

Rayat Shikshan Sanstha's

**YASHAVANTRAO CHAVAN INSTITUTE OF
SCIENCE, SATARA**

(An Autonomous College)

Reaccredited by NAAC with 'A+' Grade

New Syllabus For

Master of Science

Part - II

FORENSIC SCIENCE

Syllabus

To be implemented from June, 2022 onward

Rayat Shikshan Sanstha's
Yashavantrao Chavan Institute of Science, Satara
Syllabus for Master of Science Part II

1. Title: M.Sc. Forensic Science

2. Year of Implementation: 2022-23

3. Preamble:

This syllabus is framed to give advanced knowledge of Forensic Science to post graduate 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 the 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.

4. General Objectives:

- Construction and designing of the courses to suit industrial needs.
- More emphasis on applied aspects of forensic science.
- To develop the aptitude of students in the field of research.
- Enrichment of basic knowledge in areas of Forensic Science.

5. Duration: Two Year

6. Pattern: Semester wise

7. Medium of Instruction: English

8. Structure of Course:

- a. Semester III: Theory: 07 Papers & Practical's: 02 Paper
- b. Semester II: Theory: 02 Papers & Practical's: 02 Paper

Structure of Course: M.Sc. – I
Semester – I

M.Sc.(Forensic Science) - Semester –I					
Level	Code	Course (Subject)	No.of Lectures per week	Credits	
8	MFST-101	Forensic science and crime scene management	04	04	
	MFST-102	Criminology and Law	04	04	
	MFST-103	Forensic Ballistics and Explosives	04	04	
	CCS(Elective: Any one among two)				
	MFST-104 E1	Analytical Instrumental Technique I	04	04	
	MFST-104 E2	Analytical Instrumental Technique II			
	MFSP 105	Laboratory Exercise in Crime Scene Management & Criminology	04	04	
	MFSP 106	Laboratory Exercise in Forensic Ballistic & Analytical Instrumental Techniques	04	04	
	AECC-1	Communicative English I	02	02	
	SEC-1	Fundamental of Information Technology I	02	02	
		Total	28	28	
AECC: Ability Enhancement Core Course; SEC: Skill Enhancement Course *CCS (Elective : Any one among two)					

M.Sc (Forensic science) Semester –II			
Code	Course (Subject)	No. of Lectures per week	Credits
MFST-201	Fingerprint and Impressions	04	04
MFST-202	Questioned Document	04	04
MFST-203	Forensic Physics	04	04
CCS(Elective: Any one among two)			
MFST-204 E1	Forensic Chemistry	04	04
MFST-204 E2	Forensic Toxicology		
MFST-205	Cryptography and Fundamentals of MSF	04	04
MFSP-206	Laboratory Exercise in Fingerprints & Questioned Document	04	04
MFSP-207	Laboratory Exercise in Forensic Physics & Forensic Chemistry and Toxicology	04	04
AECC-II	Communicative English II	02	02
SEC-II	Fundamental of Information Technology II	02	02
	Total	32	32
*CCS (Elective : Any one among two)			

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M.Sc. (Forensic science) Semester –III

Level	Code	Course (Subject)	No. of Lectures per week	Credits	
9	MFST-301	Forensic Biology, Serology and DNA Profiling	04	04	
	MFST-302	Forensic Toxicology and Pharmacology	04	04	
	MFST-303	Forensic Medicine and Anthropology	04	04	
	CCS (Elective: Any one among two)				
	MFST-304 E1	Cryptography and Fundamentals of MSF	04	04	
	MFST-304 E2	Data Structure			
	MFST-305	Research methodology and clinical research	04	04	
	MFSP-306	Laboratory Exercises in Forensic Biology and Forensic Toxicology	04	04	
	MFSP-307	Laboratory Exercises in Forensic Medicine and Cyber Forensic	04	04	
	SEC – III	Startups and entrepreneurship	02	02	
	SEC – IV	–	01	01	
		Research Training (20 to 40 working days)	-	01	
	Total	32	32		
*CCS (Elective : Any one among two)					

M.Sc (Forensic science) Semester –IV
(Specialization in Forensic Chemistry and Toxicology)

Level	Code	Course (Subject)	No. of Lectures per week	Credits
9	MFSTCT -401	Forensic Chemistry	04	04
	CCS(Elective: Any one among two)			
	MFSTCT-402	Forensic Toxicology	04	04
	MFSTCT-402 E2	Spectroscopy		
	MFSPCT 403	Practical	04	04
	MFSPCT 404	Major Project	-	01
	SEC –V		02	02
	SEC – VI	Internship / Industrial Training (30 to 60 days)	-	02
	MOO’S/SWA YAM/NPTL		-	01
	Total		16	18

*CCS (Elective : Any one among two)

M.Sc (Forensic science) Semester –IV
(Specialization in Fingerprint and Questioned Document)

Level	Code	Course (Subject)	No. of Lectures per week	Credits
9	MFSTFQ -401	Fingerprint Development Technology	04	04
	CCS(Elective: Any one among two)			
	MFSTFQ-402 E1	Paper Ink and Printing Technology	04	04
	MFSTFQ-402 E2	Advanced Document Examination		
	MFSPFQ 403	Practical	04	04
	MFSPFQ 404	Major Project	-	01
	SEC –V		02	02
	SEC – VI	Internship / Industrial Training (30 to 60 days)	-	02
	MOO’S/SWA YAM/NPTL		-	01
		Total	16	18

*CCS (Elective : Any one among two)

M.Sc (Forensic science) Semester –IV
(Specialization in Forensic Physics and Cyber Forensic)

Level	Code	Course (Subject)	No. of Lectures per week	Credits
9	MFST PC-401	Forensic Physics	04	04
	CCS(Elective: Any one among two)			
	MFST PC-402 E1	Cyber Forensic-Cloud Security	04	04
	MFST PC-402 E2	Operating System		
	MFSP PC 403	Practical	04	04
	MFSP PC 404	Major Project	-	01
	SEC –V		02	02
	SEC – VI	Internship / Industrial Training (30 to 60 days)	-	02
	MOO’S/SWA YAM/NPTL		-	01
		Total	16	18

*CCS (Elective : Any one among two)

M.Sc (Forensic science) Semester –IV
(Specialization in Forensic Serology and DNA Profiling)

Level	Code	Course (Subject)	No. of Lectures per week	Credits
9	MFST SD-401	Forensic Serology	04	04
	CCS(Elective: Any one among two)			
	MFST SD-402 E1	DNA Profiling	04	04
	MFST SD-402 E2	Eukaryotic Genetics & DNA Fingerprinting		
	MFSP SD 403	Practical	04	04
	MFSP SD 404	Major Project	-	01
	SEC –V		02	02
	SEC – VI	Internship / Industrial Training (30 to 60 days)	-	02
	MOO’S/SWA YAM/NPTL		-	01
	Total	16	18	

*CCS (Elective : Any one among two)

Class	M.Sc. I	M.Sc. II	Total
Credits	60	50	110

Forensic Science Syllabus
M.Sc.-II
M.Sc. SEMESTER- III

MFST-301

Title of Paper: **Forensic Biology, Serology and DNA Profiling** (Theory)

Course Code: **MSFT-301**

No. of Credits: 04

Learning Hours: 60 hrs

Course Objective-

1. To learn the scope of forensic biology
2. To understand the basic concepts of human genetics
3. To understand the Immuno-chemical Technique.
4. To learn the techniques in bioinformatics
5. To learn the conventional and modern methods of wildlife forensic

Credits=4	SEMESTER-III MFST- 301 Forensic Biology, Serology and DNA Profiling	No. of hours per unit/ credits
Credit –I UNIT I	<p>Fundamentals of biology- scope of forensic biology, structure and functions of cell, basic concepts of anatomy and physiology of the skeletal system.</p> <p>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>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>	(15)
Credit –1 UNIT II	<p>Immuno-chemical Technique- Gel immuno-diffusion, Immuno-electrophoresis, complement fixation, Radioimmunoassay (RIA), ELISA, Fluorescence immuno assay.</p> <p>Enzyme Techniques- Enzyme kinetics, Purification and protein estimation, Enzyme assay technique, Visible & Ultraviolet Spectrophotometric methods, Luminescence method, Radio-isotope method, Immuno-chemical method, Automated enzyme analysis, Immobilized enzymes.</p> <p>Introduction to bioinformatics and its application in forensics. Integrated</p>	(15)

	information retrieval. Major databases in bioinformatics. Sequence alignment, Phylogenetic analysis and related tools. 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. 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.	
Credit –1 UNIT III	<p>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>Composition and examination of body fluids - blood, semen, saliva, vaginal fluid, urine, sweat and menstrual blood and identification using current and emerging techniques.</p>	(15)
Credit –1 UNIT IV	<p>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>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>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>	(15)

Course outcomes

Student should 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.

