


CIRCULAR NO.SU/Sci. & Tech./Colleges./NEP/23/2023

It is hereby inform to all concerned that, the syllabi prepared by the Board of Studies & Ad-hoc Boards and recommended by the Dean, Faculty of Science & Technology, the Hon'ble Vice-Chancellor has accepted **the following curriculum of All Post Graduate Degree Courses as per Norms of National Education Policy - 2020 under the Faculty of Science & Technology run to the Affiliated Colleges, Dr.Babasaheb Ambedkar Marathwada University** in his emergency powers under section 12(7) of the Maharashtra Public Universities Act, 2016 on behalf of the Academic Council as appended herewith.

Sr.No.	Syllabi of Affiliated BAMU, Aurangabad.	Semester
1.	M.Sc. Biotechnology	Ist and IInd Semester
2.	M.Sc.Forensic Science.	Ist and IInd Semester
3.	M.Sc Forensic Cyber.	Ist and IInd Semester
4.	One Year PG Diploma in Forensic Sci. & Realated Law	Ist and IInd Semester
5.	One Year PG Diploma in Digital and Cyber Forensic and Related Law.	Ist and IInd Semester
6.	M.Sc.Forensic Applied Physics and Ballistics	Ist Semester
7	M.Sc.Forensic Toxicology.	Ist Semester

This is effective from the Academic Year 2023-24 and onwards.

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

University Campus,
Aurangabad-431 004.

REF.No.SU/NEP/2023/10092-100

Date:- 16.08.2023.

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*Deputy Registrar,
Academic Section*

Copy forwarded with compliments to :-

- 1] The Principal of all concerned affiliated Colleges, Dr. Babasaheb Ambedkar Marathwada University,.
- 2] 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.
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BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD



NAAC Reaccredited with 'A' Grade

Faculty of Science and Technology
2 Years P.G. Programme in Science (M.Sc.)

Subject: Forensic Toxicology

Course Structure and Curriculum for Affiliated Colleges
(Outcome-Based Credit System)

As per National Education Policy 2020
(Effective from Academic Year -2023-24)

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Table of Contents

Preamble.....	3
Course Structure.....	3
Vision	4
Mission	4
Program Educational Objectives	4
Program Outcomes and Program-Specific Outcomes	5
Eligibility.....	6
Duration	6
Medium of Instruction.....	6
Attendance.....	6
Assessment Scheme/Scheme of Examination	6
Curriculum and Structure as per NEP 2020.....	8
Detailed Curriculum of Semester-I	10
Discipline-Specific Core Courses	10
Discipline-Specific Core Courses	20
Research Methodology.....	27

Computer and computer-related crimes have increased tremendously in the last couple of years. Criminals are using various modus operandi to commit such crimes. Master's program in Forensic Toxicology has been aimed to generate quality human resources for the field. Dr. Babasaheb Ambedkar Marathwada University, Aurangabad is committed to providing a comprehensive syllabus for PG programs in Forensic Toxicology in line with the objectives and philosophies of National Education Policy 2020.

The Course Structure as per the Government Resolution of the Department of Higher and Technical Education, Government of Maharashtra Dated 16/05/2023 is as follows:

Faculty of Science & Technology

Year / level	Sem.	Major subject		RM	OJT /FP	RP	Credits	Degree
		DSC Core Mandatory	DSE (Elective)					
First year 6.0	I	3(4) +2=14	4	4			22	PG Diploma (After 3 years degree)
	II	3(4) +2=14	4		4 Complete during summer break		22	
Cum. Cr. For PG Diploma		28	08	4	4		44	
Exit option with Post-graduate Diploma (44 credits) after the first year or two semesters with completion of courses equivalent to 44 credits								
Second Year 6.5	III	3(4) +2= 14	4			4	22	PG Degree after 3 years UG or PG Degree after 4 years UG
	IV	3(4) =12	4			6	22	
Cum. Cr. For 1 year PG Degree		26	8			10	44	
Cum. Cr. For 2 years PG Degree		54	16	4	4	10	88	
2 Years -4 sem.PG Degree (88 credits) after three-year UG Degree or 1 Year -2 sem. PG Degree (44 credits) after four-year UG degree								

Abbreviations

Major: A course, which should compulsorily be studied by the student as a requirement of core or major subject is termed as a core course.

