

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY



CIRCULAR NO.SU/Sci./Forensic Sci./67/2021

It is hereby inform to all concerned that, the syllabus prepared by the Ad-hoc Board in Forensic Science and recommended by the Dean, Faculty of Science & Technology the Hon'ble Vice-Chancellor has accepted the following syllabi in his emergency powers under section 12(7) of the Maharashtra Public Universities Act, 2016 on behalf of the Academic Council as appended herewith for University and Affiliated Colleges.

Sr.No.	Syllabus (under Choice Based Credit System)
1.	M.Sc. Forensic Cyber semester Ist to IVth.
2.	M.Sc. Forensic Toxicology semester Ist to IVth.
3.	M.Sc. Applied Physics and Ballistics semester Ist to IVth.
4.	PG Diploma in Digital and Cyber Forensic & Related Law semester Ist and IInd
5.	PG Diploma in Forensic Science & Related Law semester Ist and IInd
6.	Service Course

This shall be effective from the Academic Year 2021-22 and onwards.

All concerned are requested to note the contents of this circular and bring notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.

REF.NO. SU/Sci/2021/4692-700

Date:- 06-12-2021.

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*Deputy Registrar,
Academic Section.*

Copy forwarded with compliments to :-

- 1] **The Principal of all affiliated concerned Colleges,**
Dr. Babasaheb Ambedkar Marathwada University,
- 2] **Head of the Department, Department of Forensic Science,**
Dr. Babasaheb Ambedkar Marathwada University, Aurangabad.
- 3] **The Director, University Network & Information Centre, UNIC,**
with a request to upload this Circular on University Website.

Copy to :-

- 1] The Director, Board of Examinations & Evaluation, Dr. BAMU, A'bad.
- 2] The Section Officer, [M.Sc. Unit] Examination Branch, Dr. BAMU, A'bad.
- 3] The Programmer [Computer Unit-1] Examinations, Dr. BAMU, A'bad.
- 4] The Programmer [Computer Unit-2] Examinations, Dr. BAMU, A'bad.
- 5] The In-charge, [E-Suvidha Kendra], Rajarshi Shahu Maharaj Pariksha Bhavan, Dr. BAMU, A'bad.
- 6] The Public Relation Officer, Dr. BAMU, A'bad.

**Dr. Babasaheb Ambedkar Marathwada University,
Aurangabad**



**STRUCTURE AND CURRICULAM
FOR**

**M.Sc. Forensic Toxicology Programme
(Choice Based Credit System)**

Academic Year **2021-22** onwards

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University, Aurangabad

Attendance:-

Students must have minimum of 75 % attendance in each theory, practical paper for appearing examination otherwise he / she will not be strictly allowed for appearing the University examination. However, students having 65 % attendance may request Head of the concerned Institution for the condonation of attendance on medical ground.

Evaluation Methods:-

The assessment will be based on continuous internal assessment (CIA) and semester end examination (SEE). There shall Continuous Internal Assessment for each theory paper. In all semester, 20% (i.e. 15) marks shall be for CIA and 80% (i.e. 60) marks for SEE. Marks obtained by the student in all heads viz. CIA and SEE shall be added while declaring the final result.

Continuous Internal Assessment (CIA):-

The internal marks shall be assigned on the basis of tutorials/ home assignment /seminar presentation and weekly tests/preliminary examination to be conducted by the concerned Institution. These marks shall be communicated to the University before commencement of semester end examination.

Semester End Examination (SEE) :

The semester end examination for each theory and practical paper shall be conducted by the University at the end of each semester.

Results Grievances / Redressal and ATKT rules :-

Result Grievances / redressal /revaluation and ATKT rules shall be as made applicable by the University from time to time.

Earning Credits:-

At the end of every semester, a letter grade will be awarded in each course for which a student had registered. A student's performance will be determined by the number of credits that he/she earned by the weighted Grade Point Average (GPA). The SGPA (Semester Grade Point Average) will be awarded after completion of respective semester and the CGPA (Cumulative Grade Point Average) will be awarded at the end of the 4th semester by the University.

Grading System:-

- A ten point rating scale shall be used for the evaluation of the performance of the students to provide letter grade for each course and overall grade for the Master Programme. Grade points are based on the total number of marks obtained by him / her in all heads of the examination of the course. The grade points and their equivalent range of marks are shown in the following Table

Table : Ten point grade and grade description

Marks Obtained (%)	Grade Point	Letter Grade	Description
90-100	9.00- 10	O	Outstanding
80-89	8.00-8.90	A ⁺⁺	Exceptional
70-79	7.00-7.90	A ⁺	Excellent
60-69	6.00-6.90	A	Very Good
55-59	5.50-5.90	B ⁺	Good
50-54	5.00-5.40	B	Fair
45-49	4.50-4.90	C ⁺⁺	Average (Above)
41-44	4.1-4.49	C	Average
40	4.0	P	Pass
< 40	0.0	F	Fail (Unsatisfactory
	0.0	AB	Absent

- Non appearance in any examination / assessment shall be treated as the students have secured zero marks in that subject examination / assessment.
- Minimum P grade (4.00 grade points) shall be the limit to clear / pass the course / subject. A student with F grade will be considered as 'failed' in the concerned course and he / she has to clear the course by appearing in the next successive semester examinations.
- Every student shall be awarded grade points out of maximum 10 points in each subject (based on 10 point scale). Based on the grade points obtained in each subject, Semester Grade Point Average (SGPA) and then Cumulative Grade Point Average (CGPA) shall be computed. Results will be announced at the end of each semester and CGPA will be given on the completion of M. Sc. programme.