Reference Books:

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.
5. Edmund Sinnett; "Principles of Genetics", McGraw Hill Publications, 1950.
6. Giblett, Eloise R.; "Genetic Markers in Human Blood", Blackwell Scientific Publications, 1969.
7. Altenburg, Edgar; "Genetics", Oxford & IBH Publishing Co., 1970.
8. GJV Nossal; "Antigens, Lymphoid Cells and the Immune Response", Academic Press, 1971.
9. Wiener, Alexander S; "Advances in Blood Grouping II", Grune & Stratton, 1965.
10. Boorman, Kathleen E & Churchill; "Blood Group Serology", Livingstone, 1977.
11. Race, R.R, Blackwell; "Blood Groups in Man", Scientific Publications, 1975.
12. Sussan, Leon N & Charles Thomas; "Paternity Testing by Blood Grouping", 1968.
13. Prakash, M; "Physiology of Blood", Anmol Publications, 1998.
14. Gupta, S.K; "Essentials of Immunology", Arya Publications, 2008.
15. Franklin 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. Lincecum, 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.
21. Nataraj Publishers; "Wildlife (Protection Act, 1972)", Nataraj Publishers, 1997.
22. Herbert Stone; "The Timbers of Commerce", International Book Distributor, 1985.
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.
25. Esau Katherine; "Plant Anatomy", Wiley Eastern Ltd., 1965.
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-302

Title of Paper: **Forensic Toxicology and Pharmacology** (Theory)

Course Code: **MFST-302** No. of Credits: 04

Learning Hours: 60 hrs

Course Objectives:

Students should be able to:

1. To make the student aware about Forensic Toxicology.
2. To enhance the understanding the knowledge of Extraction of poisons and Drugs

3. To enhance the understanding the knowledge of
4. To make the student aware about Quality Management and Forensic Statistics

Credits =4	SEMESTER-I MFST- 302 Forensic Toxicology and Pharmacology	No. of hours per unit/ Credits
Credit –I UNIT I	<p>Forensic toxicology: introduction and concepts of forensic toxicological examination and its significance. Law relating to poisons.</p> <p>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>	15
Credit –1 UNIT II	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, 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.	15
Credit –1 UNIT III	Examination of metallic poison, Plant poison, volatile poisons, snake venom, insects bites poisons involving animal poisons cases and their examination, 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.	15

Credit –1 UNIT IV	Forensic pharmacology- forensic pharmacological studies, absorption, distribution, metabolism, pathways of drug metabolism, 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.	(15)
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Course Outcomes

Student should 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

Reference Books:

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. Clark E.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; “TextBook 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 D et al; “Handbook of toxicology”, CRC Press Publication, USA 1995.
10. Casarett, L J and Doull 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. Zweig G; “Analytical Methods of Pesticides”, Academic Press, 1966.
15. Paranjape, H.M., Bothara, G.K., Jain, M.M; “Fundamentals of Pharmacology”, 1st edition, Nirali Prakashan, 1990.
16. Budhiraja, R.D; “Elementary Pharmacology and Toxicology”, Popular Prakashan, 2nd edition, 1999.
17. Hardman, J. G. and Limbird, L.E; “Goodman and Gilman’s The Pharmacological Basis of Therapeutics”, 9th edition, McGraw-Hill, 1996
18. Moffat, A.C, Osselson, D. M, Widdop, B; “Clarke’s Analysis of Drugs and Poisons in Pharmaceuticals, body fluids and postmortem material”, 3rd edition, Pharmaceutical Press, 2004.

MFST-303

Title of Paper: **Forensic Medicine and Anthropology.** (Theory)

Course Code: **MFST 303**

No. of Credits: 04

Learning Hours: 60 hrs

Course Objectives -

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	SEMESTER-III MFST- 303 Forensic Medicine and Anthropology.	No. of hours per unit/ Credits
Credit –I UNIT I	Forensic anthropometry and osteometrysomatoscopy including determination of race. Portrait parley and its use in crime investigation. Reconstructions of mutilated faces- identikit ad photo fit reconstruction	15
Credit –I UNIT II	Bone: Identification of bones- morphological, anatomical and chemical characteristics. Determination of site, age, sex, race and species origin from bones. Determination of stature from long bones. Personal identification: By photographic superimposition technique. Video superimposition. Roentgenographiccephalometry. Comparison of measurements on photograph and roengenograph of deceased. From bodily tattoo marks, mole etc.	15
Credit –I UNIT III	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. 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.	15

Credit –I UNIT IV	<p>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>Medico legal aspects of sexual offenses.</p> <p>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>	15
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Course Outcomes -

By the end of the paper, a 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.

Reference Books:

1. Review of Forensic Medicine and Toxicology- Book by Gautam Biswas.
2. Principles of Forensic Medicine and Toxicology- Book by Rajesh Bardale.
3. Textbook of Forensic Medicine and Toxicology, Nageshkumar 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/Allyn and 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., Chandran M. R, 2nd Ed., Universities Press (India) Pvt. Ltd., Hyderabad, 2006
12. Fundamental of Forensic Anthropology, Linda L. Klepinger, A John Wiley and Sons Inc. Publishers, USA, 2006.
13. Forensic recovery of human remains : archaeological approaches, Tosha L. Dupras, John J. Schultz, Sandra M. Wheeler and Lana J. Williams, CRC Press, USA, 2011

MFST-304 E1

Title of Paper: **Cryptography and Fundamentals of MSF (Theory)**

Course Code: **MFST-304**

Learning Hours: 60 hrs

No. of Credits: 04

Course Objectives

Students should be able to :

1. To understand the Metasploit framework.
2. To Study & understand the Bitcoin&Blockchain concept.
3. To understand the application of hash function
4. To Study the types of Classical cipher

Credits=4	SEMESTER-III MFST- 304 E1 Cryptography and Fundamentals of MSF	No. of hours per unit/ Credits
Credit –I UNIT I	Fundamentals of Metasploit framework	15
	Metasploit History, Metasploit Architecture, Hardware Prerequisites, Metasploitable, Ubuntu 7.04, msfconsole, Metasploit Exploits, Metasploit Payloads, Keylogging, Persistent Meterpreter Service, Meterpreter Backdoor Service, PHP Meterpreter, Backdooring EXE Files.	
Credit –I UNIT II	Classical Ciphers	15
	Caesar Cipher, Vigenere Cipher, Rail-fence Cipher, Row Transposition Cipher, Requirement and Basic Properties, Main Challenges, Confidentiality, Integrity, Availability, Non-Repudiation, Secret Key Cryptography, Data Encryption Standard[1] Symmetric Ciphers (Stream Cipher & Block cipher) Advanced Encryption Standard (AES)-Triple DES-Blowfish, RC4, RC5/RC6 family, Public Key Cryptography, Principles of public key cryptosystems-The RSA algorithm-Key management –DiffieHellman Key exchange.	
Credit –I UNIT III	Bitcoins & Blockchain	15
	Bitcoin introduction, working, blockchain, block chain operation with bitcoins, bitcoinglossary, bitcoin wallets, setup for bitcoin payments, bitcoin mining.10	
Credit –I UNIT IV	Message authentication code and Hash Functions	15

	Message authentication code Authentication functions, Hash Functions-Hash Algorithms (MD5, Secure Hash Algorithm), Digital signatures (Authentication protocols, Digital signature Standard). Digital Certificate and Public Key Infrastructure.	
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Course Outcomes

Student should be able to:

1. Learn Metasploit framework process
2. Understand the Bitcoin&Blockchain Process
3. Importance of Hash function in Cyber case investigation
4. Use types of hashes for security purpose

Reference books:

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

MFST-304 E2

Title of Paper: **Data Structure (Theory)**

Course Code: **MFST-304**

Learning Hours: 60 hrs

No. of Credits: 04

Course Objectives

Students should be able to :

- 1.To understand the Data and Algorithm.
- 2.To Study & understand the Linear Data structure and Algorithm analysis.
- 3.To understand the Graphs and Trees
- 4.To Study Hashing and their types

Credits=4	SEMESTER-III MFST- 304 Data Structure (Theory)	No. of hours per unit/ Credits
Credit –I UNIT I	Data	15
	Overview: Introduction to algorithm, analysis of algorithm, designing of algorithm, the correctness and complexity of algorithm, Searching and sorting	
Credit –I UNIT II	LINEAR DATA STRUCTURES AND ALGORITHM ANALYSIS	15
	LINEAR DATA STRUCTURES AND ALGORITHM ANALYSIS: Array, Stack, Queue , Priority Queue, Linked list, Doubly linked list, circular link list operations addition , deletion, traversing.	
Credit –I UNIT III	Graphs and Tress	15
	Graphs: introduction to graph theory, graph isomorphism's, graph data structure: Adjacency lists, Adjency matrices, elementary graph, algorithm: BFS, DFS, Topological sort, strongly connected components. Trees: introduction to trees, Tree traversal – preorder. Post order, inorder. Binary tree. Balanced tree: B and B+ trees, Application of trees, minimum spanning tress, single source shortest path , all pair shortest path, heap	
Credit –I UNIT IV	Hashing	15

	Hashing : Hash functions, collision resolution ,Dynamic programming and greedy algorithms NP Vs P: The spaces P and NP, Polynomial reduction, NP Complete Problem.	
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Course Outcomes

Student should be able to:

- 1.Learn Data and Algorithm.
- 2.Understand the Linear data structure and algorithm analysis
- 3.Understand the Graph and Trees
- 4.Learn about the Hashing and their functions

Reference books:

- 1.Data Structures : By Seymour Lipschutz, Tata Mcgraw- Hill Publication.
2. Introduction to Algorithm, Thomas Cormen
3. Data structures and Algorithms – Alfred V. Aho
4. Fundamentals of Data Structure in C++- Ellis Horowitz 70
5. Fundamentals of Data structures, by Horowitz and Sahani (Galgotia publications).
6. .An introduction to data structures and application, by Jean Paul Tremblay & Pal G. Sorenson (McGraw Hill).
7. Data Structures, by Tannenbaum, (PHI).