DSE: Generally, a course that can be chosen from a pool of courses that may be very specific or specialized or advanced, or supportive to the discipline/subject of study or which provides an extended scope or which enables exposure to some other discipline/subject/domain or nurtures the candidates' proficiency/skill is called as an elective course.

OJT: On-Job Training: Internship/Apprenticeship

FP: Field Project

RP: Research Project

Vision

The vision of the curriculum is as follows:

- To produce graduates with the highest skill and professional ethics competitive to the global demands.

Mission

The mission of the curriculum is as follows:

- To facilitate the updated domain knowledge and skills at par with the global forensic scenario
- To inculcate professional ethics, teamwork, leadership, and value system among students
- To provide research skills among students for further learning and finding innovative solutions

Program Educational Objectives

The educational objective of the PG program in Forensic Cyber is as follows:

- **PEO1:** To develop scientific and technical competency among graduates leading to a successful career in forensic toxicology and allied disciplines
- **PEO2:** To develop analytical and problem-solving skills among students to solve complex issues/problems related to forensic analysis in crime investigation
- **PEO3:** To inculcate professionalism, ethics, teamwork, communication, and leadership quality in the students

- **PEO4:** To make the students responsive toward the environment and society
- **PEO5:** To inculcate the practices of lifelong learning in the direction to have a successful career and responsive citizen of the globe

Program Outcomes and Program-Specific Outcomes

The university is committed to implementing a student-centric curriculum throughout its programs. Program outcomes, program-specific outcomes, and course outcomes have been defined as per Bloom's taxonomy. These are as follows:

Program Outcomes (POs): Program outcomes describe what skills, knowledge, and behaviors students acquire as they progress through the program. The program outcomes are as follows:

PO1: Basic and Discipline-specific knowledge: Apply the knowledge of computer science and related discipline to various forensic toxicology-related crimes.

PO2: Problem Analysis: Identify and analyze crime and crime investigation issues using standard methods based on a scientific approach.

PO3: Modern tool usage: Understand, select, and apply appropriate techniques, resources, and modern scientific techniques with an understanding of their merits and limitations.

PO4: Design/ Develop research-based solutions: Design novel solutions for regular or complex problems based on research outcomes.

PO5: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of forensic practices.

PO6: Effective Communication: Speak, read, write, and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media, and technology.

PO7: Forensic practices for society and criminal Justice setup: Understand and analyze the impact of forensic solutions on society and criminal justice setup.

PO8: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in a multidisciplinary setting.

PO9: lifelong learning: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of Technological change.

Program-Specific Outcomes (PSOs): Program Specific Outcomes are statements that describe what the graduates of a specific program should be able to do. The PSOs of the PG Program in Forensic Cyber are as follows:

- **PSO1:** Understand the basic and advanced techniques in various disciplines of forensic cyber.
- **PSO2:** Analyze the forensic samples using basic and state-of-the-art techniques of various disciplines of digital forensics.
- **PSO3:** Evaluate the results of various techniques and make decisions on simple or complex forensic problems.
- **PSO4:** Design and develop research-based solutions to complex forensic problems.

Eligibility

A candidate who has passed B.Sc. (three years) in science as a major from a recognized university with 45% marks will be eligible for getting admission to PG programs. Reservation policy and relaxation of marks will be as per the norms of the university and Government of Maharashtra.

Duration

As per the guidelines of the Government of Maharashtra and the university, the PG Program will be of two-year duration. However, the students need to pass the minimum credits within the four years from the date of admission. Re-entry to the program, if left in between, can be made within five years. Lateral entry and exit will be as per the guidelines issued by the university from time to time.