Computation of SGPA (Semester Grade Point Average) and CGPA (Cumulative Grade Point Average)

Grade in each subject / paper will be calculated based on the summation of marks obtained in internal and semester end examination.

The computation of SGPA and CGPA will be as below

- Semester Grade Point Average (SGPA) is the weighted average points obtained by the students in a semester and will be computed as follows

$$\text{SGPA} = \frac{\text{Sum (Course Credit X Number of Grade Points in concern Course Gained by the Student)}}{\text{Sum (Course Credit)}}$$

The SGPA will be mentioned on the mark sheet at the end of every semester.

- The Cumulative Grade Point Average (CGPA) will be used to describe the overall performance of a student in all semester of the course and will be computed as under.

$$\text{CGPA} = \frac{\text{Sum (All four Semester SGPA)}}{\text{Total Number of Semester}}$$

The SGPA and CGPA shall be rounded off to the second place of decimal.

Grade Card:-

Results will be declared and the grade card (containing the grades obtained by the student along with SGPA) will be issued by the university after completion of every semester. The grade card will be consisting of following details.

- Title of the courses along with code opted by the student.
- Credits associated with the course.
- Grades and grade points secured by the student.
- Total credits earned by the student in a particular semester.
- Total credits earned by the students till that semester.
- SGPA of the student.
- CGPA of the student (at the end of the 4th semester).

Cumulative Grade Card:-

The grade card sheet showing details grades secured by the student in each subject in all semester along with overall CGPA will be issued by the University at the end of 4th semester.

Course Structure:**MSCFTS- M.Sc. Forensic Toxicology Semester, P-Paper, L-Lab, D- Dissertation****Semester I**

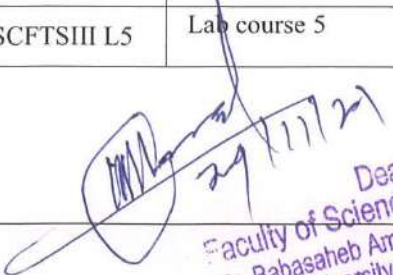
Course	Course Title	Teaching time/week	Marks	Credits
MSCFTSI P1	Essentials of Toxicology	4 hours	100	4
MSCFTSI P2	Forensic Chemistry	4 hours	100	4
MSCFTSI P3	Instrumentation- Spectroscopy	4 hours	100	4
MSCFTSI P4	Analytical Chemistry & Chromatography	4 hours	100	4
MSCFTSI L1	Lab course 1	8 hours	100	4
MSCFTSI L2	Lab course 2	8 hours	100	4

Total Credits for Semester I : 24 (Theory : 16 ; Laboratory : 08)**Semester II**

MSCFTSII P1	Forensic Toxicology	4 hours	100	4
MSCFTSII P2	Forensic Drug Analysis	4 hours	100	4
MSCFTSII P3	Methods of Chemical Analysis	4 hours	100	4
MSCFTSII P4	Pharmacotoxicology	4 hours	100	4
MSCFTSII L3	Lab course 3	8 hours	100	4
MSCFTSII L4	Lab course 4	8 hours	100	4

Total Credits for Semester II : 24 (Theory : 16 ; Laboratory : 08)**Semester III**

MSCFTSIII P1	Applied Toxicology	4 hours	100	4
MSCFTSIII P2	Analytical Toxicology	4 hours	100	4
MSCFTSIII P3	Research Methodology	4 hours	100	4
MSCFTSIII P4	Systemic Toxicology	4 hours	100	4
MSCFTSIII L5	Lab course 5	8 hours	100	4


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MSCFTSIIL6	Lab course 6	8 hours	100	4
Total Credits for Semester III : 28 (Theory : 16 ; Laboratory : 08; Service course : 04)				
*** students have to opt a service of 4 credit in this semester as per the prevailing norms of the university.				
Semester IV				
MSCFTSIV P1	Food Toxicology	4 hours	100	4
MSCFTSIV P2	Pesticide & Metal Toxicology	4 hours	100	4
MSCFTSIV L7	Lab course 7	8 hours	100	4
MSCFTSIV D	Project/Dissertation	24 hours	100	12
Total Credits for Semester IV : 24 (Theory : 08 ; Laboratory : 04 ; Research Project : 12)				
Total Credits : 100 (Sem I : 24 + Sem II : 24 +Sem III : 28 + Sem IV : 24)				

Notes:

- Tutorial / assignments are integral components of all theory courses.
- Tutorials consist of conceptual as well as numerical problems / questions based the respective theory courses in the semester covering all four (04) units
- Each course / paper should be taught for 60 contact hours (48 lectures and 12 tutorials).
- Teaching duration for LAB COURSES in all semesters should be of 08 hours per week per batch.
- One batch of the students will be consisting students for laboratory courses as well as project.
- Each of the courses is divided into four units.
- The content of theory course / paper as well laboratory (practical) course may be modified time to time (with the approval DC) to keep pace with the recent developments and trends in the subject.