MFST- 305

Title of Paper: **RESEARCH METHODOLOGY AND CLINICAL RESEARCH**

Course Code: **MFST-305**

No. of Credits: 04

Learning Hours: 60 hrs

Course Objectives

Students will be able to:

1. To understand basics of research
2. To understand how define research problem
3. To make students aware of Importance of Knowing How Research is done.
4. To learn drug development processes

Credits= 4	SEMESTER-III MFST- 305 RESEARCH METHODOLOGY AND CLINICAL RESEARCH	No. of hours per unit/ Credits
Credit –I UNIT I	<p>Introduction: Meaning of Research, Objectives of Research, Types of Research, Research Approaches, Significance of Research, Research Methodology, Research and Scientific Method</p> <p>Defining the Research Problem: What is a Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem.</p>	15

Credit –I UNIT II	<p>Research Design Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Basic Principles of Experimental Designs</p> <p>Sampling Design Census and Sample Survey, Implications of a Sample Design, Steps in Sampling Design, Criteria of Selecting a Sampling Procedure, Characteristics of a Good Sample Design, Different Types of Sample Designs, How to Select a Random Sample, Random Sample from an Infinite Universe</p>	15
Credit –I UNIT III	<p>Introduction to clinical research and Drug Development Process Overview of Drug Development Process, briefing of clinical trials phases Protocol and clinical trial Designing: Definition of protocol, its importance and purpose, Protocol format: Chapters (Headings) and broad contents of protocol, Important scientific and administrative aspect included in protocol, Introduction to Research Methodology, Protocol writing team and role of each member, Clinical trial design: Types of study designs, Sampling, sample size, randomization, Inclusion & Exclusion criteria, Phases of clinical trial & Types of trials</p>	15
Credit –I UNIT IV	<p>Good Clinical Practice (GCP) ICH regulations: Ethical Principles and their origin, Ethics in clinical research: As per ICMR & GCP, Ethics committees: Roles & responsibility of IEC and IRB, Ethics in relation to vulnerable groups & special situations, Responsibilities of Sponsors, Investigators & Regulators, ICH: Purpose, regulations & guidelines, Informed consent and Informed consent form, Essential Documents Drug</p> <p>Regulatory Affairs (Clinical Trial): Regulatory Authority in India (DCGI & CDSCO), Schedule Y of Drugs & Cosmetics Act, International Scenario of Regulatory Aspects: FDA, CFR</p>	15

Course Outcomes

Student should be able to:

1. Drug development processes and phase trials
2. Good Clinical Practices, Good Manufacturing Practices, GLP/ GMP
3. Importance of documentations.
4. Drugs and Cosmetics Act.

Reference books:

1. C. R. Kothari (2009) "Research Methodology: Methods & Techniques" (Second Revised Edition), New Age International Publishers, New Delhi.
2. Mathur U.C., Product and Brand Management, Naraina phase I, New Delhi, 2007.
3. S.A. Sherlekar, K. Nirmala Prasad & S.J. Salvadore Victor – Principles of Marketing – published by Himalaya Publishing House “Ramdoot”, Dr. Bhalero Marg, Girgaon, Mumbai. 2nd Edition.
4. Basic and Clinical Pharmacology, Prentice hall, International, Katzung, B.G. (Unit I)
5. Clinical Pharmacology, Scientific book agency, Laurence, DR and Bennett PN. (Unit I, II)
6. Clinical pharmacokinetics, Pub. Springer Verlag, Dr. D.R Krishna, V. Klotz (Unit I)
7. Remington Pharmaceutical Sciences, Lippincott, Williams and Wilkins (Unit I, II)
8. Drug interaction, KvenStockley. Hamsten (Unit III)
9. Drug interaction, Basic BusinessPubl, Bombay, J.K. Mehra (Unit I, III)
10. Clinical pharmacology and drug therapy Grahame smith and Aronson, (Unit I, III)
11. TextBook of Therapeutics Drug and Disease Management Hardbound. Richard A Helms, (Unit III)

MFSP-306 Laboratory Exercises in Forensic Biology and Forensic Toxicology

Credits=4	SEMESTER-III MFSP- 306 Laboratory Exercises in Forensic Biology and Forensic Toxicology	No. of hours per unit/ Credits – (60)
	<p style="text-align: center;">Section A : Forensic Biology</p> <ol style="list-style-type: none"> 1. Blood examination for diseases 2. Estimation of hemoglobin percentage 3. To determine blood group from stains of blood and various body fluids with Absorption Inhibition, mixed agglutination and absorption-elution techniques. 4. To perform a precipitin test for species of origin determination. 5. Rocket immunoelectrophoresis 6. Identification of Fibers-man-made and natural fibers. 7. To study the isolation and methods of Diatoms analysis. 8. Identification of Pug marks by various animals. 9. Microscopic examination of Human and Animal hair. 10. To study the Microscopic analysis of pollen grains. 11. To study the PCR techniques and DNA amplifications methods. 12. To study the BLAST and FASTA techniques. <p style="text-align: center;">Section B : Forensic Toxicology</p> <ol style="list-style-type: none"> 1. Analysis of alcoholic liquor as per BIS specifications. 2. Determination of methanol and ethanol in alcoholic liquors.(wet test, GC, TLC) 3. Analysis of gasoline as per BIS specifications. 4. Estimation of ethyl alcohol in blood sample by wet test, TLC, GC-HS. 5. Analysis of viscera (simulated sample) for organo-chloro /organo-phosphorus pesticides by TLC.(2 Nos 6. Adulteration of vegetable oils by GC & HPLC. 7. Systematic analysis of pharmaceutical products as per IPC specification by using HPLC 8. Systematic analysis of pharmaceutical products as per IPC specification by using GC. 9. Analysis of explosion residues (Preliminary analysis, GC, GC-MS, ion chromatography.(2 Nos.) 10. Analysis of fire arson samples (extraction, GC, GC-MS) (2 Nos) 	

MFSP-307 Laboratory Exercises in Forensic Medicine and Cyber Forensic

Credits - 4	SEMESTER-III MFSP-307 Laboratory Exercises in Forensic Medicine and Cyber Forensic	No. of hours per unit/ Credits (60)
	<p style="text-align: center;">Section A: Forensic Medicine</p> <ol style="list-style-type: none"> 1. To identify types of human bones. [2] 2. To determine the origin of skeletal remains (human/animal). [1] 3. To determine the number of individuals from skeletal remains. [1] 4. To estimate stature from long bones. [1] 5. To determine sex from skull and pelvis. [2] 6. To determine age from skull and teeth. [2] 7. To study the features of Bite marks. [1] <p style="text-align: center;">Section B: Cyber Forensic</p> <ol style="list-style-type: none"> 1. Implement Caesar cipher encryption-decryption 2. Implement Playfair cipher encryption-decryption 3. Implement Polyalphabetic cipher encryption-decryption 4. Implement Atbash cipher 5. To implement Simple AES encryption 6. Implement Diffie Hellman Key exchange method 7. Write a program to generate SHA-1 Hash 	

Semester IV

Specialization in Forensic Chemistry and Toxicology

MFST-CT-401

Title of Paper: **Forensic Chemistry (Theory)**

Course Code: **MFST-CT-401**

No. of Credits: 04

Learning Hours: 60 hrs

Course Objective:-Students should be able to

- 1) To make the student aware about Forensic Chemistry, drugs and drug abuse.
2. To enhance the understanding & knowledge of beverages, trace evidences, pigments, fibers etc
3. To enhance the understanding & knowledge of Nanomaterials, Forensic Nanotechnology.
4. To lean and understand about the Fertilizers, Pesticides and Other Chemicals

Credits= 4	SEMESTER- IV MFST-CT-401 Forensic Chemistry (Theory)	No. of hours per unit/ Credits
Credit –I UNIT I	Forensic chemistry: introduction, types of case/exhibits, preliminary screening, presumptive test(color and spot test) inorganic analysis, micro-chemical methods of analysis, examination procedures involving standard methods and instrumental techniques, Drugs of abuse; introduction, classification of drugs of abuse, drugs of abuse in sports, narcotic drugs and psychotropic substances, designers drugs and their forensic examination, drugs and cosmetic act, excise act, NDPS act and detective dye added.	15
Credit –I UNIT II	Analysis of beverages: alcoholic and nonalcoholic, country made liquor, illicit liquor and medicinal preparations containing alcohol and drugs as constituents, analysis of trace evidence, cosmetics, dyes trap related evidence material, paint, pigment, fibers, oil, fats, greases, industrial dusts chemicals and plants materials.	15
Credit –I UNIT III	Forensic Nanotechnology Introduction to Nanomaterials, Strategies for scalable synthesis of quantum dots and related nano dimensional materials Detection of Forensic evidence by nanotechnology i.e. Biological samples, fingerprints, documents, explosives, drugs and trace materials etc.	15
Credit –I UNIT IV	Fertilizers, Pesticides and Other Chemicals	15

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

Student should be able to:

1. Forensic chemistry, types of exhibits in chemistry.
2. Drugs, types of drugs and related Acts.
3. Nanotechnology and basics of non materials, detection techniques.
4. Analysis methods of beverages, trace evidence, dye, pigments etc.
5. Introduction to fertilizer, pesticides and other chemicals, Forensic analysis.

Reference Books:

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", 6th Edition, 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 Forensic Science, 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. Pearson D; "Chemical Analysis of Food", Chemical Publ. Co. New York, 1971.
10. Somani S M; "Chemical Warfare Agent", CRC Press, 2000.
11. Sun Yin and Kwok Yong; "Detection Technologies for Chemical Warfare Agent and Toxic Vapours", CRC Press, Washington DC, 2004.
12. Yinon, J. and Zitrin, S; "The Analysis of Explosives", Oxford, Pergamon, 1981.
13. Beveridge, A; "Forensic Investigation of Explosives", Taylor & Francis, 2000.
14. Yallop, H. J: "Explosion Investigation", Forensic Science Society & Scottish, 1980.
15. Siegel, J. A, Saukko, P. J. and Knupfer, G.C; "Encyclopedia of Forensic Sciences", Academic Press, 2000.
16. Feigl F; "Spot Test in Inorganic Analysis", Elsevier Publication, New Delhi, 2005. 17. Feigl, F; Spot Test in Organic Analysis", Elsevier Publication, New Delhi, 2005.
17. Clark E.G.C; "Isolation and Identification of drugs". Vol.1 and Vol.2, Academic Press 1986.
18. NDPS Act, 1985.
19. Feigl; "Spot Test in Organic Analysis", Elsevier Pub. New Delhi.
20. "Working Procedure Manual – Chemistry, Explosives & Narcotics", BPR&D Publications.