Medium of Instruction

Presently, the medium of instruction is English. However, any change in this will be as per the guidelines of the university and the government of Maharashtra.

Attendance

Students must have minimum of 75 % attendance in each theory and practical courses for appearing in the Semester End Examination (SEE), otherwise he / she will not be strictly allowed for appearing for the SEE. However, students having 65 % attendance may request Head of the concerned Institution for the condonation of attendance on medical ground.

Assessment Scheme/Scheme of Examination

The assessment scheme is as follows:

- Each course has been assigned marks equivalent to 25 marks/credit. Thus, each theory course is 75/100 marks while the practical/Laboratory course is 25/50 marks. Moreover, research project shall be 100/150 while On-Job-Training shall be 100 marks.

- Continuous Internal assessment (CIA) will be for 40% while Semester End Examination (SEE) will be for 60%.
- It shall be mandatory for the students to pass individually for both SEE and CIA for each course to complete the program successfully.
- Passing percentage for both theory and practical shall be 40%.
- The CIA may be in terms of class tests, group, and individual assignments, and presentation. Two tests on completion of 40%, and 100% syllabus, each of 20 marks will be conducted and the average result will be reported. Presentation of 10 marks and assignments of 10 marks will also be conducted to get an aggregate of 40% weightage.
- Changes in examination scheme is possible as per the guidelines issued by the university from time to time.

Curriculum and Structure as per NEP 2020

As per the Government Resolution of the Department of Higher and Technical Education, Government of Maharashtra, the course structure of the PG program in Forensic Toxicology is as follows:

Credit distribution and structure of two years/one-year program in Forensic Science with multiple entry and exit options

M.Sc. First Year (First Semester)

Course Type	Course Code	Course Name	Teaching Scheme (Hrs./week)		Credit Assigned		Total credits
			Th	Pr	Th	Pr	
Major Mandatory DSC	FOT/MJ/500T	Forensic Science	3	-	3	-	14
	FOT/MJ/501T	Essentials of Toxicology	3		3	-	
	FOT/MJ/502T	Spectroscopy	3	-	3	-	
	FOT/MJ/500P	Practical based on FOT/MJ/500T	-	2	-	1	
	FOT/MJ/501P	Practical based on FOT/MJ/501T	-	2	-	1	
	FOT/MJ/502P	Practical based on FOT/MJ/502T	-	2	-	1	
	FOT/MJ/503	Skill/Practical based activity	-	4	-	2	
DSE (Choose anyone from the courses: Theory and Practical together make a complete course)	FOT/DSE/504T	Forensic Chemistry	3	-	3	-	4
	FOT/DSE/504P	Practical based on FOT/DSE/504T	-	2	-	1	
	FOT/DSE/505T	Forensic Drug Analysis	3	-	3	-	
	FOT/DSE/505P	Practical based on FOT/DSE/505T	-	2	-	1	
RM	FOT/RM/509	Research Methodology and Statistics	4	-	4	-	4
			16	12	16	06	22

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M.Sc. First Year (Second Semester)

Course Type	Course Code	Course Name	Teaching Scheme (Hrs./week)		Credit Assigned		Total credits
			Th	Pr	Th	Pr	
Major Mandatory DSC	FOT/MJ/550T	Forensic Toxicology	3	-	3	-	14
	FOT/MJ/551T	Analytical Chemistry and Chromatography	3	-	3	-	
	FOT/MJ/552T	Methods of Chemical Analysis	3	-	3	-	
	FOT/MJ/550P	Practical based on FOT/MJ/550T	-	2	-	1	
	FOT/MJ/551P	Practical based on FOT/MJ/551T	-	2	-	1	
	FOT/MJ/552P	Practical based on FOT/MJ/552T	-	2	-	1	
	FOT/MJ/553	Skill/Practical based activity	-	4	-	2	
DSE (Choose anyone from the courses: Theory and Practical together makes a complete course)	FOT/DSE/554T	Food Toxicology	3	-	3	-	4
	FOT/DSE/554P	Practical based on FOT/DSE/554T	-	2	-	1	
	FOT/DSE/555T	Environmental Toxicology	3	-	3	-	
	FOT/DSE/555P	Practical based on FOT/DSE/555T	-	2	-	1	
OJT/FP	FOT/OJT/599	OJT/FP	-	4	-	4	4
			12	20	12	10	22