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Semester I

MSCFTSI P1 ESSENTIALS OF TOXICOLOGY

UNIT-I

Introduction to Toxicology

Definition, history and scope of toxicology

Various types of toxicity (Acute, subacute, sub chronic and chronic)

In vitro and in vivo models in toxicological studies

Animal House- Design and Regulations

Ethics in toxicological studies

UNIT-II

Basics of Poison/ Toxicant and Toxicokinetics

Introduction of Poison, Toxicant and Xenobiotics.

Types and classification of Toxicant Exposure of Toxicants

Translocation of Toxicants

Bioaccumulation of Xenobiotics

Biotransformation of Xenobiotics

Antidotal therapy

UNIT-III

Concepts of Toxicology

Principle of Toxicology

Dose response relationship (ED_{50} , LD_{50} , EC_{50} , LC_{50})

Mechanism of Toxicity

Chemical interactions (Additive effect, potentiation, synergism and antagonism)

Risk Assessment and Safety Evaluation of Toxicant

UNIT-IV

Toxic effects of Chemicals (Drugs, Nanomaterials etc.)

Toxic effects of Pesticides

Toxic effects of Metals

Toxic effects of Solvents

Toxic effects of Plant poisons

Toxic effects of Insects & Animal poisons

Reference books:

1. Casarett & Doll Toxicology: The Basic Science of poisons.
2. Holfmann, F.G.: Handbook of Drug and Alcohol Abuse.
3. Turner: Drugs & Poisons.
4. Samford : Poisons Their Isolation Identification
5. Stoleman: Progress in Chemical Toxicology

MSCFTSI P2 Forensic Chemistry

Unit I: Forensic Analysis of Explosive

Explosives: Introduction, Temperature of chemical explosion, Force and pressure of explosion, Kinetics of explosive reactions. Development of explosives : Black powder, Nitro Cellulose, Nitro Glycerin, Dynamite, Ammonium nitrate, Commercial explosives (permitted explosives, ANFO and slurry explosives), Military explosives (picric acid, TNT, Nitro guanidine, PETN, RDX, HMX and polymer bonded explosives)

Role of Forensic scientist in Post blast investigation, Disposal of bombs, Explosions effects, Collection of samples, Technical report frame work, Homemade crude bombs, Evaluation and assessment of explosion site and reconstruction of sequence of events, General methods of manufacture of explosives, Analysis of explosive by TLC, HPLC, IR And GC-MS

Unit II: Investigation of Arson and Fire

Arson and Fire: Chemistry of fire, difference between Arson and Fire, Material and Chemicals used in initiating fire and arson Examination of scene of fire/arson recognition and collection of evidences, packing, labeling and forwarding of exhibits, methods of extraction from exhibit direct extraction, distillation and micro diffusion methods, analysis of arson exhibits by color test, TLC, Head-space GC and GC-MS.

Unit III: Forensic Examination of Dyes, Fertilizers and Trap cases

Dyes: Different type of dyes, role of dyes in crime investigation, food colors (edible and nonedible dyes), and dyes used in cosmetic and pharmaceutical. Chemical and instrumental methods for analysis of dyes.

Fertilizers: Introduction to fertilizer, different type of fertilizers and classification, substandard and sub-standard adulterated fertilizers, common adulterants. Chemical and Instrumental methods of analysis of fertilizers.

Trap cases: Introduction and forensic significance, trap chemicals: phenolphthalein and anthracene, mechanism of color reaction, factor affecting the color, detection of phenolphthalein and alkali, method of detection of degraded product on conversion of pink color to colorless solution by TLC and UV visible spectrophotometer.

Unit-IV Analysis of petroleum products and beverages

Petroleum: Origin, Composition, Refining, Reforming, Fractionation, Cracking, Knocking, Octane number, Cetane number; Introduction to Petroleum Products, Properties and Testing of Petroleum Products; Analysis of Petrol, Kerosene and Diesel as per BIS/ASTM Specifications.

Analysis of Beverages: Alcoholic and non-alcoholic beverages and their composition, Analysis of alcoholic beverages as per BIS specifications.

Suggested Readings:

1. Systematic Quality Management Gary B Clark. (1995) Practical Laboratory Management Series.
2. Froede, R. C.: The Laboratory Management of the Medico-Legal, Specimen Analytical Chemical Laboratory Sciences.
3. DFS –Working Procedure Manual- Chemistry, Explosives and Narcotics.
4. Feigl; Spot Test in Organic Analysis, Elsevier Pub., New Delhi (2005)
5. Jehuda Yinon; Forensic and Environmental Detection of Explosives
6. Yinon Jitrin; Modern Methods & Application in Analysis of Explosives, John Wiley & Sons England (1993)
7. Houck, M. M. & Siegel, JA; Fundamentals of Forensic Science, Academic Press, London, 2006.
8. Asthana N.C and Nirmal Anjali; The Ultimate Book Of Explosives, Bombs and I E Ds ,Pointer Publishers (2008).
9. Sucasca, T; Test Methods for Explosives, Springer (1995).

MSCFTSI P3 Instrumentation- Spectroscopy

Unit I:

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.

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

Unit II:

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

Unit III:

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.

