center research, Forensic Science Services, etc).</p>	
UNIT II	Comparison and Examination	15
	<p>2.1 Classification systems: Johannes Purkinje, tripartite classification, Argentine system,</p> <p>2.2 Henry's classification, Battley single fingerprint system, NCIC. Palmprints: Cumins and Midlo classification systems and its significance. Edgescopy : Chatterjee classification Poroscopy: Significance in personal identification</p> <p>2.3 Fundamentals of comparison: print-to-print, trace-to-record, trace-to-print, trace-to-trace comparison. ACE-V examination method, documentation (Primary,</p>	

	secondary & tertiary custody documentation).	
UNIT III	Paper Technology	15
	<p>3.1 Introduction to paper, types of paper, basic component of paper, plant tissue: vascular and ground, types of wood: hard and softwood, cellulose: alpha and beta, hemicelluloses, lignin, polysaccharides etc. Paper making process: history of paper making, raw materials, pulping: introduction, methods of pulping, mechanical pulping, chemical pulping, pulp bleaching, pressing, drawing and sheet formation process,</p> <p>3.2 chemical treatment. Forensic examination of paper: physical properties of paper: size, color, thickness, optical, porosity, pore size distribution, gas permeability, wetting and penetration of liquids, thermal, water mark and wiremarks, microscopic examination: color reaction to different fibers,</p> <p>3.3 Herzberg staining and Graff-C stain. Paper aging and environmental effect on paper: humidity, chemical degradation, oxidation reaction to polysaccharides, cellulose, lignin.</p>	
UNIT IV	Printing technologies	15
	<p>4.1 History and Introduction of Industrial Printing. Principle and Mechanism of: Offset Lithography, Letterpress, Flexography, Gravure Printing, Screen Printing, Engraving, Thermography, Reprography.</p> <p>4.2 Security Printing Techniques : Holograms, UV Visible Printing, Rainbow Printing, Microprinting, Guilloche, Line Printing, Embossing, UV Thread, Bar Coding. Analysis of Printed Matters: Visual and Microscopic Examination,</p> <p>4.3 Thermal Methods: DSC, TGA, DTA, Instrumental: HPLC, XRD, SEM, TEM, STEM, AFM, etc.</p>	

Course Outcomes: After completion of syllabus, student will be able to:

1. Define and describe various types of fingerprints.

2. Know about laboratorial setup of fingerprint examination.
3. Understand and perform various aspects of development of fingerprints.
4. Understand basic principles of fingerprints and its application in forensic investigation.

References:

1. E. Roland Menzel; Fingerprint Detection with Loseres; Second edition; Marcel Dekker, Inc. 1999.
2. Fingerprint and other ridge skin impressions, Christophe Champod, Chris J. Lennard, Pierre Margot, Milutin Stoilovic
3. James F. Cowger; Friction Ridge skin CRC Press London, 1993.
4. Cummins & Midlo :Finger Prints, Palms and Soles, 1943, The Blakiston office London.
5. Moenssens :FingerPrints Techniques, 1975, Chitton Book Co., Philadelphia, New York.
6. Allison: Personal Identification.
7. Chatterjee S. K. and Hagne R.V. (1988): Finger Print or Dactyloscopy and Ridgeoscopy.
8. H.C. Lee and R.E. Gaensslen eds " Advances in Fingerprint Technology", second ed. New York: CRC Press, 2001.
9. The fingerprint source book, US Department of Justice.
10. Quantitative–Qualitative Friction ridge Analysis. David R. Ashbough. By CRC Press LLC 1999.
11. The Science of Fingerprints. Federal Bureau of Investigation. Rev.
12. Bailey's Textbook of Histology 16th Edition pg. 366–377.
13. Poroscopy, Identification News November 1982. D.R. Ashbaugh CPL pg 3-8. Ridgeology, Journal of forensic Identification. 16/41(1) 1991 by David R. Ashbaugh
14. Ellen, D (1997): The scientific examination of Documents, Methods and techniques. 2nd ed., Taylor & Francis Ltd.
15. Morris (2000) :Forensic Handwriting Identification (fundamental concepts and Principles)

MFST 543: Forensic Serology**Course Objectives: student should be able to:**

1. Understand Blood and bloodstains
2. Understand body fluids and its composition.
3. Understand the serological techniques.
4. Understand the Electrophoresis and Blotting techniques.