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Detailed Curriculum of Semester-I

Discipline-Specific Core Courses

FOT/MJ/500T	Forensic Science	Credit:03	Contact Hours:45	Marks:75
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Course Objectives

1. To understand what is forensics.
2. To know the organization and function of forensic laboratory in India.
3. To analyze evidence and chain of custody.
4. To understand the role of medical examiners
5. To learn the concept of cyber forensics.

Course Outcomes

- **CO1:** To understand basics of forensic.
- **CO2:** To understand various types of forensic examination.
- **CO3:** To understand cyber forensic.
- **CO4:** To gain knowledge in details about forensics.

Unit	Content	Contact Hours
Unit-I	Basics of Forensic Science • Basic of Forensic Science: Introduction, Definition, need, signification and scope of Forensic Science. Principles of Forensic Science, multi professional and multi personal aspects of forensic science. Domains in Forensic Science: Forensic Biology, Forensic Medicine, Forensic Toxicology, Forensic Osteology and Odontology, Forensic Physics, Forensic Photography, Ballistics, Fingerprint, Questioned Documents, Forensic Psychology, Forensic Anthropology, Wildlife Forensic, DNA profiling, Computer Forensics etc.,	09 hours
Unit-II	Forensic Scientists and other related Personnel • Functions of Forensic Scientist, Police officers, Prosecution, Judicial Officers and Medico-legal experts etc. Problem of proof in Forensic Science, corpus	

	delicti, modus operandi. Ethical issue in Forensic Science: Definition of ethics, professional standards for the practice of Criminalistics, sanction against expert for unethical conduct.	
Unit-III	Crime scene investigation Definition of crime scene, crimes without scene. Classification of crime scene: indoor & outdoor, primary & secondary, macroscopic & microscopic crime scene. Significance of crime scene, argument and ethics of crime scene.	09 hours
Unit-IV	Physical Evidence Definition of physical evidence, classification of physical evidence, types of physical evidences, sources of physical evidence, signification and value of physical evidence, linkage between crime scene, victim and criminal, study of some special crime scene such as mass disaster, terror attack, geological scene and explosive etc.	09 hours
Unit-V	Crime Scene Reconstruction Principles of crime scene reconstruction, Logics and its application in crime scene reconstruction, crime scene reconstruction of the following cases: Poisoning, drug overdose, arson, bomb blast, homicide, suicide etc.	09 hours

Suggested Readings

1. Henry Lee's Crime Scene Handbook: Henry C Lee
2. Forensic Science in Criminal Investigation and Trial, 4th edn.: B.R. Sharma
3. Forensic Science: An Introduction to Scientific and Investigative Techniques 3rd ed. : Stuart H. James
4. Criminalistics: An Introduction to Forensic Science, 9th edn.: Richard Saferstein
5. Criminal Profiling: An Introduction to a Behavioral Evidence Analysis, 3rd edn. : Brent E. Turvey
6. Forensic Science in Criminal Investigation and Trial, 4th edn.: B.R. Sharma

FOT/MJ/500P	Practical based on FOT/MJ/500T	Credit:01	Contact Hours:30	Marks:25
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Course Overview

This is a laboratory course based on Introduction to Forensic Science (FOC/MJ/500T). The course objectives and outcomes of this laboratory course have been added to the theory course. A minimum of 10 practical has to be covered in the semester for successful completion of the course.