Unit IV:

Mass Spectrometry: Introduction, Review of Mass spectrometry, Basic Principles and Theory, Instrumentations and technique, Ionization methods, Fragmentations in Mass spectrometry, selected ion monitoring

Suggested Readings:

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.
11. Spectroscopy of Organic compounds by P. S. Kalsi.
12. Settle, F.A.: Handbook of Instrumental Techniques for Analytical Chemistry, Prentice Hall, 1997
13. Lurie and Witturer : High Performance Liquid chromatography in Forensic Chemistry, 1983.
14. Brown, P.R: Advance in chromatography
15. Howard: Forensic Analysis by Gas Chromatography
16. Grahm D.: The use of X-ray Techniques in Forensic Investigation, 1973.
17. Industrial chemistry: B.K. Sharma, Goel publishing house, Meerut.
18. The British Glass Website- Types of Glass: <http://www.britglass.org.uk>.
19. R.A. Day and A.L. Underwood, Quantitative Analysis, 6th ed., Prentice Hall of India Pvt. Ltd (1993).
20. G.D. Christian, Analytical Chemistry, 6th ed, John Wiley & Sons (2001)

MSCFTSI P4 Analytical Chemistry and Chromatography**Unit I: Basic concepts**

Basic concepts in analytical, qualitative and quantitative methods; Classification of analytical methods, an overview of analytical methods, types of instrumental methods, instruments for analysis, data domains, electrical and non-electrical domains, detectors, transducers and sensors, selection of an analytical method, accuracy, precision, selectivity, sensitivity, detection limit and dynamic range, classification of techniques: calibration curve, standard addition and internal standard methods.

Unit II:

Concentration of a solution based on volume and mass units. Calculations of ppm, ppb and dilution of the solutions, concept of mmol. Stoichiometry of chemical reactions, concept of kgmol, limiting reactant, theoretical and practical yield. Solubility and solubility equilibria, effect of presence of common ion. Calculations of pH of acids, bases and acidic and basic buffers. Concept of formation constants, stability and instability constants, step wise formation constants.

Unit III: Chromatographic Technique

Chromatography: Introduction, Review of basic principles and types of chromatography. column efficiency, plate and rate theories, resolution, selectivity and separation capability, Van Deemter equation

Paper Chromatography: Principle, technique, Selection of solvents, preparation of samples and loading, Separation of various metal ions, Forensic Applications.

Column chromatography: Principle, technique, column packing material, Selection of solvents, column preparation and loadings, Column efficiency, Flash chromatography, Forensic applications.

TLC: Principle, Theory and instrumentation, visualization, Qualitative and Quantitative concepts and Forensic applications.

Unit IV:

Gas Chromatography: Principles, theory, instrumentations and technique, columns, stationary phases, detectors, Pyrolysis GC, GC-MS and its Forensic applications.

HPLC: Theory, Instrumentation Technique, column, detectors, with special reference to LC-MS, Forensic applications.

Suggested Readings:

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.
11. Spectroscopy of Organic compounds by P. S. Kalsi.
12. Settle, F.A.: Handbook of Instrumental Techniques for Analytical Chemistry, Prentice Hall, 1997
13. Lurie and Witturer : High Performance Liquid chromatography in Forensic Chemistry, 1983.
14. Brown, P.R: Advance in chromatography
15. Howard: Forensic Analysis by Gas Chromatography
16. Grahm D.: The use of X-ray Techniques in Forensic Investigation, 1973.
17. Industrial chemistry: B.K. Sharma, Goel publishing house, Meerut.
18. The British Glass Website- Types of Glass: <http://www.britglass.org.uk>.
19. R.A. Day and A.L. Underwood, Quantitative Analysis, 6th ed., Prentice Hall of India Pvt.Ltd (1993).
20. G.D. Christian, Analytical Chemistry, 6th ed, John Wiley & Sons (2001)

MSCFTSI L1 Lab course 1

1. Analysis of phenolphthalein in trap cases by TLC and color tests (2).
2. Analysis of Phenolphthalein in trap cases by UV and FTIR (2)
3. Analysis of Phenolphthalein in trap cases by HPLC.

4. To study the thermal behavior of calcium carbonate by TGA.
5. To study the thermal behavior of fibre thread by TGA.
6. Detection of explosive content from given sample by HPLC
7. Extraction and identification of Benzodiazepine (alprazolam) from stimulated copy sample.
8. Detection of Benzodiazepine (alprazolam) by UV, FTIR, HPLC (3).
9. Detection of cholesterol by UV, FTIR, HPLC (3).

MSCFTSI L2 Lab course 2

1. Experiments on UV absorption of drug/dyes/Chemicals.
2. Experiments on IR spectroscopy of Paints / Drugs / Organic compounds.
3. Comparison of polythene films by IR spectrophotometry.
4. Identification of drugs / solvents/ chemicals by Gas Chromatography and Gas Chromatography – Mass Spectrometry (GC-MS).
5. Identification of drugs/chemicals by Liquid Chromatography and Liquid Chromatography – Mass Spectrometry (LC – MS).
6. Identification of elements by Inductively Coupled Plasma Mass Spectrometry (ICP MS).
7. Sample preparation for various pesticides from different food matrices
8. Determination of food additives
9. Determination of food adulterants and contaminants

Semester II

MSCFTSII P1 Forensic Toxicology

Unit-I Introduction to Forensic Toxicology

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. 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.