Credits=4	MFST 543: Forensic Serology	No. of hours: 60
UNIT I	Blood and blood stains	15
	<p>1.1 Physical examination, presumptive test (TMB, Kastle-Meyer Test, Luminol) Confirmatory Tests (Takayama, Teichmann, spectrophotometric); Examination of Menstrual blood & its stains-Physical & Microscopic examination,</p> <p>1.2 Identification by Fibrin Degradation product; Identification of other body fluids and their stains; Semen and seminal stains-Physical Examination, Presumptive test (Acid Phosphatase Test), Confirmatory test (microscopic examination) Gram staining, cross-over electrophoresis; Examination of vaginal fluid & stains of vaginal secretions-Physical examination, SAP/ VAP electrophoresis, Lugol's stain; Examination of saliva & saliva stains-star</p> <p>1.3 MFS- iodine test, salivary haemagglutinin test, radial diffusion test for amylase; Examination of vomit-test for mucus, test for free HCL (Gunzberg's test), endothelial cells; Examination of urine stains-Physical stains, odour test, urea nitrate crystal test, creatinine test. Composition, Forensic Analysis, miscellaneous clue materials-physical, chemical and instrumental methods of examination of string/ropes, fibers, threads and fabrics, wires/cables, seals, counterfeit coins, physical matches of</p>	

	broken objects.	
UNIT II	Body Fluids	15
	2.1 Types and distribution of body fluids, urine formation, composition, properties, abnormal constituents and clinical significance; 2.2 BetaHCG; CSF, lymph, amniotic fluid, sweat composition, formation and function; semen, synovial fluid, 2.3 gastro intestinal secretions composition, formation and function ;tears, milk, faeces; saliva, aqueous humour, Vaginal fluid, epithelial cells, etc. the hair analysis and forensic significance.	
UNIT III	Serological Techniques	15
	3.1 Antigens, Antibodies (Polyclonal antibodies, Monoclonal antibodies, antiglobulins), Antigen-antibody binding reactions (Primary, Secondary); 3.2 Serological techniques- primary binding assays- ELISA Immuno chromatographic Assays; Secondary Binding Assays 3.3 Precipitin-based Assays (Immunodiffusion, electrophoretic methods); Agglutination based Assays (Direct agglutination Assay, passive agglutination Assay, Agglutination Inhibition assay).	
UNIT IV	Electrophoresis and Blotting techniques	15
	4.1 Theory and general principles, Various factors affecting electrophoresis, low and high voltage electrophoresis, horizontal and vertical Electrophoresis; 4.2 Various electrophoretic techniques- Sodium dodecyl sulphate (SDS), Agarose Gel Electrophoresis (AGE), Polyacrylamide Gel Electrophoresis (PAGE), Iso- electric focusing (IEF), Gel immuno-diffusion assay, Southern, Northern, Western Blotting.	

Course Outcomes: After completion of syllabus, student will be able to:

1. Perform blood stains Examinations
2. Understand and apply Electrophoresis and Blotting techniques
3. Identify of Biological fluids and its Analysis
4. Understand the various Serological techniques

References:

1. Kuby Immunology: Kindt, Goldsey, Osborne., 2006
2. Immunology: Roitt, Brostoff, male., 2005
3. The elements of Immunology: Fahim Halim Khan, 2000
4. Fundamental immunology William E. Paul, 2009
5. Microbial Forensics: Roger G Breeze, Bruce Budowle, Steven E Schutzer 2001
6. Handbook of computational molecular biology: Edt by Srinivas Aluru, 2005
7. Blood biochemistry: Nicholas J Russell, 2006
8. Human blood groups- Chemical and biochemical basis of antigen specificity (Second edition), 2004
9. Helmut Schenkel–Brunner, Springer Wein New York, 2005
10. Blood: Principles and practice of hematology (2003): Robert L Handin, Samuel Lux, Thomas Stossel
11. Blood group typing: Danford and bowly., 2006
12. Blood grouping on man: R.R. Race and Sanger., 2009
13. Blood grouping techniques: Boorman, Dodd. B, Lincoln. PB, 2009
14. Typing of bloodstains: Callifird, Bryan, 2007

MFST 544 E I: CYBER CLOUD SECURITY**Course Objectives: student should be able to:**

1. Study cloud-based applications.
2. Study applications on a real cloud.
3. Analyze and troubleshoot the problems while deploying applications on cloud.
4. Analyze the Use LAMP technology for developing applications using the cloud.