MFST CT-402 E1

Title of Paper: **Forensic Toxicology (Theory)**

Course Code: **MFST CT-402** No. of Credits: 04

Learning Hours: 60 hrs

Course Objective:- Students should be able to

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

Credits= 4	SEMESTER- IV MFST CT-402 E1 Forensic Toxicology	No. of hours per unit/ Credits
Credit –I UNIT I	Introduction to Forensic Toxicology	15
	<p>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>Collection, handling and preservation of viscera, blood, urine and other biological samples in poisoning cases, submission of samples into 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>	
Credit –I UNIT II	Plant and animal poisons	15
	<p>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, Semele carpus, Anacardium, Digitalis purpurea, Aconitum napellus, Plumbago rosea. Animal Poisons: classification of snakes, snake venom: composition, mode of action and tests for identification. Food Poisoning: classification: bacterial and nonbacterial, bacterial: infection type, toxin type and botulism, nonbacterial: viruses, fungus and poisonous foods.</p>	
Credit –I UNIT III	Extraction and Identification Methods-I	15

	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.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.Extraction of toxic anions from biological matrices by dialysis method and their identification using color tests and other methods.	
Credit –I UNIT IV	Extraction and Identification Methods-II	15
	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, Extraction of organophosphorus, carbamates and organochlorine compounds from various biological matrices including viscera, blood and urine and their subsequent identification using color tests and instrumental techniques. Extraction of volatile poisons including alcohol from various matrices and their subsequent identification. 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.	

Course Outcomes:

Student should be able to:

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

Reference Books:

1. Drugs, Poisons, And Chemistry- Suzanne Bell
2. Clarke's Analytical Forensic Toxicology- Adam Negrusz and Gail AA Cooper
3. Casarett and Doull's Toxicology: The Basic Science of Poisons- Curtis D. Klaassen
4. Fundamentals of Analytical Toxicology- Robert J Flanagan, Andrew Taylor, Ian D Watson and Robin Whelpton.
5. Analysis of Plant Poisons- M. P. Goutam and ShubhraGoutam.
6. 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.

MFST CT-402 E2

Title of Paper: **Spectroscopy (Theory)**

Course Code: **MFST CT-402 E2**

No. of Credits: 04

Learning Hours: 60 hrs

Course Objective:- Students should be able to

- 1) Understand the basic concepts of spectroscopy.
- 2) Understand the IR and Raman Spectroscopy
- 3) Understand the NMR Spectroscopy.
- 4) Understand the Mass spectroscopy

Credits= 4	SEMESTER- IV MFST CT-402 E2 Spectroscopy	No. of hours per unit/ Credits
Credit –I UNIT I	Basics of Spectroscopy	15
	Basic concepts-Atomic and molecular spectroscopy-Interaction of electromagnetic radiation with matter and its consequences. Reflection, absorption, transmission, scattering, emission, fluorescence, phosphorescence. Atomic spectra: energy levels, quantum numbers and designation of states, selection rules, qualitative discussions of atomic spectra. Molecular spectra: Qualitative discussion of molecular binding, molecular orbital, types of molecular energies, qualitative discussions of rotational, vibrational and electronic spectra, spectra of polyatomic molecules 33 UV/VIS-Spectroscopy: Introduction, UV-Visible spectroscopy-Fundamental laws of spectrophotometry, Deviation from Beer's Law, Instrumentation and techniques, qualitative and quantitative methods in UV-Visible spectroscopy, Forensic applications.	
Credit –I UNIT II	IR & RAMAN Spectroscopy	15
	IR-Spectroscopy: Introduction, Principle of FTIR, Modes/types of vibrations, functional group and fingerprint region, Review of IR spectroscopy, Dispersive and Nondispersive IR spectrophotometers, Fourier transform IR spectrophotometers, Instrumentation and Techniques, Interpretation of IR spectra, Forensic applications. Raman Spectroscopy: Basic principles, Theory of Raman spectroscopy, Instrumentation, Analytical applications of Raman spectroscopy. , Forensic applications	
Credit –I UNIT III	NMR Spectroscopy	15
	NMR-Spectroscopy: Introduction, Nuclear Spin States, Resonance, Basic principle, Chemical Shift and Shielding effect, Chemical equivalence, Spin-spin splitting (n+1 Rule), Problem based on NMR, Forensic analysis by NMR tools.	

Credit –I UNIT IV	Mass Spectroscopy	15
	Mass Spectrometry: Introduction, Review of Mass spectrometry, Basic Principles and Theory, Instrumentations and technique, Ionization methods, Fragmentations in Mass spectrometry, selected ion monitoring	

Course Outcomes:

Student should be able to:

1. Understand basic concepts of spectroscopy.
2. Understand important aspects of IR and Raman spectroscopy
3. Understand important aspects of NMR Spectroscopy
4. Understand important aspects of Mass spectroscopy

Reference Books:

1. Forensic Science in Criminal Investigation and Trials by B. R. Sharma, Fourth Edition, Universal Law Publishing Co.
2. Modi's: Medical Jurisprudence & Toxicology, M. M. Trirathi Press Ltd. Allahabd, 1988.
3. S. N. Tiwari: Analytical Toxicology, Govt. of India Publications, New Delhi, 1987.
4. Curry: Analytical Methods in Human Toxicology, Part II, 1986.
5. Arena Poisoning: Chemistry, Symptoms and Treatment.
6. Borrow : Molecular Spectroscopy, 1980.
7. Wouldard, H. H., et al : Instrumental Methods of Analysis, 1974.
8. Moonesens A.A. et al : Scientific Evidence in Criminal Cases, 1973.
9. Lundquist & Curry : Methods of Forensic Science, 1963.
10. Lee & Gaensslen : Advances in Forensic Science, (Vol. 2) Instrumental Analysis.

MFSP-CT-403

Title of Paper: **Practical**

Course Code: **MFSP-CT-403**

No. of Credits: 02

Credits=2	SEMESTER-IV	No. of hours per unit/ Credits –(30)
	<ol style="list-style-type: none"> 1. Analysis of given fertilizers. 2. Estimation of sugar in jaggery sample by Fehling's solution. 3. Analysis of unknown tablet. 4. Selective detection of dichlorvos by TLC. 5. Confirmation of dichlorvos by preparative TLC. 6. Determination of active pharmaceutical ingredients in paracetamol tablet by titrimetric method. 7. Estimation of Paracetamol from Paracetamol tablet by U V visible spectrometer. 8. TLC detection of Dimethoate (Rogor) using mercurous nitrate as spray reagent. 9. Extraction and detection of codeine an opium alkaloid. 	

<p>10. Confirmation of codeine by preparative TLC and FTIR spectroscopy.</p> <p>11. TLC detection of thimate (phorate) in visceral material.</p> <p>12. Determination of sodium carbonate in washing soda sample.</p> <p>13. TLC detection of Baygon-A carbamate insecticide.</p> <p>14. To determine active an available chlorine in bleaching powder.</p> <p>15. Analysis of ink by UV and HPLC (2)</p> <p>16. Extraction of alkaloid from the Datura seeds and identification by color test and TLC.</p> <p>17. Identification and confirmation of Atropine alkaloids extracted from by UV-VIS and FTIR(2)</p> <p>18. Identification of active ingredient from cannabis sativa extracted by colour test and TLC.</p> <p>19. To find the concentration of ethyl alcohol(mg/100 ml) in given sample by oxidation method.</p> <p>20. To find out the percent (v/v) of ethyl alcohol by specific gravity method and detection by colour test.</p> <p>21. Estimation of lime (calcium oxide) in given sample of cement ascertain its purity.</p> <p>22. Detection of concentration of potassium in given unknown liquid by using flame photometry.</p> <p>23. To determine the moisture (LOD) coal sample.</p> <p>24. To determine the normality and strength of HCl using 0.1N NaOH solution pH metrically.</p> <p>25. Detection of kerosene residues in homicidal cases.</p> <p>26. Instrumental analysis of given organic compound by UV and HPLC (2)</p> <p>(*Minimum 15 practical)</p>	
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OR

Specialization in Fingerprint and Questioned Document

MFST FQ-401 Fingerprint Development Technology

Title of Paper: **Fingerprint Development Technology**

Course Code: **MFST FQ-401** No. of Credits: 04

Learning Hours: 60 hrs

Course Objectives Students should be able to

- 1) To make the student aware about overall aspects of fingerprint development.
2. To enhance the understanding & knowledge of development of fingerprints.
3. To enhance the understanding & knowledge of complex types of fingerprint impressions.
4. To make the student aware about several techniques and modern approaches of fingerprint development.

Credits=4	SEMESTER- IV MFST FQ – 401 Fingerprint Development Technology	No. of hours per unit/ Credits
Credit –I UNIT I	Origin and classification of fingerprints	15
	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. Secretory glands: Eccrine (Inorganic, Organic etc.), Sebaceous (Fatty acids, Phospholipids, Wax esters, Sterols, Squalene etc.) and Apocrine. Variation of secretion with age, Composition of Latent Print residue by different agencies (UK Home Office, Oak Ridge National Library, Pacific Northwest National Library, Savannah River Technical Center research, Forensic Science Services, etc).	
Credit –I UNIT II	Fuming and optical detection techniques	15
	Principle, chemistry & mechanism, pretreatments, reagent application, limitations, environmental conditions, fixation and enhancement, applications: Iodine fuming, Cyanoacrylate fuming (vacuum, atmospheric, fluorescent CA fuming), Hydrogen fluoride, osmium/ruthenium tetroxide, soot method, disulphurdinitride. Alternate light sources: luminescence diffused reflection and reflected UV imaging. Metal deposition techniques: Principle, mechanism, pretreatments, reagent application, limitations, environmental conditions, fixation and enhancement, applications: vacuum metal deposition, multi metal deposition.	
Credit –I UNIT III	Chemical techniques	15
	Principle, chemistry & mechanism, pretreatments, reagent application, limitations, environmental conditions, fixation and enhancement, applications: silver nitrate, Ninhydrin and its analogue's, DMAC, physical developers and SPR. Development of prints on challenging surfaces (thermal paper, gloves, guns, cartridges, wet surfaces, adhesive tape, and skin), Enhancement of bloody prints. Effect of fingerprint detection techniques on subsequent DNA profiling. Age estimation of latent prints..	
Credit –I UNIT IV	Comparison and Examination	15

	<p>Classification systems: Johannes Purkinje, tripartite classification, Argentine system, Henry's classification, Battley single fingerprint system, NCIC. Palm prints: Cumins and Midlo classification systems and its significance. Edgeoscopy : Chatterjee classification Poroscopy : Significance in personal identification. 15 Fundamentals of comparison: print-to-print, trace-to-record, trace-to-print, trace-to-trace comparison. ACE-V examination method, documentation (Primary, secondary & tertiary custody documentation).</p>	
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Course Outcomes

Student should be able to:

1. Define and describe various types of fingerprints.
2. Students will know about laboratorial set up 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.
5. Understand the important aspects of comparison and examination of fingerprints.
6. Evaluate forensic examination of fingerprints by using fuming, chemical and other techniques.