List of Practical (Students have to perform at least 10 practical)

1. Collection, preservation, handling, physical evidence method of different Crime
2. To compare physical evidence (Cloth, Thread)
3. Examination of Bomb Blast Scene
4. To compare and calculate diameter of given bangle piece
5. To collect and compare physical evidence of Hit and run crime scene Samples.
6. Collection and Handling of arson scene Samples
7. Packaging and forwarding of physical evidence.
8. Collection of special evidence.
9. Reconstruction of poisoning cases
10. Reconstruction of hit-and-run cases
11. Reconstruction of drug overdose cases
12. Reconstruction of homicide/suicide cases

FOT/MJ/501T	Essentials of Toxicology	Credit:03	Contact Hours:45	Marks:75
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Course Objectives

1. To learn Basics of Toxicology.
2. To understand the poison.
3. To understand the toxicants
4. To understand the toxic effects of various substances

Course Outcomes

- **CO1:** understand basics of toxicology
- **CO2:** understand the poison and toxicants
- **CO3:** compare toxic effects of various substances
- **CO4:** Understand toxicokinetics

Unit	Content	Contact Hour
Unit-I	Introduction to Toxicology • Definition, history and scope of toxicology • Various types of toxicity (acute, subacute, subchronic, chronic) • In vitro and in vivo models in toxicological studies • Animal House- Design and regulations • Ethics in toxicological studies	09 hours
Unit-II	Basics of Poison/Toxicant Toxicokinetic • 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	09 hours
Unit-III	Concepts of Toxicology • Principle of Toxicology • Dose response relationship (ED 50, LD 50 EC 50, LC 50)	09 hours

	• Mechanism of Toxicity • Chemical interactions (Additive effect, potentiation, synergism, and antagonism) • Risk Assessment and Safety Evaluation of Toxicant	
Unit-IV	Toxic effects-I • Toxic effects of Chemicals (Drugs, Nanomaterials etc.) • Toxic effects of Pesticides • Toxic effects of Metals	09 hours
Unit-V	Toxic effects-II • Toxic effects of Solvents • Toxic effects of Plant poisons • Toxic effects of Insects and Animal poisons	09 hours

Suggested Readings

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

FOT/MJ/501P	Practical based on FOT/MJ/501T	Credit:01	Contact Hours:30	Marks:25
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Course Overview

This is a laboratory course based on **Essentials of Toxicology** (FOT/MJ/501T). The course objectives and outcomes of this laboratory course have been added to the theory course. A minimum of 10 practical has to be covered in the semester for successful completion of the course.

List of Practical (Students have to perform at least 10 practical)

1. Extract various poisons from tissue samples (metallic, solvents, plant, pesticides) (at least 8 practicals, 2 from each category)
2. Extract various drugs from tissue samples (therapeutics drugs) (at least 2 practical)

FOT/MJ/502T	Spectroscopy	Credit:03	Contact Hours:45	Marks:75
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Course Objectives

1. To learn basic concepts of spectroscopy
2. To learn concepts of UV-Visible spectroscopy
3. To learn concepts of IR spectroscopy
4. To learn concepts NMR spectroscopy
5. To learn concepts of Mass spectroscopy

Course Outcomes

- **CO1:** Understand the concepts of spectroscopy
- **CO2:** Apply spectroscopic techniques in forensic applications
- **CO3:** Analyse samples using spectroscopic techniques
- **CO4:** Compare properties of a compound using various spectroscopic techniques

Unit	Content	Contact Hours
Unit-I	Basics of Spectroscopy • 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, and spectra of polyatomic molecules.	09 hours
Unit-II	UV-Visible 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	09 hours

Unit-III	IR Spectroscopy - 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	09 hours
Unit-IV	NMR Spectroscopy 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	09 hours
Unit-V	Validating and Testing Forensics Software Mass Spectrometry: Introduction, Review of Mass spectrometry, Basic Principles and Theory, Instrumentations and technique, Ionization methods, Fragmentations in Mass spectrometry, selected ion monitoring	09 hours

Suggested Readings/Reference Books

1. Douglas A. Skoog, F. James Holler, Stanley R. Crouch, Principles of Instrumental Analysis, Cengage Learning
2. Hobart H. Willard, Lynne Lionel Merritt, John Aurie Dean, Frank A. Settle, Instrumental Methods of Analysis, CBS Publishers.