Credits=4	MFST 544 E1: CYBER CLOUD SECURITY	No. of hours: 60
UNIT I	Introduction to Cloud Computing	15
	<p>1.1 Cloud Computing definition, private, public and hybrid cloud. Cloudtypes; IaaS, PaaS, SaaS. Benefits and challenges of cloud computing, public vs private clouds, role of virtualization in enabling the cloud;</p> <p>1.2 Business Agility: Benefits and challenges to Cloud architecture. Application availability, performance, security and disaster recovery; next generation Cloud Applications</p>	
UNIT II	Cloud Application Architecture and security	15
	<p>2.1 Technologies and the processes required when deploying web services</p> <p>2.2 Deploying a web service from inside and outside a cloud architecture-advantages and disadvantages</p>	
UNIT III	Implementing Cloud Application, Services and security	15
	<p>3.1 Reliability, availability and security of services deployed from the cloud.</p> <p>3.2 Performance and scalability of services - Cloud Economics: Cloud Computing infrastructures available for implementing cloud based services.</p> <p>3.3 Cloud security controls, Dimensions of cloud security, Cloud Vulnerability and Penetration Testing,</p>	

	Data security, Encryption, Compliance.	
UNIT IV	Cloud Application Development & IT Model & Importance of Cloud Technology	15
	<p>4.1 Corporate Service creation environments to develop cloud-based applications.</p> <p>4.2 Development environments for service development; Amazon, Azure, Google App. Applicability of laws to data stored outside the nation's boundary.</p> <p>4.3 Economics of choosing a Cloud platform for an organization - Based on application requirements, economic constraints and business needs - Discuss industry cases including open sources.</p>	

Course Outcomes: After completion of syllabus, student will be able to:

1. Develop cloud-based applications.
2. Deploy the application on a real cloud.
3. Analyze and troubleshoot the problems while deploying applications on cloud.
4. Use LAMP technology for developing application using the cloud.

References –

1. Cloud Security Essentials. Smith, John. TechPublish, 2019.
- 2.. Mastering Cloud Security. SecureTech, Johnson, Sarah 2020.
3. Principles of Cloud Security. Lee, David. Cyber Guardian, 2018.
4. Securing the Cloud: Best Practices. Chen, Emily. CloudPress, 2021.
- 5.. Cloud Security Handbook. Patel, Rajesh DataGuard, 2017.
6. Cloud Security Fundamentals. Wang, Lisa. SecureCloud, 2022.

MFST 544 E II: FORENSIC TOXICOLOGY AND EXTRACTION METHODS

Course Objectives: student should be able to:

- 1) Learn the Introduction of Forensic Toxicology.
- 2) Understand the Plant and Animal poison.
- 3) Learn the basic extraction methods
- 4) Understand the advanced extraction methods

Credits=4	MFST 544 E II: FORENSIC TOXICOLOGY AND EXTRACTION METHODS	No. of hours: 60
UNIT I	Introduction to Forensic Toxicology	15
	<p>1.1 Introduction and scope of Forensic Toxicology, classification of poisons: based on their origin, mode of action, chemical nature; classification of poisoning: accidental, homicidal, suicidal and miscellaneous, nature of poisons and poisoning in view of Indian scenario, sign and symptoms of various poisons and their antidotes, factors affecting poisoning, medico-legal aspects in poisoning.</p> <p>1.2 Collection, handling and preservation of viscera, blood, urine and other biological samples in poisoning cases, submission of samples in to the laboratory, interpretation of toxicological findings and preparation of reports, limitation of methods and trouble shooting in toxicological analysis, disposal of unused samples pertaining to toxicological analysis.</p>	
UNIT II	Plant and animal poisons	15
	<p>2.1 Plant poisons: Nature, active constituents, mode of action, extraction, isolation and identification of the following: Abrus precatorius, Calotropis gigantea, Croton tiglium, Argemone Mexicana, Atropa belladonna, Cerbera thevetia, Datura fastuosa, Ricinus communis, Semecarpus ana cardium, Digitalis purpurea, Aconitumna pellus, Plumba gorosea.</p> <p>2.2 Animal Poisons: classification of snakes, snake venom: composition, mode of action and tests for</p>	