Reference Books:

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, MilutinStoilovic
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 : Finger Prints 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. Gaenssleneds "Advances in Fingerprint Technology", second ed. New York: CRC Press, 2001.
9. The fingerprint sourcebook, 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.
- 12-84 by U.S. Government Printing Office Washington D.C. 12. Bailey's Textbook of Histology 16th Edition pg. 366 – 377.
13. Poroscopy, Identification News November 1982. D.R. Ashbaugh CPL pg 3-8.
14. Ridgeology, Journal of forensic Identification. 16/41 (1) 1991 by David R. Ashbaugh.

MFST FQ – 402 E1 Paper Ink and Printing Technology

Title of Paper: **Paper Ink and Printing Technology**

Course Code: **MFST FQ – 402 E1**

No. of Credits: 04

Learning Hours: 60 hrs

Course Objectives

Students should be able to

1. To make the student aware about the questioned document examination.
2. To enhance the understanding & knowledge of multiple aspects of papers.
3. To enhance the understanding & knowledge of inks and printing technologies.
4. To make the student aware about different types of examinations of questioned documents.

Credits= 4	SEMESTER- IV MFST FQ - 402 Paper Ink and Printing Technology	No. of hours per unit/ Credits
Credit –I UNIT I	Paper	15
	Introduction to paper, types of paper, basic component of paper, plant tissue: vascular and ground, types of wood: hard and soft wood, 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, 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, 16 water mark and wire marks, microscopic examination: color reaction to different fibers, Herzberg staining and Graff-C stain. Paper aging and environmental effect on paper: humidity, chemical degradation, oxidation reaction to polysaccharides, cellulose, lignin.	
Credit –I UNIT II	Ink	15

	Introduction to ink, history of ink, types of ink: nigrosine ink, logwood ink, iron nut gall ink, fountain pen ink, ball pen ink, gel pen ink, printing inks. Chemical ingredients of ink: vehicle, binder, colorant and additives (humectant, surfactant, anti-foaming agent, anti-bacterial, pH modifier, and others). Ink formulation. Ink analysis: introduction, preliminary examination, ink color assessment, pen line microscopy, microscopic specular reflectance, video spectral analysis, identification and comparison of ink by spectroscopic (UV Visible, FTIR, Raman spectroscopy, Mass spectroscopy and laser induced fluorescence methods) and chromatographic (TLC, HPTLC and HPLC) methods. Ink ageing or dating: first date production method, ink tag method, relative age comparison method, R-ratio method, p-extraction method, dye ratio method. Admissibility of report on ink dating in court.	
Credit –I UNIT III	Printing technologies	15
	History and Introduction of Industrial Printing. Principle and Mechanism of: Offset Lithography, Letterpress, Flexography, Gravure Printing, Screen Printing, Engraving, Thermography, Reprography. 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, Thermal Methods: DSC, TGA, DTA, Instrumental: HPLC, XRD, SEM, TEM, STEM, AFM, etc.	
Credit –I UNIT IV	Typewriters Digital Printers and Photocopiers	15
	Typewriters: History and Introduction of Typewriters, Mechanism of typewriting, Types of crimes including typewriters, Forensic Examination of Typewritten matter: Visual, Microscopic and Examination of Ink. Digital Printers: Introduction and history of digital printer, types of printers, Impact and Non-impact printing technologies: dot matrix printer, daisy wheel, ink jet continuous and drop on demand (DOD), thermal, laser printer etc. Components and working mechanism of: Dot matrix Printer, Inkjet printer, Laser printer and Variable Data Printers. Forensic examination of dot matrix, ink jet, laser. Photocopier: History of xerography, Components and working process of photocopier. Kinds of forgery by photocopy, inquiry related to photocopy, forensic examination of photocopier.	

Course outcomes

By the end of the paper, a student will be able to (Learning outcomes):

1. Define and describe various aspects of papers, inks, printing technologies.
2. Students will Know about the organizational structure of questioned document division.
3. Understand and perform various aspects of instrumentation and analysis of QD.
4. Understand basic principles of handwriting analysis and its application in forensic investigation.
5. To analyse and evaluate questioned documents.
6. Evaluate documents gathered from different sources like typewriters, printers etc.

Reference Books:

1. Ellen, D (1997): The scientific examination of Documents, Methods and techniques. 2nd ed., Taylor & Francis Ltd.
2. Morris (2000) : Forensic Handwriting Identification (fundamental concepts and Principals)
3. Harrison, W.R.: Suspect Documents & their Scientific Examination, 1966, Sweet & Maxwell Ltd., London.
4. Hilton, O: The Scientific Examination of Questioned Document, 1982, Elsevier North Holland Inc., New York.
5. Sulner, H.F.: Disputed Document, 1966 Oceana Publications Inc., New York.
6. Saxena's : Saxena's Law & Techniques Relating to Finger Prints, Foot Prints & Detection of Forgery, Central Law Agency, Allahabad (Ed. A.K. Singla).
7. Quirke, A.J. : Forged, Anonymous & Suspect Documents, 1930, George Rontledge & Sons Ltd., London.
8. Osborn, A. S. : Questioned Documents 1929, Boyd Printing Co., Chicago.
9. Levinson, J: Questioned Documents, 2000, Academic Press, Tokyo.
10. Kelly, J.S and Lindblom, B.S: Scientific Examination of Questioned Documents, 2006, Taylor & Francis, New York.
11. Brunelle, R.L. and Reed, R.W: Forensic Examination of Ink and Paper, 1984, Charles C Thomas Publisher, U.S.A.
12. Baker, J.N: Law of Disputed and Forged Documents, 1955, The Michie Company, Virginia.

MFST FQ – 402 E2 Advanced Document Examination

Title of Paper: **Advanced Document Examination**

Course Code: **MFST FQ – 402 E2**

No. of Credits: 04

Learning Hours: 60 hrs

Course Objectives

Students should be able to

1. To make the student aware about the Forensic Accounting and Auditing.
2. To enhance the understanding & knowledge of Forensic Linguistics and Stylistics.
3. To enhance the understanding about **Numismatic Forgery**.
4. To make the student aware about quality assurance in questioned document

Credits= 4	SEMESTER- IV MFST FQ - 402 Advanced Document Examination	No. of hours per unit/ Credits
Credit –I UNIT I	Forensic Accounting and Auditing	15
	Basic concept on account: accounting process, recording of transactions, financial statements etc., Fraud, brief history of fraud, types of fraud: employee fraud and financial statement fraud, Forensic accounting, application of forensic accounting, fraud detection, role of forensic accountant, sources of information, bank and financial institutions fraud, insurance fraud, cheque and credit card fraud, payroll fraud and their investigation etc., introduction to forensic auditing, Types of Auditing.	
Credit –I UNIT II	Forensic Linguistics and stylistics	15
	History, Definition of Forensic linguistics, disciplines of forensic linguistics: Auditory phonetics, acoustic phonetics, semantics, Discourse and pragmatics, dialect and idiolect, plagiarism detection, psycholinguistics. Language, variation in language, Stylistics: Introduction, style in language, linguistic stylistic, qualitative and quantitative analysis of style, style markers- text format, number and symbol, abbreviation, punctuation, capitalization, spelling, word formation, syntax, error and correction, high frequency word and phrases	
Credit –I UNIT III	Numismatic forgery	15
	Introduction, tool, equipments and other resource, method of forgery alteration, tooling, embossing, application and plating, Casting: Rubber mold model, wax model from mold, Burn out wax, treatment of casting, Creating dye- Cutting by hand, plating, Forensic identification of fake coins.	
Credit –I UNIT IV	Quality assurance in questioned document	15

	<p>Quality management in document laboratory, NABL guideline for accreditation of QD lab, report writing: expert intro, received document details, query, reason for opinion, opinion/report etc., importance of qualified opinion, no opinion, expert testimony: introduction, purpose, preparation for trial in court, sequence for examination of expert: examination in chief, cross examination, re-examination, Daubert guidelines, debonair of expert, limitation to forensic questioned document examiner.</p>	
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Course outcomes

By the end of the paper, a student will be able to (Learning outcomes):

1. To make the student aware about the Forensic Accounting and Auditing.
2. To enhance the understanding & knowledge of Forensic Linguistics and Stylistics.
3. To enhance the understanding about **Numismatic Forgery**.
4. To make the student aware about quality assurance in questioned document

Reference Books:

1. Tommie W. Singleton, Aaron J. Singleton – 2010 Fraud Auditing and Forensic Accounting.
2. Mark Nigrini - 2011 Forensic Analytics: Methods and Techniques for Forensic Accounting.
3. Joseph Petrucelli – 2013 Detecting Fraud in Organizations: Techniques, Tools, and Resources.
4. Mary-Jo Kranacher, Richard Riley, Joseph T. Wells – 2010 Forensic Accounting and Fraud Examination.
5. Steven L. Skalak, Thomas W. Golden, Mona M. Clayton – 2011 A Guide to Forensic Accounting Investigation
6. Larry E. Rittenberg, Karla M. Johnstone, Audrey A. Gramling – 2011 Auditing: A Business Risk Approach
7. George A. Manning, Ph.D, CFE, EA - 2010 Financial Investigation and Forensic Accounting, Second Edition
8. Saurav K. Dutta – 2013 Statistical Techniques for Forensic Accounting
9. K. H. Spencer Pickett – 2010 The Internal Auditing Handbook
10. Joseph T. Wells – 2007 Corporate Fraud Handbook: Prevention and Detection
11. Walter J. Pagano, Thomas A Expert Witnessing in Forensic Accounting
12. Jack Bologna, Robert J. Lindquist - 1995 Fraud auditing and forensic accounting: new tools and techniques
13. Xenia Ley Parker, Lynford Graham – 2007 Information Technology Audits

MFSP-FQ -403Title of Paper: **Practical**Course Code: **MFSP-FQ- 403**

No. of Credits: 02

Credits=2	SEMESTER-IV	No. of hours per unit/ Credits – (30)
	<ol style="list-style-type: none">1.To develop Latent prints by Cyanoacrylate fuming2. To develop latent prints by SPR method3. To develop fingerprints on challenging surfaces4. To study the effect of environment on fingerprint development5. To classify fingerprint cards by FBI Henry's classification system6. To classify fingerprint cards by Indian Henry's classification system7. To classify fingerprint card by NCIC classification system8. To classify fingerprint cards by Argentine classification system9. To compare chance prints with a known prints10. To make pulp for paper sheet formation through Kraft method.11. Preparation of paper sheet through recycled paper.12. Identification and detection of different types of ink through instrumental techniques.13. Microscopic examination of different types of ink.14. Identification of source of photocopier machine by examination photocopied documents.15. Identification of different types of printing technology on documents.16. Identification and detection of type written matter on documents.17.To perform TLC analysis of ink of various pens (2).18. To perform TLC analysis of toners (2).19. To perform FT-IR analysis of handwriting strokes/printed documents (3).20. To perform FT-IR analysis of currency and other security documents (2).21. To perform UV-Vis analysis of various ink dyes.22. To extract features from handwritten documents/signature (2).23. To classify data using various classifiers (3).24. To enhance charred document images.25. To study a pattern recognition framework for ink analysis26. To study a pattern recognition framework for paper analysis27. To study a pattern recognition framework for signature verification.28. To study a pattern recognition framework for Handwriting Examination.	

	<p>29. To study a pattern recognition framework for fingerprint examination</p> <p>30. To study a pattern recognition framework for matching of torn documents.</p> <p>31. To enhance various fingerprint images.</p> <p>32. To apply various pattern recognition operators. (*Minimum 20 practical)</p>	
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OR

Specialization in Forensic Physics and Cyber Forensics

MFST-PC: 401

Title of Paper: **Applied Forensic Physics**

Course Code: **MFST-PC: 401**

No. of Credits: 04

Learning Hours: 60 hrs

Course Objectives

Students will be able to -

- 1) Analyze accidents crime scene
- 2) understand fourier analysis
- 3) understand different types of microscopes
- 4) understand linkage between firearm and bullets

Credits=4	SEMESTER- IV MFST PC-401 Applied Forensic Physics	No. of hours per unit/ Credits
Credit –I UNIT I	Vehicular accidents reconstruction	15
	Introduction, Analytical tools used, Converting Scene data into an event sequence, Basic energy methods, Basic momentum methods, Accident analysis; Post crash movements, Collision model and Accident reconstruction calculations, Skid marks and evaluation of speed, Occupant kinematics, Biomechanics of injuries, Tips and solution strategies. Hit and Run cases and investigation: 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.	

Credit –I UNIT II	Speaker identification and tape authentication	15
	voice production theory- vocal anatomy, speech signal processing and pattern recognition-basic factors of sound in speech acoustic characteristics of speech signal, Fourier analysis, frequency and time domain representation of speech signal, analogue to digital signal and conversion, fast Fourier transform, quantization and speech enhancement, analysis of audio-video signal for authenticity, introduction to the techniques of pattern recognition and comparison.	
Credit –I UNIT III	Forensic Microscopy	15
	Basics of microscope, common terms used in microscopy, Construction, working, applications and limitations of - Compound microscope, Comparison microscope, Stereomicroscope, Polarizing microscope, Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM). Introduction to: Environmental Scanning Electron Microscope (ESEM), X- Ray Photoelectron Spectroscopy (XPS), Secondary Ion Mass Spectrometer (SIMS), X- Ray Fluorescence (XRF), Atomic Force Microscope (AF & TS), Phase contrast Microscope and Digital Microscope.	
Credit –I UNIT IV	Firearm Identification	15
	Introduction, Class and Individual Characteristics, Identification on basis of fired cartridge, Bullet, Pellet, Comparison: Side by side match, composite match, superimposition technique, Deciphering of serial numbers, Recovery of Test Fired Cartridge Case Bullet, Velocity measurement, Pattern Testing, Study of Injury report /PM Report, Distinguishing a fired shot from unfired, An examination of Cartridge case, Identification of Shooter: Collection of GSR, Marks on the Target, Detection	

Course outcomes

Student should be able to:

1. understand vehicular accidents reconstruction
2. Photographs and plans of accident scene
3. Velocity estimation from skid marks.
4. Restoration of erased / obliterated marks.
5. To study brake action of various automobiles.

Reference Books:

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

MFST-PC 402 E1**Forensic Physics & Cyber Forensics**Title of Paper: **Cloud Security (Theory)**Course Code: **MFST-PC402 E1**

No. of Credits: 04

Learning Hours: 60 hrs

Course Objectives:

1. To Study cloud-based applications.
2. To Study applications on a real cloud.
3. To analyze and troubleshoot the problems while deploying applications on cloud.
4. To Analyze the Use LAMP technology for developing applications using the cloud.
5. To Perform & understand Vulnerability Assessment
6. To Enhance knowledge of cloud security compliance management.

Credits= 4	SEMESTER- IV MFST PC-402 Cloud Security	No. of hours per unit/ Credits
Credit –I UNIT I	Introduction to Cloud Computing	15
	Cloud Computing definition, private, public and hybrid cloud. Cloud types; IaaS, PaaS, SaaS. Benefits and challenges of cloud computing, public vs private clouds, role of virtualization in enabling the cloud; Business Agility: Benefits and challenges to Cloud architecture. Application availability, performance, security and disaster recovery; next generation Cloud Applications	
Credit –I UNIT II	Cloud Application Architecture and security	15
	Technologies and the processes required when deploying web services - Deploying a web service from inside and outside a cloud architecture - advantages and disadvantages	

Credit –I UNIT III	Implementing Cloud Application, Services and security	15
	Reliability, availability and security of services deployed from the cloud. Performance and scalability of services - Cloud Economics: Cloud Computing infrastructures available for implementing cloud based services. Cloud security controls, Dimensions of cloud security, Cloud Vulnerability and Penetration Testing, Data security, Encryption, Compliance.	
Credit –I UNIT IV	Cloud Application Development & IT Model & Importance of Cloud Technology	15
	Corporate Service creation environments to develop cloud-based applications. Development environments for service development; Amazon, Azure, Google App. Applicability of laws to data stored outside the nation's boundary. Economics of choosing a Cloud platform for an organization - Based on application requirements, economic constraints and business needs - Discuss industry cases including open sources.	

Course Outcomes:

Student should be able to:

1. Develop cloud-based applications.
2. Deploy the application on a real cloud.
3. To analyze and troubleshoot the problems while deploying applications on cloud.
4. Use LAMP technology for developing application using the cloud.
5. Use public cloud like IBM Bluemix, Amazon AWS, for developing an application.
6. Performing vulnerability assessment and penetration testing on cloud.
7. Performing configuration review on different clouds.
8. Enhance knowledge of cloud security compliance management.

MFST PC 402 E2

Title of Paper: Operating System(**Theory**)

Course Code: **MFST PC 402 E2**

No. of Credits: 04

Learning Hours: 60 hrs

Course Objectives:

1. Understand the basics of operating system
2. Understand the memory management
3. Understand Input Output and File management.
4. Understand the knowledge about deadlocks

Credits= 4	SEMESTER- IV MFST PC-402 E2 Operating System	No. of hours per unit/ Credits
Credit –I UNIT I	Basics of Operating System	15
	Introduction: Basics of Operating Systems: Definition – Generations of Operating systems – Types of Operating Systems, OS Service, System Calls. OS structure: Layered design, Monolithic, Microkernel Operating Systems ,Kernel based OS, Concept of Virtual Machine. Processes: Definition , Process Relationship , Process states , Process State transitions , Process Control Block , Threads – Concept of multithreads , Benefits of threads – Types of threads	
Credit –I UNIT II	Memory Management	15
	Memory Management :Basic Memory Management: Definition, Logical and Physical address map, Memory allocation: Contiguous Memory allocation – Fixed and variable partition – Internal and External fragmentation and Compaction , Paging : Principle of operation – Page allocation – Hardware support for paging – ,Protection and sharing – Disadvantages of paging. Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault , Working Set , Dirty page/Dirty bit – Demand paging (Concepts only) – Page Replacement policies : Optimal (OPT) , First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU)	
Credit –I UNIT III	I/O & File Management	15
	I/O Management Principles of I/O Hardware: I/O devices, Device controllers , Direct memory access Principles of I/O Software: Goals of Interrupt handlers , Device drivers , Device independent I/O software , Secondary-Storage Structure: Disk structure ,Disk scheduling algorithm File Management File concept, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table),efficiency & performance. Process Scheduling: Definition , Scheduling objectives ,Types of Schedulers ,Scheduling criteria : CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time (Definition only) , Scheduling algorithms : Pre emptive and Non , pre emptive , FCFS – SJF – RR , Multiprocessor scheduling : Types , Performance evaluation of the scheduling. Interprocess Communication.	
Credit –I UNIT IV	Deadlocks	15

	Deadlocks: Definition, Deadlock characteristics , Deadlock Prevention , Deadlock Avoidance :banker’s algorithm, Deadlock detection and Recovery. Recovery and Fault Tolerance :Recovery Concept ,Recovery Data, Tolerance and Faults, Unix/Linux Operating System Development Of Unix/Linux, Role & Function Of Kernel, System Calls, Elementary Linux command & Shell Programming, Directory Structure, System Administration Case study: Linux, Windows Operating System Windows 2008 Operating system: Installation and create Active directory	
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Course Outcomes:

Student should be able to:

1. Understand the basics of operating system
2. Understand the memory management
3. Understand Input Output and File management.
4. Understand the knowledge about deadlocks

Reference Books –

1. Operating System Concepts (8th Edition) by Silberschatz, Peter B. Galvin and Greg Gagne, Wiley Indian Edition (2010).
2. Modern Operating Systems (Third Edition) by Andrew S Tanenbaum, Prentice Hall India (2008).
3. Principles of Operating Systems by Naresh Chauhan, Oxford Press (2014). 69
4. Operating Systems by D.M. Dhamdhere, Tata McGraw Hill 2nd edition.
5. Operating Systems (5th Ed) – Internals and Design Principles by William Stallings, Prentice Hall India, 2000.
6. UNIX Concepts and Applications(4th Edition)– by Sumitabha Das, Tata McGraw Hill.
7. Unix Shell Programming – by Yashwant Kanetkar, BPB publications.

