

Credit Distribution			
L	T	P	Total
4	0	0	4

Course Title: - Basics of Forensic Chemistry I
Course Code: UG

Course Objective: - The objectives of the course:

- To understand the basic concepts related to liquid state.
- To understand the physical properties of liquid state.
- To apply the physical properties in forensic science.
- To understand the chemistry of solutions.
- To apply the knowledge of thermodynamics and chemical kinetics in forensic investigation.
- To understand the periodic table and periodic properties.

Course Prerequisite: - Basic knowledge of chemistry.

Course Contents:	Weightage (%)
Module I: LIQUID STATE AND SOLUTIONS <ul style="list-style-type: none"> ▪ Liquid state: Free volume of liquid and density measurement, physical properties of liquid, vapor pressure, surface tension, surfactants, viscosity, molar refraction, optical activity, structure of liquid ▪ Solutions: Method of exploring concentration of solutions, binary liquids, vapor pressure, composite diagram of binary liquids and solutions, distillation, fractional distillation, vacuum distillation 	30%
Module II: CHEMICAL THERMODYNAMICS AND CHEMICAL KINETICS <ul style="list-style-type: none"> ▪ Chemical thermodynamics and kinetics, first law of thermodynamics, internal energy, enthalpy, second law of thermodynamics, entropy and its significance, free energy and work function ▪ Rate of reaction, order of molecularity of reaction, slow reaction and fast reaction, first order reaction, half life period of first order reaction, activation energy, temperature dependence of activation energy, explosive reactions, oscillatory reactions 	40%
Module III: INTRODUCTION OF PERIODIC TABLE & PHYSICAL INSTRUMENTS <ul style="list-style-type: none"> ▪ Study of Modern Periodic Table, Long form of Periodic Table, periodic properties, atomic radiation, ionization potential, electron affinity, electro negativity, metallic characters, Non-metallic characters and magnetic properties, Comparative study of S and P block elements ▪ Conductance, Conductometry, Electro Motive Force, Potentiometry 	30%
Total	100%

Student Learning Outcomes: - At the completion of this course the candidate can:

- **Understand** the basic concepts of liquid state and solutions.
- **Describe** the methodologies basic laws of chemical kinetics and thermodynamics.
- **Differentiate** between kinetics of various chemical reactions.
- **Analyze** the various periodic properties of the elements.
- **Review** various methods used for expressing the concentration of solution.

Pedagogy: - This course will be taught in the active –learning mode, featuring both lecture and discussions including presentations, different assignments and class tests which provide students abundant opportunity for learning and interaction.

Assessment/ Examination Scheme:

Theory L/T (%)	Lab/Practical/Studio (%)	Total
100	0	100

Theory Assessment (L&T):

Components	CIA (30%)			ESE (70%)
	A	H	CT	
Weightage (%)	5	10	15	70

Lab/ Practical/ Studio Assessment: NA

Course Title: - Basics of Forensic Chemistry II
Course Code: UG

Credit Distribution			
L	T	P	Total
4	0	3	7

Course Objective: - The objectives of the course:

- To understand the basic concepts of analytical chemistry suitable for forensic science professionals.
- To understand the IUPAC nomenclature system of various organic compounds.
- To understand the chemistry of reactive intermediates.
- To understand the chemistry of Heterocyclic compounds and natural products.
- To apply the knowledge of pesticides and insecticides in forensic investigation.
- To know the chemistry of dyes and paints.

Course Prerequisite: - Basic knowledge of chemistry.

Course Contents:	Weightage (%)
Module I: INTRODUCTION OF ANALYTICAL TECHNIQUES <ul style="list-style-type: none"> ▪ Introduction, Principle, applications and limitations of Gravimetric analysis. ▪ Introduction, Principle, types, applications and limitations of Volumetric analysis. ▪ Chromatographic separation techniques- Introduction, Principle, applications and limitations of paper, column and Thin Layer Chromatography. 	30%
Module II: INTRODUCTION OF INORGANIC AND ORGANIC CHEMISTRY <ul style="list-style-type: none"> ▪ Introduction to Empirical and molecular formulae, hybridization, nature of chemical bonding, polarization, hydrogen bonding, Van der Waals forces. ▪ IUPAC nomenclature of alkanes, alkenes, haloalkanes, alcohol, ether, aldehydes, ketones, carboxylic acids, nitro compounds, nitrites etc. ▪ Introduction, formation, stability, structure and reactions of Reactive intermediates. 	40%
Module III: INTRODUCTION OF CHEMICAL COMPOUNDS <ul style="list-style-type: none"> ▪ Introduction to Heterocyclic Chemistry, Natural products. ▪ Introduction, classification, properties and applications of Petroleum products. ▪ Introduction, classification, properties, applications and forensic significance of insecticides, pesticides. ▪ Introduction, classification, properties and applications of dyes and Paints. ▪ Introduction, classification, properties and applications of polymers. 	30%
Total	100%

Student Learning Outcomes: - At the completion of this course the candidate can:

- **Understand** the basic concepts of analytical chemistry.
- **Describe** the methodologies of analytical chemistry.
- **Differentiate** between various analytical techniques conducted for chemical analysis.
- **Analyze role of** pesticides and insecticides in forensic investigation.
- **Review** various analytical measures used in forensic analyses.