Unit II: Plant and animal poisons

Plant poisons: Nature, active constituents, mode of action, extraction, isolation and identification of the following:

- *Abrus precatorius*, *Calotropis gigantea*, *Croton tiglium*, *Argemone Mexicana*.
- *Atropa belladonna*, *Cerbera thevetia*, *Datura fastuosa*, *Ricinus communis*.
- *Semecarpus 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 non-bacterial, bacterial: infection type, toxin type and botulism, nonbacterial: viruses, fungus and poisonous foods.

Unit III: Extraction and Identification Methods-I

Extraction: Introduction and fundamental principles of extraction, pre-conditions of extraction, types of extraction methods: liquid-liquid extraction, solid-phase extraction and microextraction; 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.

Unit IV: Extraction and Identification Methods-II

Extraction of alkaloids from various matrices using stass-otto, modified stass-otto and ammonium sulphate 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.

Suggested Readings:

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 Shubhra Goutam.
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.

MSCFTSII P2 Forensic Drug Analysis

Unit-I Drugs of abuse

Introduction to drug of abuse; drug dependence, drug addiction and its problems; classification of drug of abuse: depressant, stimulant and hallucinogen. Depressants: opium and opioids, barbiturates and benzodiazepines. Stimulants: cocaine, nicotine and amphetamines.

Hallucinogens: Cannabis and its derivatives, Phencyclidine and LSD.

Unit-II: Drugs of abuse in sports

Introduction of drugs of abuse in sports, Prohibited classes of substances, prohibited substances in Sport (alcohol and Beta Blockers), in competition (Narcotics, Stimulants, Cannabinoids, Glucocorticosteroids). Introduction of WADA, doping control policies and operational

guidelines, identification of sport drugs by Instrumental, techniques such as GC, GC-MS, and HPLC

Unit-III Forensic Pharmacology

Introduction to Forensic Pharmacology, routes of drug administration, Pharmacokinetics: membrane transport, absorption and distribution, metabolism and excretion of drugs. Pharmacokinetics parameters: clearance, volume of distribution, bioavailability and half-life. Therapeutic drug monitoring. Pharmacodynamics: mechanism of drug action. Adverse drug effect.

Unit-IV Extraction and analysis of drug from various matrices

Methods of extraction of drugs (from all the three major classes) from various matrices including viscera, stomach wash, vomit, urine, blood, suspected drinks/foods; subsequent detection and quantification of extracted drugs from spot test and instrumental methods.

Suggested Readings:

1. L.L. Brunton, J.S. Lazo, K.L. Parker, The Pharmacological Basis of Therapeutics, 11th ed., Magraw Hill, US, (2006).
2. Hollinger Manfred; Introduction to Pharmacology, Taylor & Francis (1997).
3. Turner Paul; Recent Advances in Pharmacology and toxicology, Churchill Living Stone (1998).
4. Sethi P D; Quantitative Analysis of Drugs in Pharmaceutical Formulations 3rd Edn. CBS Publ. (2005).
5. Clark E.G C; Isolation and Identification of drugs Vol. I and Vol.2, Academic Press (1986).

MSCFTSII P3 Methods of Chemical Analysis

UNIT: I

Classical approach for aqueous extraction: Introduction, Liquid-Liquid extraction (LLE) (Theory of LLE, selection of solvents, solvent extraction, problems with LLE process), purge and trap for volatile organics in aqueous samples

Solid Phase extraction (SPE): Introduction, Types of SPE media, SPE formats and apparatus, method for SPE operation, solvent selection, factors affecting SPE, selected methods of analysis for SPE, Automation and On-Line SPE

Solid phase micro-extraction:

Introduction, theoretical considerations, experimental, Methods of analysis: SPMEGC, Methods of analysis: SPME-HPLC-MS, Automation of SPME, New development in micro extraction (liquid micro extraction, membrane micro extraction).

Microwave assisted extraction: Introduction, instrumentation, Forensic Applications

Supercritical Fluid Extraction: Introduction, instrumentation, Forensic Applications.

UNIT: II

Radio analytical Methods of Analysis

Activation analysis: Neutron activation analysis, principle, technique, steps involved in neutron activation analysis. Radiochemical and instrumental methods of analysis, important forensic application of NAA.

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

Radiometric titration: Principle, techniques based on complex formation and precipitation, radiometric titration curves for estimation of ions from their mixture.

UNIT: III

X- Ray Methods of Analysis:

Principle, Theory- X-ray spectral lines, X-ray tube, X-ray emission, Absorptive apparatus: Sources, Collimation, sample handling, wavelength dispersive devices, Energy dispersive devices, detectors, readout device, Chemical analysis using X-ray absorption, X-ray Fluorescence- instrumentation and chemical analysis, X-ray Diffraction, Chemical analysis with X-ray diffraction, numerical problems. Forensic application.

UNIT: IV

Electrophoretic Technique: General principles, Factors affecting electrophoresis, Low voltage thin sheet electrophoresis, High voltage electrophoresis, Sodium dodecylsulphate (SDS) polyacrylamide gel electrophoresis, Isoelectric focusing (IEF), Isoelectrophoresis, Preparative electrophoresis, Horizontal and Vertical electrophoresis. Forensic application.