MFSP-PC -403

Title of Paper: **Practical**

Course Code: **MFSP-PC - 403**

No. of Credits: 02

Credits=2	SEMESTER-IV	No. of hours per unit/ Credits – (30)
	<ol style="list-style-type: none"> 1. To study the different camera controls. 2. Document photographic techniques – Close up photography , UV , IR, Transmitted and oblique light photography 3. Contact and trick photography. 4. Preparation of Juxtapose charts. 5. Photography of Watermarks and wire marks. 6. Analysis of samples using optical microscope. 7. Analysis of samples using Comparison microscope 8. Study of calibre and rifling characteristics 9. Examination of firearm(s). 10. To study assembling and dismantling of firearms. 	

<p>11. To study the working mechanism of firearm(s). 12. Examination of air guns / rifles as per Arms Act 1959. 13. Determination of shot number from size and weight of shots. 14. Physical examination of propellant of ammunition. 15. Examination of choking in shotgun. 16. Study of constructional features of improvised firearms. 17. To study proof mark of firearm. 18. Study of constructional features of cartridge. 19. To study proof mark of cartridge. 20. To study lands and grooves in rifled weapons. 21. Restoration of erased serial numbers using physical / chemical methods 22. Examination of vehicle identification numbers.. 23. Examination of bulb filament. 24. Examination and analysis of paint chips collected from hit and run cases. 25. Examination and analysis of glass pieces collected from hit and run cases (*Minimum 10 practical in above session)</p> <p>1. Working with advance network diagnostic and connectivity commands 2. To study networking commands for foot print 3. To configure DSL and Router for Internet Connection 4. To study network cable crimping and configure LAN in a office 5. To study working of TCP/IP and DHCP 6. To shear printer, Local drive in network 7. Performing VLAN and routing configuration 8. Wireless networking and VPN configuration 9. Network administration services and security measure application 10. Detail MAC Analysis 11. Email header and URL analysis 12. Network filtering audit 13. Lan Scanner using look@LAN, wireshark. 14. Auditing with and without network traffic 15. Live Network evidence Capture process 16. To Install and configure windows server and Linux server 17. Live system evidence Capture process 18. Advance Mobile device forensic analysis 19. Working on Cell phone tower site and Cell phone Hub 20. Understanding content providers and permissions: 21. Read phonebook contacts using content providers and display in list. 22. Read messages from the mobile and display it on the screen 23. To Perform Installation Process of Cloud based application. 24. To Perform Vulnerability Assessment On Docker.</p>	
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	25.To understand Security controls of Cloud based applications. 26.To understand the Cloud configuration process. 27.Building and Deploying JAVA/NODE.js based application on public cloud-based application 28.Perform Black box penetration testing on Cloud applications to get access to internal cloud resources 29.Performing cloud configuration review on a public cloud platform 30.Performing vulnerability assessment on EC2 containers using Nessus. 31.Performing vulnerability assessment on Docker using Nessus. 32.Performing signature rapping attacks and side channel attacks in cloud-based applications. 33.Security Controls in Cloud and Tools used for Security Control Implementation (*Minimum 10 practical in above session)	
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OR

Specialization in Forensic Serology and DNA Profiling

MFST SD-401

Title of Paper :**Forensic Serology**

Course Code: **MFST SD-401**

No. of Credits: 04

Learning Hours : 60 hrs

Course Objectives: Students will able to:

- 1.understand Blood and blood stains
- 2.understand body fluids and its composition
- 3.understand the serological techniques
- 4.understand the Electrophoresis and Blotting techniques

Credits= 4	SEMESTER- IV MFST SD-401 Forensic Serology	No. of hours per unit/ Credits
Credit –I UNIT I	Blood and blood stains	15

	Physical examination, presumptive test(TMB, Kastle-Meyer Test, Luminol) Confirmatory Tests (Takayama, Teichmann, spectrophotometric);Examination of Menstrual blood & its stains-Physical & Microscopic examination, Identification by Fibrin Degradation product; Identification of other body fluids and their stains; Semen and seminal stains-Physical Examination, Presumptive test(Acid Phosphatase Test),Confirmatory test (microscopic examination) Gram staining, cross-over electrophoresis;Examination of vaginal fluid & stains of vaginal secretions-Physical examination, SAP/VAP electrophoresis, Lugol's stain;Examination of saliva & saliva stains-starMFS-iodine test,salivary haemagglutinin test,radial diffusion test for amylase; Examination of vomit-test for mucus,test for free HCL(Gunzberg's test),endothelial cells;Examination of urine stains-Physical stains, odour test,urea nitrate crystal test, creatinine test.	
Credit –I UNIT II	Body Fluids	15
	Types and distribution of body fluids, urine formation, composition, properties, abnormal constituents and clinical significance; Beta HCG; CSF, lymph, amniotic fluid, sweat composition, formation and function; semen, synovial fluid, gastrointestinal secretions composition, formation and function; tears, milk, faeces; saliva, aqueous humour, Vaginal fluid, epithelial cells, etc. their analysis and forensic significance.	
Credit –I UNIT III	Serological reagents	15
	Antigens, Antibodies (Polyclonal antibodies, Monoclonal antibodies, antiglobulins), Antigen-antibody binding reactions (Primary, Secondary); Serological techniques- primary binding assays-ELISA Immunochromatographic Assays; Secondary Binding Assays Precipitin-based Assays (Immunodiffusion, electrophoretic methods);Agglutination based Assays (Direct agglutination Assay, passive agglutination Assay, Agglutination Inhibition assay).	
Credit –I UNIT IV	Electrophoresis and Blotting techniques	15
	Theory and general principles, Various factors affecting electrophoresis, low and high voltage electrophoresis, horizontal and vertical Electrophoresis; Various electrophoretic techniques– Sodium dodecyl sulphate (SDS), Agarose Gel Electrophoresis (AGE), Polyacrylamide Gel Electrophoresis (PAGE), Iso- electric focusing (IEF), Gel immuno-diffusion assay, Southern, Northern, Western Blotting.	

Course Outcomes

After studying this Paper Students will be able to

- 1.Understand the Blood and blood stains Examinations
- 2.Understand Electrophoresis and Blotting techniques
- 3.Identification of Biological fluids and its Analysis
- 4.Understand the various Serological techniques

Reference Books

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

MFST SD-402 E1

Title of Paper :**DNA Profiling and Interpretation**

Course Code: **MFST SD-402 E1**

No. of Credits: 04

Learning Hours : 60 hrs

Learning Objective:

1. To Study the DNA as a evidence
2. To Study the methods of DNA extractions
3. To analyze the techniques in molecular biology
4. To study the DNA profiling Techniques and its applications

Credits= 4	SEMESTER- IV MFST SD-402 E1 DNA Profiling and Interpretation	No. of hours per unit/ Credits
Credit –I UNIT I	Sample collection	15

	DNA sample sources, biological evidence at crime scenes, evidence collection and preservation, collection of reference DNA samples, storage and sample characterization, sample storage and transport of DNA evidence, sample characterization: blood stain, saliva stains, semen stains, body fluid identification by RNA testing, contamination concerns	
Credit –I UNIT II	DNA extraction and Quantification methods	15
	Organic (Phenol-chloroform) extraction, chelex extraction, FTA paper, Solid phase DNA extraction methods: Qiagen extraction Chemistry and kits, DNA IQ (Identification & quantification), Profiler, Differential extraction, Direct PCR. DNA quantification: Slot blot, Pico-green micro-titer plate assay, AluQuant human DNA quantification system, endpoint PCR, real time quantitative PCR (QPCR).	
Credit –I UNIT III	Molecular Biology	15
	Structure of STR loci, Development of STR multiplexes, Detection of STR polymorphisms, Interpretation of STR profiles, Assessment of STR profiles, Stutter peaks, split peaks, pull up, template DNA, overloaded profiles, low template DNA typing, peak balance, mixtures, degraded DNA, PCR inhibition	
Credit –I UNIT IV	DNA profiling Techniques	15
	DNA profiling applications & case studies in disputed paternity cases, child swapping, missing person's identity, civil immigration, veterinary, wildlife and agriculture cases ;Legal perspectives – legal standards for admissibility of DNA profiling – procedural & ethical concerns, status of development of DNA profiling in India & abroad; Limitations of DNA profiling; Population databases of DNA markers –STRs, Mini STRs, SNPs. New & future technologies: Analysis of SNP, DNA chip technology- Microarrays cell free DNA , Synthetic DNA, Degraded DNA, Principles and components of capillary electrophoresis, new technologies and automation: Mass spectrometry, pyro-sequencing	

Course outcomes:

After studying this Paper Students will be able to

1. Understand the DNA and other evidence collection and preservation
2. Understand DNA extractions and quantifications methods
3. Study the DNA profiling techniques.