FOT/MJ/502P	Practical based on FOT/MJ/502T	Credit:01	Contact Hours:30	Marks:25
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Course Overview

This is a laboratory course based on Spectroscopy (FOT/MJ/502T). The course objectives and outcomes of this laboratory course have been added to the theory course. A minimum of 10 practical has to be covered in the semester for successful completion of the course.

List of Practical (Students have to perform at least 10 practical)

1. Analysis of the sample using a UV-Visible Spectrophotometer (Five practical)
2. Analysis of the sample using an IR Spectrophotometer (Five practical)
3. Analysis of the sample using a Raman Spectrophotometer (Five practical)
4. Analysis of the sample using an NMR Spectrophotometer (Five practical)
5. Analysis of the sample using a Mass Spectrophotometer (Five practical)

FOT/MJ/503	Skill/Practical-Based Activity	Credit:02	Contact Hours:60	Marks:50
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Course Overview

The course has been designed to let the students acquire skills in his/her area of interest. As the aim of the course is to develop skills, the students can choose any one of the activities, which can be conducted under the guidance of a teacher.

List of activities

- Analysis of forensic samples using a spectroscopic technique
- Any other skill-based activities chosen by the students as per their interests

Discipline-Specific Core Courses

FOT/DSE/504T	Forensic Chemistry	Credit:03	Contact Hours:45	Marks:75
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Course Objectives

1. To learn forensic analysis of explosive
2. To learn forensic analysis of fire and arson
3. To learn forensic analysis of dyes and fertilizers
4. To learn examination of trap cases
5. To learn examination of petrolieum and beverages

Course Outcomes

- **CO1:** Understand various concepts of forensic chemistry
- **CO2:** Analyze post blast explosive debris
- **CO3:** Compare various constituents of petroleum products and beverages
- **CO4:** Analyze trap cases

Unit	Content	Direct-teaching learning hours
Unit-I	Explosive and its analysis • Explosives: Introduction, Temperature of a chemical explosion, Force and pressure of explosion, Kinetics of explosive reactions. Development of explosives: Black powder, Nitro Cellulose, Nitro Glycerine, 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 framework, 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	09 hours

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.	09 hours
Unit-III	Forensic examination of dye and fertilizers - 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.	09 hours
Unit-IV	Forensic examination of trap cases 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.	09 hours
Unit-V	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.	09 Hours

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 Jitrit; 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).

FOT/DSE/504P	Practical based on FOT/DSE/504T	Credit:01	Contact Hours:30	Marks:25
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Course Overview

This is a laboratory course based on Forensic Chemistry (FOT/DSE/504T). The course objectives and outcomes of this laboratory course have been added to the theory course. A minimum of 10 practical has to be covered in the semester for successful completion of the course.

List of Practical (Students have to perform at least 10 practical)

1. Analysis of low explosive material
2. Analysis of high-explosive material
3. Analysis of dyes
4. Analysis of fertilizers
5. Analysis of chemicals in trap cases
6. Analysis of Petrol, Kerosene, and Diesel as per BIS/ASTM Specifications (three)
7. Analysis of alcoholic beverages as per BIS/ASTM specifications (three)
8. Analysis of post-blast debris
9. Analysis of fire debris
10. Collection and packaging of evidence in fire/arson cases
11. Collection and packaging of evidence in explosion cases

FOT/DSE/505T	Forensic Drug Analysis	Credit:03	Contact Hours:45	Marks:75
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Course Objectives

1. To learn the classifications of drugs
2. To learn about drugs used in sport
3. To learn forensic pharmacology
4. To learn extraction and isolation of drugs

Course Outcomes

- **CO1:** Understand various concepts of drugs and their analysis
- **CO2:** Classify drugs into various classes
- **CO3:** Perform extraction of drug from various matrices.
- **CO4:** Analyze drugs extracted from various matrices

Unit	Content	Direct-teaching learning hours
Unit-I	Drug 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.	09 hours
Unit-II	Drug 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	09 hours
Unit-III	Forensic Pharmacology • Introduction to Forensic Pharmacology, routes of	09 hours

	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 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	09 hours
Unit-V	Analysis of extracted drugs • Subsequent detection and quantification of extracted drugs from spot tests and instrumental methods.	09 hours

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).