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

Suggested Readings:

- 1) Introduction to Instrumental Analysis by R. D. Broun, Mc Graw Hill (1987)
- 2) Instrumental methods of chemical analysis by H. Willard, L. Merrit, J.A. Dean and F.A. Settle. Sixth edition CBS (1986)
- 3) Fundamentals of Analytical Chemistry, 6th edition, D.A. Skoog, D.M. West and F.J. Holler, Saunders college publishing.
- 4) Principles of Instrumental Analysis, Skoog, Holler, Nieman, (Sixth Ed.)
- 5) Vogel's Textbook of Quantitative analysis 6th Ed. 7
- 6) Modern analytical techniques in the pharmaceutical and bio analysis By Dr. Istvan Bak (Book Available Online).
- 7) Preparative chromatography Chrome Ed. book series, Raymond P. W. Scott (free e book available on internet)
- 8) Extraction technique in analytical science, John R. Dean, Wiley (2009)
- 9) Practical HPLC method Development, Snyder, Kirkland, Glajch, Wiley India Pvt.
- 10) Standard methods of chemical analysis, Sixth Edition, F.J. Welcher.
- 11) Quantitative Inorganic Analysis including Elementary Instrumental analysis, By A. I. Vogel, 3ed, ELB
- 12) Introduction to instrumental analysis by R. D. Braun, MC. Graw Hill- International edition.
- 13) Analytical spectroscopy by Kamallesh Bansal- First edition.
- instrumental methods of chemical analysis by Willard, Dean and Meritsee- Sixth edition.
- 14) Analytical chemistry principles by John H. Kenedey- Second edition, Saunders college publishing.
- 15) Spectroscopic identification of organic compounds Fifth Ed., Silvestrine, Bassler, Morrill, John Wiley and son.

MSCFTSII P3 PHARMACOTOXICOLOGY

UNIT- I

Basic Principles of Pharmacology

Introduction to Pharmacology
Pharmacopoeias IP, USP, EP
Drug & Drug Receptor mechanisms
Factor affecting the effects of Drug
Pharmaceuticals induced side effects
Drug dependence and drug abuse

UNIT- II

Pharmacokinetics and Pharmacodynamics

Pharmacodynamics
L-ADME
Bioavailability and Bioaccumulation
Dose response relationship
Drug Interactions like Agonism, Antagonism, Addition, Synergism, Potentiation
Adverse drug reactions and drug induced side effects

UNIT- III

Pharmacology and Pharmaceutical Analysis I

General and local Anesthetics
NSAIDs
Antibiotics
Cardiovascular drugs
Antihistamines

UNIT- IV

Pharmacology and Pharmaceutical Analysis II

Anticonvulsants
Antidepressants
Chemotherapeutic drugs
Tranquilizers
Stimulants

Reference Books:

3. Pharmacology and Therapeutics-Bhandarkar& Satoskar
4. Medical Pharmacology- Tripathy
5. Pharmacology: An Introduction

MSCFTSII L3 Lab course 3

1. Preparation of Analytical Standards
2. Recovery Studies along with matrix match calibration
3. Analytical Method development and Validation
4. Systematic extraction and detection of poisons and drugs from

visceral samples by various suitable chemical and instrumental techniques.

5. Detection of metallic poisons from viscera samples and food samples.
6. Identification of vegetable poisons of Forensic interest.

MSCFTSII L4 Lab course 4

1. Separation of organic binary mixture. (minimum 5 and maximum 6)
2. To prepare Aspirin from salicylic acid and identification by TLC and M. P. (2)
3. Preparation of Benzanilide from Benzophenone.
4. Preparation of p- nitroaniline from Acetanilide.
5. Estimation of Vitamin "C" Iodometrically in biological fluids.
6. To determine the dissociation constant of Cu (II) and Fe (III) solution photometrically .
7. Determination of percentage of number of hydroxyl group in an organic compound by acetylation method.
8. Determination of Fe³⁺ spectrophotometrically with thiocyanate using isobutanol as extracting agent.
9. To determine sulphate ions by turbidometry.

Semester III

MSCFTSIII P1 Applied Toxicology

UNIT- I

Predictive and Preventive Toxicology

Structure activity relationship
Predictive models for toxicity of compounds
Prevention of toxic substance exposure
Risk characterization and assessment models

UNIT- II

Cosmetic Toxicology

Introduction
Government regulation of cosmetics
Drug and Cosmetic act
Various rinse off and leave on products, Tattoo etc.
Chemicals of concern

UNIT- III

Veterinary and Wildlife Toxicology

Feed related toxicants
Mycotoxins
Biotoxins

Poisonous plants
Accidental poisoning of domestic and wild animals

UNIT- IV

Tools and Techniques in Toxicology

Biosensors and Biochemical response
Bioanalytical systems
Bioassays and Biomarkers
Animal models in Toxicology

Reference Books:

1. Essentials of Environmental Toxicology by William Hughes
2. Environmental Toxicology by J Rose
3. Veterinary Toxicology- Ramesh C Gupta
4. Nanotoxicology: Characterization, Dosing and Health Effects
5. Predictive Toxicology- Christoph Helma