4. Understand the molecular techniques used in analysis of forensic evidences

Reference Books:

1. An Introduction to Forensic DNA Analysis, Rudin, Norah CRC Leviw Publishers, (2002)
2. An Introduction to Forensic DNA Analysis, Inman, Keith CRC Press, (1997)
3. Ancient DNA, Herrmann, Bernd Springer Publishing Co., (1994)
4. Basics of DNA and Evidentiary Issues, Vij, KrishanJaypee Brothers, (2004)
5. DNA, forensic and legal applications Kobilinsky, Lawrence John Wiley & Sons, (2005)
6. DNA Cloning 4: Mammalian systems, Glover, D.M.; IRL Press,(1995)
7. DNA Damage and repair, Nickoloff, Jac A Humana Press,(1998)
8. DNA Evidence and Forensic Science, Newton, David E. Viva books private limited,(2010)
9. DNA fingerprinting, Kirby, Lorne W H Freeman and Co, (1992)
10. DNA Fingerprinting: Approaches and applications. T. Burke, Terry BirkhauserVerlage,(1991)
11. DNA in forensic science, Robertson, J Ellis Horwood Ltd., (1990)
12. DNA profiling Eastel, Simon, Harwood academic Publishers,(1993)
13. DNA profiling and DNA fingerprinting, Epplen, Jorg T BirkhauserVerlage,(1999)
14. DNA technology, Alcamo, I Edward Harcourt Academic Press,(1999)
15. DNA tests in Criminal Investigation Trial & Paternity Disputes Singh, Yashpal, Alia Law Agency,(2006)
16. Forensic DNA typing, J.M. Butler Elsevier Academic press,(2005)
17. Forensic DNA technology, Mark A. Farley & James J. Harrington CRC Press,(1991)
18. Forensic DNA analysis, J. Thomas McClintock Lewis Publications, (2008)
19. Forensic DNA typing protocol: Carracedo

MFST SD-402 E2

Title of Paper : Eukaryotic Genetics & DNA Fingerprinting

Course Code: **MFST SD-402 E2**

No. of Credits: 04

Learning Hours : 60 hrs

Learning Objective:

1. Understand the Mendelian genetics & chromosomal inheritance
2. Understand the genome organization
3. Understand the mutations and repair
4. Understand the forensic genetics and non human testing.

Credits= 4	SEMESTER- IV MFST SD-402 E1 Eukaryotic Genetics & DNA Fingerprinting	No. of hours per unit/ Credits
Credit –I UNIT I	Mendelian genetics and Chromosomal inheritance	15

	Mendelian laws of inheritance and its deviations, Types of inheritance (Dominant inheritance, recessive inheritance, sex-linked inheritances, and polymorphic traits) Population genetics (Mendelian Population, gene pool, Hardy- Weinberg equilibrium, deviation from H-W equilibrium, genotypes, phenotypes, multiple alleles, genetic variants), Mitosis, meiosis, sex chromosomes, sex linkage, nondisjunction of X chromosomes, genotypic sex determination, genic sex determination, X –linked recessive inheritance, X-linked Dominant inheritance, Ylinked inheritance.	
Credit –I UNIT II	Genome organization	15
	Structure of DNA (A,B,Z forms of DNA) Structure of chromatin, chromosome, centromere, telomere, nucleosome, genome organization, chromatin remodeling; types of histones, histone 47 modifications-methylation, acetylation, phosphorylation and its effect on structure and function of chromatin, DNA methylation, repetitive and non-repetitive DNA sequence, Law of DNA constancy, C value paradox and genome size, Karyotype and ideogram, chromosome banding pattern, types of chromosomes, Giant chromosomes- polytene and lamp brush chromosome	
Credit –I UNIT III	Mutations & Repair	15
	Mutations and their causes, types of mutation (Chromosomal and Gene), mutagens , inducedmutagenesis (UV, nitrosoguanidine, ethyl methane sulfonate) mutation rate, genetic load). Disorders: Metabolic disorders: introduction and examples (Amino acid metabolism - Phenylketonuria, Carbohydrate metabolism: lactose intolerance, genetic disorders and examples (Hemophilia, thalessemia, sickle cell anemia, Down’s syndrome, Turners syndrome), molecular Basis and detection of inherited disease, gene mapping and genetic risk assessment, Repair mechanisms (Photoreactivation, Base excision, Mismatch, Nucleotide excision, SOS repair)	
Credit –I UNIT IV	Introduction to Forensic Genetics and Non-human DNA testing	15

	Human genetic variations, human chromosomes, Normal chromosome set, Genetic markers and their forensic significance, Types of STR markers, STRs used in forensic DNA typing, core and common STR markers. Non-human DNA testing: Sources, domestic animal DNA testing (cat DNA, dog DNA), Canine STR Loci and assays, Canine mtDNA Testing, species identification: (mtDNA Cytochrome b gene, mtDNA 12S rRNA gene, mtDNA COI gene), Wildlife DNA testing: genetic markers, geographic origin identification (Divergent populations with gene exchange, populations with high gene-exchange, and populations with low gene-exchange) Biosensors, use of remote sensing techniques for population study of endangered plants and animal species. DNA banks for endangered animals and DNA database controversies.	
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Course outcomes:

After studying this Paper Students will be able to

1. Understand the Mendelian genetics & chromosomal inheritance
2. Understand the genome organization
3. Understand the mutations and repair
4. Understand the forensic genetics and non human testing.

Reference Books –

1. Genetics a conceptual approach: Fourth edition by Benjamin Pierce.
2. An Introduction to Forensic Genetics: William Goodwin, Adrian Linacre, SibteHadi
3. Forensic DNA Typing : Biology, Technology, and Genetics behind STR Markers by John M. Butler
4. An Introduction to Forensic Genetics, (2007): Goodwin William, John Wiley & Sons Ltd,
5. Basic human genetics (1991) :Kapur V, Jaypee Brothers
6. Essentials of Human Genetics (2009): Kothari, Manu L, Universities Press (India) Pvt .Ltd.
7. Fundamentals of Genetics,(2006) :Singh, B.D., Kalyani Publishers
8. Genes IX,(2008): Lewin, Benjamin Jones and Bartlett Publishers
9. Genetic influences on neural and behavioral functions. (2000): Pfaff, Donald W CRC Press
10. Genetic Markers in Human Blood,(1969): Giblett, Eloise R. Blackwell Scientific Publications
11. Genetics, (2003): Winter, P.C; Viva Books Pvt. Ltd.,
12. Genetics Altenburg, (1970): Edgar, Oxford& IBH Publishing Co.
13. Genetics Strickberger, (2005): Monroe, Prentice Hall of India Lt

MFSP-SD -403

Title of Paper: **Practical**

Course Code: **MFSP-SD - 403**

No. of Credits: 02

Credits=2	SEMESTER-IV	No. of hours per unit/ Credits – (30)
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<ol style="list-style-type: none"> 1. PCR amplification of DNA. 2. RFLP 3. To Perform RAPD 4. Accessing DNA Databases: NCBI, DDBJ, Ensemble 5. Accessing Protein Databases: Swissprot , Genpept, tremble, uniprot. 6. Bioinformatics softwares: Clustal V, Clustal W 1. 7. RasMol, Oligo, Molscript, Treeview, Alscript, Genetic analysis software 7. Comparing different Gene sequences using BLAST 8. Detection of mercury, arsenic, lead, petroleum products with the help of HPLC and GC-MS techniques. 9. Culture and identification of important microbes for forensic studies. 10. Etiological study of forensic plant pathological pathogens. 11. Detection of Pesticides in soil and water sample. 12. Study of various water samples for pollutants 13. Visit to Mortuary 14. Study of injuries 15. Extraction of plasmid and transformation in bacterial cell. 16. Southern hybridization /Blotting 17. DNA– Isolation from bones/teeth/tissues/saliva/hair root/ seminal stains/nails 18. PCR– amplifications and polyacrylamide gel electrophoresis and silver staining. 19. Differential centrifugation for separation of epithelial cell from sperm 20. Identification of wood using physical and anatomical features. 21 Identification and classification of diatoms. 22. Examination of hair of different animals as cat, dog, cow, horse and goat. 23. Identification of pollen grains to genus level 24. Identification of starch granules. 25. Staining techniques and laboratory exercises for identification of different plant cell types. 26. Microscopy of various plants fibers. 8. Differentiation of fibers including sisal, manila, jute and cotton based on ashing. 27. Microscopic examination of man-made fibers. 28.10. Section and cutting of plant material and their examination. 29. Step wise method for collection of botanical evidence 30. Collection and processing of algal evidence in forensic investigation 31. Collection, identification and preservation of entomological evidence 32. Laboratory rearing of forensically significant insects. 33. Impact of drugs and toxin on insect development 	
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	34. Identification of human bones and determination of their sides. 35. Determination of age from skull, teeth, sex from skull and pelvis 36. Alignment of the bones according to their anatomical positions 37. Stature estimation from long bones (*Minimum 20 practicals)	
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Course Code: **MFSP CT 404/ MFSP FQ 404/ MFSP PS 404 / MFSP SD 404**

Title of Paper: **Major Project**

No. of Credits: 01

Credits= 1	<p style="text-align: center;">SEMESTER-IV</p> <p style="text-align: center;">Major Project</p>
	<p>The major project will be compulsory to all students. The format for project report will be similar to the research thesis style; incorporating chapters on: Introduction, Materials and Methods, Results and Discussion and References / Bibliography. The project will be submitted in a typewritten and bound form. Copy of each project will be submitted to the department and the centre will store it permanently. Project on forensically significant and need based problems in the area of specialization.</p>