Pedagogy: - This course will be taught in the active –learning mode, featuring both lecture and discussions including presentations, different assignments and class tests which provide students abundant opportunity for learning and interaction.

Course Contents: - Lab/Practical
<ul style="list-style-type: none"> ▪ Determination of different physical constants of liquids. ▪ Determination of the strength of the base by Acid-Base titration. ▪ Identification of given organic compound by qualitative analysis, ▪ Identification of given inorganic compound by qualitative analysis.

Assessment/ Examination Scheme:

Theory L/T (%)	Lab/Practical/Studio (%)	Total
100	100	100

Theory Assessment (L&T):

Components	CIA (30%)			ESE (70%)
	A	H	CT	
Weightage (%)	5	10	15	70

Lab/ Practical/ Studio Assessment: NA

Text & References:

- 1. Thermodynamics for Chemists by S, Glasstone

- 2. Principles of Physical Chemistry and Puri, Sharma and Pathania
- 3. Advanced Inorganic Chemistry by Madan, Malik and Tuli
- 4. Concise Inorganic Chemistry by J.D. Lee
- 5. Organic Chemistry by Moris and Boyed
- 6. Heterocyclic Chemistry by Gupta and Kumar Vol I and Vol II
- 7. Insecticides with Modes of Action by I. Ishaya and D. Deghilee
- 8. Natural Products by S.V. Bhat
- 9. Instrumental Analysis by Skoog, Holler and Crouch
- 10. Practical Books:
- 11. Physical Chemistry Parcticals by J.B. Yadav
- 12. Qualitative Analysis by Vogel

Course Title: Advanced Forensic Chemistry

Course Code:

Level: UG

Credit Distribution			
L	T	P	Total
4	0	0	4

Course Objective: - The objectives of the course:

- To understand the basic concepts of chemistry typically from chemical thermodynamics, chemical kinetics, electrochemistry, etc. which is building block for forensic science professionals.
- To know about the inorganic chemistry, particularly metals and non-metals.
- To get aware about basic molecular spectroscopic techniques for qualitative and quantitative analysis.

Course Prerequisite: Basic knowledge of general chemistry and some background about electromagnetic spectrum.

Course Contents:	Weightage (%)
Module II: Physical Chemistry <ul style="list-style-type: none">▪ Basic concepts in chemical thermodynamics such as Gibbs-Helmholtz energy, entropy, work functions, etc.▪ Order, molecularity, rate and half-life of reaction, etc. with respect to first order reaction kinetics, advanced topics from chemical kinetics such as collision theory and activated complex theory▪ Fundamental topics from electrochemistry such as Faraday's laws of electrochemistry, electro chemical cell, salt bridge, EMF, etc.	40%
Module III: Inorganic Chemistry <ul style="list-style-type: none">▪ Basic concepts from inorganic chemistry such as metals and non-metals.▪ Extraction of metals▪ Concept volumetric analysis and the types of acid-base titrations▪ Concept of gravimetric analysis.	30%
Module IV: Analytical Chemistry (Spectroscopy) <ul style="list-style-type: none">▪ Electromagnetic spectrum,▪ UV-visible spectrophotometry▪ Infra-red spectroscopy,▪ Raman Spectroscopy▪ Theory, instrumentation and applications of these molecular spectroscopic techniques.	30%
Total	100%

Student Learning Outcomes: - At the completion of this course the candidate can:

- **Identify** the basic concepts of general chemistry.
- **Describe** chemical thermodynamic and chemical kinetics.
- **Differentiate** between order, molecularity with relevant examples from chemical kinetics.
- **Differentiate** between metals and non-metals, their extraction, etc.
- **Analyze** and interpret the molecular spectroscopic data.
- **Review** the role of physical, inorganic and analytical chemistry in forensic chemistry.

Pedagogy: - This course will be taught in the active –learning mode, featuring both lecture and discussions including presentations, different assignments and class tests which provide students abundant opportunity for learning and interaction. The further assessment will be done through numerical problems based on chemical thermodynamics, chemical kinetics and molecular spectroscopy.

Assessment/ Examination Scheme:

Theory L/T (%)	Lab/Practical/Studio (%)	Total
100	0	100

Theory Assessment (L&T):

Components	CIA (30%)			ESE (70%)
	A	H	CT	
Weightage (%)	5	10	15	70

Lab/ Practical/ Studio Assessment: NA

Course Title: Advanced Forensic Chemistry
Course Code:
Level: UG

Credit Distribution			
L	T	P	Total
4	0	3	7

Course Objective: - The objectives of the course:

- To understand the basic concepts of analytical chemistry those are related to the qualitative and quantitative analysis.
- To gain the knowledge about sampling techniques and micro-chemical analysis.
- To get aware about some evidences related to forensic chemistry such as gold, silver, tobacco, tea, sugar, salts, fertilizers, dyes, drugs, paints, fats, etc., their characteristics, analysis and legal aspects.