MSCFTSIH P2 Analytical Toxicology

UNIT- I

Basics of Analytical Toxicology

Overview and Introduction
Provision of analytical toxicology services
Selection of analytical method
Standard Operating Procedure (SOP)
Good Laboratory Practices (GLP)
Applications of analytical toxicology

UNIT- II

Basic Laboratory Operations

Introduction
Aspects of quantitative analysis
Use of internal standards
Method comparison
Nonparametric statistics
Quality control and proficiency testing

UNIT- III

Sample Collection, Transport, and Storage

Introduction
Types of samples and methods of sampling
Guidelines for sample collection for analytical toxicology
Sample transport and storage
Common interferences

UNIT- IV

Sample Preparation

Introduction

Modes of sample preparation

Extraction of Analyte of Interest from different matrix

Derivatization Methods

GLP Audits and Inspections

Interpretation of Analytical Results

Introduction

Pharmacogenetics

Effects of age, sex and disease on drug disposition

Enzyme induction and inhibition

Investigation of acute poisoning

Postmortem toxicology

Reference books:

1. Robert J. Flanagan, Andrew Taylor, Ian D. Watson, Robin Whelpton. Fundamentals of Analytical Toxicology, John Wiley & Sons, Ltd.
2. D.A.Skoog, F.J.Holler and T.A.Neman, Harcourt Principles of Instrumental Analysis college publishers, Singapore
3. G.D.Christian and J.E.O'Reilly, Instrumental Analysis, Allyn and Bacon, Inc., Boston.
4. F.W.Fifield and D.Kealey, Principles and practice of Analytical Chemistry, International Textbook Company, London.
5. R.P.Bauman, Absorption Spectroscopy, John Wiley, New York.
6. M. Donhrow, Instrumental Methods in Analytical Chemistry; Their Principles and practice Vol.2, optical method, Pitman, New York.

MSCFTSIII P3: Research Methodology

Unit I: Fundamentals of research

Introduction to research methodology, definition and basic concepts of research, objectives of research, motivation behind a research, types of research, research process: defining research problem, review the literature, formulation of hypothesis, research design, collection and analysis of data, interpretation and writing a report. Criteria for a good research, measuring research impact and quality: JCR report, impact factor and citation index, ethics and scientific conduct, Ethics in human and animal studies.

Unit II: Writing and presenting research

Components of research paper the IMRAD system, title, authors and addresses, abstract, acknowledgements, references, tables and illustration; preparation for publication, submission of manuscript, publication processes; presentation of research: oral and poster presentations, presentation in conferences and symposia; presentation and submission of research proposals to the funding agencies.

A brief idea about government research agencies including DBT, DFSS, DST, ICMR, CSIR, UGC, BPR&D, and DRDO.

Plagiarism: definition, forms, consequences, unintentional plagiarism, copyright infringement, collaborative work.

Unit III: Basic concepts of Statistics and data analysis

Basic definitions and applications of statistics, sampling: Representative sample, sample size, sampling bias and sampling techniques. Data collection and presentation: Types of data, methods of collection of primary and secondary data. Methods of data presentation-graphical representation by histogram, polygon, ogive curves and pie diagram. Measures of central tendency: mean, median and mode; measures of dispersion: range, mean deviation, standard deviation, variance, quartile, standard error and coefficient of variation; correlation and regression: positive and negative correlation and calculation of Karl-Pearsons coefficient of correlation, skewness and kurtosis.

Unit IV: Probability and Test of hypothesis

Introduction to probability theory, various definitions of probability, Basic terms: random experiments, event, trial, sample space, independent and mutually exclusive events; conditional probability, Addition and multiplication theorem, Baye's theorem, likelihood ratio and discriminating power. Distribution of data: normal, binomial and Poisson distribution.

Test of hypothesis: introduction and concepts; test for small and large sample: Z-test, t-test, chi square test, F-test and ANOVA.

Software related to statistical analysis: MS-Excel, SPSS etc.

Suggested readings:-

1. Statistics in Biology, (1967) Vol. 1: Bliss, C.I.K. McGraw Hill, New York.
2. Practical Statistics for experimental biologist (1985): Wardlaw, A.C.
3. Statistical Methods in Biology (2000): Bailey, N.T. J. English Univ. Press.
4. Biostatistics - 7th Edition : Daniel
5. Fundamental of Biostatistics : Khan
6. Bio-statistical Methods : Lachin
7. Statistics for Biologist (1974):Campbell R.C. Cambridge
8. Research Methodology Tools And Techniques : H.C Purohit
9. Research Methodology: An Introduction : Wayne Dean Goddard, Stuart Melville
10. Research Methodology in the Medical and Biological Sciences: PetterLaake
Haakon Breien Benestad (Author) Bjorn Reino Olsen (Editor)
11. Research Methodology For Biological Science : Gurumani N Gurumani
12. Research Methodology- G.R. Basotia and K.K. Sharma.
13. Research Methodology- C.H. Chaudhary, RBSA Publication
14. Research Methodology: An Introduction - Wayne Goddard & Stuart Melville
15. Research Methodology - Ranjit Kumar
16. Research Methodology: Methods & Techniques - Kothari, C.R.