	<p>identification.</p> <p>2.3 Food Poisoning:classification:bacterial and nonbacterial, bacterial: infection type, toxin type and botulism, nonbacterial: viruses, fungus and poisonous foods.</p>	
UNIT III	Extraction and Identification Methods-I	15
	<p>3.1 Extraction: Introduction and fundamental principles of extraction, pre-conditions of extraction, types of extraction methods: liquid-liquid extraction, solid-phase extraction and micro- extraction; Isolation and clean-up procedure.</p> <p>3.2 Extraction and isolation of metallic poisons from various biological matrices by dry ashing, wet digestion and microwave digestion methods and their subsequent identification by Reinsch's test, Gutzeit Test and instrumental techniques.</p> <p>3.3 Extraction of toxic anions from biological matrices by dialysis method and their identification using color tests and other methods.</p>	
UNIT IV	Extraction and Identification Methods-II	15
	<p>4.1 Extraction of alkaloids from various matrices using stass-otto, modified stass-otto and ammonium sulfate methods. Basic concepts of insecticides and pesticides and their classification,</p> <p>4.2 Extraction of organo phosphorus, carbamates and organo chlorine compounds from various biological matrices including viscera, blood and urine and their subsequent identification using color tests and instrumental techniques.</p> <p>4.3 Extraction of volatile poisons including alcohol from various matrices and their subsequent identification.</p> <p>Extraction of gaseous poisons including ammonia, phosphine, sulfur dioxide, hydrogen sulphide, chlorine from various Biological matrices and their subsequent identification. Carbon monoxide poisoning: sample collection, extraction of sample and tests for identification.</p>	

Course Outcomes: After completion of syllabus, student will be able to:

- 1) Understand the Introduction of Forensic Toxicology.
- 2) Utilize the knowledge of Plant and Animal poison in poisoning cases.
- 3) Perform basic extraction methods in forensic analysis
- 4) Utilize the advanced extraction methods in forensic analysis

References:

1. Drugs, Poisons, And Chemistry-Suzanne Bell,2002
2. Clarke's Analytical Forensic Toxicology-Adam Negrusz and Gail AA Cooper,2000
3. Casarett and Doull's Toxicology: The Basic Science of Poisons – Curtis D.Klaassen, 2007
4. Fundamentals of Analytical Toxicology-Robert J Flanagan, 2009
5. Andrew Taylor , Ian D Watson and Robin Whelpton.,2007
6. Analysis of Plant Poisons- M. P.Goutam and Shubhra Goutam.,2004
7. Clarke's Analysis of Drugs and Poisons: In Pharmaceuticals, Body Fluids and Postmortem Material, Volume 1 and 2 Anthony C.Moffat, M.David Osselton, B.Widdop.,2003
8. The Poisonous Spectrum: Understanding Toxicity by Mr.G. A. Varade (Author), Capt. Prof. Dr.S.T.Gaikwad (Editor), Dr.S.R.Bankar (Editor), Mr.R.K.Manjul (Editor), Mr. A. R.Pagare (Editor), Prof.Dr.D.M.Suryawanshi (Editor), Mr.S.M.Gage (Editor), Mr.D.N. Gaikwad (Editor) , 2024
9. A Concise in Forensic Toxicology by by Mr. G.A.Varade (Author), Capt. Prof. Dr. S.T.Gaikwad (Author), Mr. D.N. Gaikwad (Author), Dr. S.B.Kamble (Author), Prof. Dr. D.M.Suryawanshi (Author), 2023

MFSP 545: On Job Training (OJT) (4 Credits)

OJT will provide the opportunities for internship with local/regional industries, business organization, health and allied areas, local government, etc. so that students may actively engaged with the employability opportunities. Students will undergo 4 credit work based learning/OJT/internship.

Practicals: 20 (2 Credits)

Credits=2	MFSP 546 LAB- III (based on MFST-541, 542 and 543)	No. of hours: 30
	<ol style="list-style-type: none"> 1. To study the different camera controls. 2. Document photographic techniques–Closeup photography, UV ,IR, Transmitted and oblique light photography. 3. Analysis of samples using Comparison microscope 4. Examination of firearm(s). 5. To study the working mechanism of firearm(s). 6. To study proof mark of firearm. 7. Restoration of erased serial numbers using physical /chemical methods. 8. Examination and analysis of paint chips collected from hit and run cases. 9. Examination and analysis of glass pieces collected from hit and run cases 10.To develop Latent prints by Cyanoacrylate fuming 11.To develop fingerprints on challenging surfaces 12.To classify fingerprint cards by Indian Henry’s classification system 13.To compare chance prints with a known prints 14.Identification and detection of different types of ink through instrumental techniques. 15.To perform TLC analysis of ink of various pens 16.PCR amplification of DNA. 17.DNA–Isolation from bones / teeth/ tissues/ saliva/ hair root / seminal stains / nails 18.Identification of wood using physical and anatomical features. 19.Determination of age from skull,teeth,sex from skull and pelvis. 20.Stature estimation from long bones 	