FOT/DSE/505P	Practical based on FOT/DSE/505T	Credit:01	Contact Hours:30	Marks:25
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Course Overview

This is a laboratory course based on **Forensic Drug Analysis** (FOT/DSE/505T). The course objectives and outcomes of this laboratory course have been added to the theory course. A minimum of 10 practical has to be covered in the semester for successful completion of the course.

List of Practical (Students have to perform at least 10 practical)

1. Extraction of depressant drugs from various matrices (three)
2. Extraction of stimulant drugs from various matrices (three)
3. Extraction of hallucinogens from various matrices (three)
4. Analysis of stimulants using TLC/HPLC/UV-Visible spectrophotometry (three)
5. Analysis of depressants using TLC/HPLC/UV-Visible spectrophotometry (three)
6. Analysis of hallucinogens using TLC/HPLC/UV-Visible spectrophotometry (three)

Research Methodology

FOT/RM/549	Research Methodology and Statistics	Credit:04	Contact Hours:60	Marks:100
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Course Overview

Research is an important aspect for academic growth of an individual. Research means contributing something new in the existing stock of knowledge. In addition to the general component of research, what is important is validation of data and its analysis. Statistics helps to collect, present, analyse and interpret the data collected during the research. Combining both the components, the course has been designed to give the complete idea of a scientific research and its statistical analysis.

Course Objectives

The course has the following objectives:

- To make the students aware the concepts of research
- To facilitate the students to make research plan
- To enable the students to do scientific writings
- To enable students to apply statistical methods in their research
- To enable students to design their research methods

Course Outcomes

After the completion of the course, the students will be able to do the following:

- CO1: Explain the concepts of research process, writing of research, basics on descriptive statistics, basics of inferential statistics and probability.
- CO2: Execute literature review, select research problem, formulate hypothesis, collect data, analyze the data and test the hypothesis.
- CO3: Draw connections between various ideas presented in a research article/journal and book.
- CO4: Author master dissertation, research paper and present the findings in a conference.
- CO5: Apply statistical tools to calculate central tendency, dispersion and higher statistics.
- CO6: Test the hypothesis for both small and large samples.

Unit	Course Content	Contact Hours
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 good research,	12

	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 and submission of research proposals to the funding agencies. • A brief idea about funding agencies for research and development: UGC, CSIR, DFSS, DST, ICMR, BPR&D, DBT, BARTI. • Plagiarism: definition, types, consequences, UGC regulations.	12
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-Pearson's coefficient of correlation, skewness and kurtosis.	12
Unit-IV	Probability • Introduction to probability theory, various	12

	definitions of probability, Basic terms: random experiments, event, trial, sample space, independent and mutually exclusive events, exhaustive events; conditional probability, addition and multiplication theorem, Bayes' theorem, likelihood ratio and discriminating power. Distribution of data: normal, binomial and Poisson distribution.	
Unit-V	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	12

Suggested Readings/Reference Books:

1. Fundamentals of Statistics (2018), S C Gupta, Himalaya Publishing House
2. Statistics in Biology, (1967) Vol. 1: Bliss, C.I.K. McGraw Hill, New York.
3. Practical Statistics for experimental biologist (1985): Wardlaw, A.C.
4. Statistical Methods in Biology (2000): Bailey, N.T. J. English Univ. Press.
5. Biostatistics - 7th Edition: Daniel
6. Fundamental of Biostatistics: Khan
7. Bio-statistical Methods: Lachin
8. Statistics for Biologist (1974): Campbell R.C. Cambridge
9. Research Methodology Tools and Techniques: H.C Purohit
10. Research Methodology: An Introduction: Wayne Dean Goddard, Stuart Melville
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.