MSCFTSIII P4: SYSTEMIC TOXICOLOGY

UNIT- I

Basics of Systemic toxicity/target organ for toxicity

Hepatic toxicity, fatty liver, liver steatosis, liver cirrhosis and fibrosis, Cholestasis, hepatic necrosis, hypersensitivity

Nephrotoxicity, vulnerability of kidney to toxic insult, Chemically induced renal injury, kidney dysfunctions, renal erythropoietin factor, renal function tests, analysis of toxicants in urine

UNIT- II

Hematotoxicity, pathology, agent of hematotoxicity,

Blood cells and platelets toxicity and hemostasis

Cardiovascular toxicity, pathology of cardiovascular toxicity, types of cardiovascular toxicants, mechanisms of cardiovascular toxicity, heart attack

UNIT- III

Respiratory toxicity, site of toxicity, Systemic lung toxins, oxidative stress, lung pathology and inflammation, lung fibrosis

Lung diseases due to smoking, pollution, environmental exposure, asthma, hypersensitivity pneumonitis, chronic bronchitis and emphysema (COPD), and lung cancer, remodeling, and repair

UNIT- IV

Neurotoxicity, Neuronal cell injury, effect of toxic agents on neurons, axonopathy, myelinopathies, Ion channel neurotoxins,

Neuronal pathology, neurodegenerative diseases, neurobehavioral dysfunction due to the exposure of environmental toxicants, oxidative stress, inflammatory diseases, Environmental factors relevant to neurodegenerative diseases

Skin as a barrier for toxicants, dermatological effects of toxicants on skin, allergic effects, carcinogenic effects etc.

Reference Books:

1. Gardner , D. E. , J. D. Crapo , and R. O. McClellan , eds.
Toxicology of the Lung , 3rd ed. New York : Raven Press , 1999 .
2. Guyton , A. C. and J. E. Hall , eds. Textbook of Medical Physiology
, 9th ed. Philadelphia : Saunders , 2000.
3. Couse , J. F. Reproductive toxicology . In *Molecular and
Biochemical Toxicology* , 4th ed., eds. R. C. Smart and E. Hodgson .
Hoboken, NJ : Wiley , 2008.
4. Crain , D. A. , S. J. Janssen , et al. Female reproductive disorders:
The roles of endocrine -disrupting compounds and developmental
timing . *Fertil. Steril.* **90** (4) : 911 – 940 , 2008 .
5. Massaro , E. , ed. Handbook of Neurotoxicology . Totowa, NJ : Humana Press ,

2002 .

MSCFTSIH L5 Lab course 5

1. Cytokinesis Block Micronucleus Assay
2. Chromosome Aberrations
3. Single Cell Gel Electrophoresis Assay
4. Alkaline elution assay
5. Cell Viability Assay-Trypan Blue, Alamar Blue
6. Cytotoxicity Assay- MTT, NRU, LDH
7. Oxidative Stress Assay-GSH, LPO, ROS

MSCFTSIH L6 Lab course 6

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 {for inorganic explosive}).(2 Nos.)
10. analysis of fire arson samples (extraction, GC, GC-MS) (2 Nos)

Semester IV

MSCFTSIV P1 Food Toxicology

UNIT- I

Principles of Food Toxicology and determination of Food Toxicants

Introduction to Food Toxicology and Safety

Food Factors and Health: Probiotics, Prebiotics and symbiotic, Antibiotics, Functional components found in food for disease and Preventive Measures

Detection of Toxicants in Food, Qualitative and Quantitative analysis of Toxicants in Food

Toxicity Testing using animal model

UNIT- II

Natural Toxins in Animal Foodstuffs

Toxicants occurring in Terrestrial animal foodstuff- Bile Acids, Vitamin A

Toxicants occurring in Marine Foodstuffs- Scromboid Poisoning, Saxitoxin Tetramine, Pyrophosphoride a, Tetrodotoxin, Ciguatoxin
Neurotoxic shellfish poisoning
Paralytic shellfish poisoning
Amnesic shellfish poisoning

UNIT- III

Food Additives and Health Implications

Preservatives
Antioxidants
Artificial sweeteners and Colouring agents
Flavouring agents and Flavour enhancers

UNIT- V

Food Adulterants and Contaminants

Introduction to Food Adulterants and their toxic manifestations
Toxicants developed during Food Processing
Uptake of Environmental and Industrial Contaminants in Food
Impact of Food Adulterants and Contaminants on Health

Reference Books:

1. Introduction to Food Toxicology- Takayuki Shibamoto
2. Introduction to Food Toxicology- Takayuki Shibamoto and Leonard F Bjeldanes
3. Handbook of Food Toxicology- S.S Deshpande

MSCFTSIV P1 Pesticide & Metal Toxicology

UNIT- I

Introduction to pesticides
Classification of pesticides, herbicides, fungicides, insecticides
Pesticides in the environment
Bio-magnification of pesticides

UNIT- II

Mechanism of pesticide toxicity- Acute and Chronic Toxicity
Toxic Manifestation of Pesticide Exposure-Reproductive & developmental effects, carcinogenicity, immunological effects
Bio indicators of pesticide exposure

UNIT- III

Introduction to Metal, heavy metal and trace element
Nutritionally required trace elements

Dean
Faculty of Science & Technology
Dr. Babasaheb Ambedkar Marathwada
University, Aurangabad