Course Prerequisite: Basic knowledge of general chemistry and some background about analytical chemistry.

Course Contents:	Weightage (%)
Module II: Qualitative and Quantitative Analysis <ul style="list-style-type: none"> ▪ Some commonly encountered organic and inorganic compounds in forensic chemistry ▪ Oils and fats, petroleum products and cement. 	30%
Module III: Forensic Chemistry <ul style="list-style-type: none"> ▪ Basic concepts from analytical chemistry such as errors, precision, standard deviation, etc. ▪ Sampling methods ▪ Inorganic analysis and micro-chemical analysis 	30%
Module IV: Miscellaneous <ul style="list-style-type: none"> ▪ Characteristics, examination, legal aspects, organic/ inorganic products of gold, silver, tobacco, tea, sugar, salts, fertilizers, dyes, drugs, paints, fats, etc. 	40%
Total	100%

Student Learning Outcomes: - At the completion of this course the candidate can:

- **Identify** the basic concepts of general chemistry.
- **Describe** general analytical concepts occurred in analysis.
- **Differentiate** between qualitative and quantitative analysis.
- **Analyze** the various forensic evidences.
- **Review** the role of inorganic and analytical chemistry in forensic chemistry.

Pedagogy: - This course will be taught in the active –learning mode, featuring both lecture and discussions including presentations, different assignments and class tests which provide students abundant opportunity for learning and interaction.

Course Contents: - Lab/Practical
<ul style="list-style-type: none"> ▪ Physical experiments ▪ Volumetric analysis by double titration, conductometric titrations, pH metric titrations, potentiometric titrations, complexometric titrations, etc. ▪ Systematic qualitative analysis of inorganic salts and organic compounds.

Assessment/ Examination Scheme:

Theory L/T (%)	Lab/Practical/Studio (%)	Total
100	100	100

Theory Assessment (L&T):

Components	CIA (30%)			ESE (70%)
	A	H	CT	

Weightage (%)	5	10	15	70
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Lab/ Practical/ Studio Assessment: NA

Text & References:

- 1. Thermodynamics for Chemists by S, Glasstone**
- 2. Principles of Physical Chemistry and Puri, Sharma and Pathania**
- 3. Advanced Inorganic Chemistry by Madan , Malik and Tuli**
- 4. Concise Inorganic Chemistry by J.D. Lee**
- 5. Organic Chemistry by Moris and Boyed**
- 6. Heterocyclic Chemistry by Gupta and Kumar Vol I and Vol II**
- 7. Insecticides with Modes of Action by I. Ishaya and D. Deghilee**
- 8. Natural Products by S.V. Bhat**
- 9. Instrumental Analysis by Skoog, Holler and Crouch**
- 10. Practical Books:**
- 11. Physical Chemistry Parcticals by J.B. Yadav**
- 12. Qualitative Analysis by Vogel**

Course Title: Applied Forensic Chemistry-V

Course Code:

Level: UG

Credit Distribution			
L	T	P	Total
4	0	0	4

Course Objective: - The objectives of the course:

- To understand the basic concepts of analytical separation and detection techniques like chromatography, spectroscopy and thermal methods used in forensic science.
- To understand the basic concepts of forensic toxicology and classification of poisons.
- To understand the methods of preparation and applications of various polymers.
- To understand the relevant provisions of The Poisons Act 1919, Explosives Act 1984 and Explosive Substances Act 1908.

Course Prerequisite: Basic knowledge of general analytical techniques and some basic understanding about law.

Course Contents:	Weightage (%)
Module II: Separation and detection technique <ul style="list-style-type: none">▪ Theoretical principle, instrumentation and technique, columns, stationary phases, detectors, and Forensic applications of Gas chromatography and HPLC.▪ Introduction, Basic principles, Instrumentation, working and Forensic applications of AAS, ICPS and Flame spectrometry▪ Introduction, Basic principles, Instrumentation, working and Forensic applications TGA, DTA, DSC.	40%
Module III: Forensic Toxicology <ul style="list-style-type: none">▪ Introduction and concept of forensic toxicological examination and its Significance▪ Classification of poisons, types of poisoning, collection and preservation of toxicological exhibits in fatal and survival cases.▪ Signs and symptoms of poisoning, mode of action and its effect on vital functions.▪ Examination of poisoning samples, excretion and detection of poisons on the basis of their metabolic studies.	30%
Module IV: Miscellaneous <ul style="list-style-type: none">▪ Introduction, types, polymerization processes, mechanism of polymerization, characteristic properties of polymers.▪ Structure, preparation and applications of Polyethylene, nylon, Teflon,PVC and Polystyrene,▪ Introduction, classification, properties and applications of plastics, rubbers, synthetic fibres, FRP and GFRP.▪ The relevant provisions of The Poisons Act 1919, Explosives Act 1984 and Explosive Substances Act 1908.	30%
Total	100%

Student Learning Outcomes: - At the completion of this course the candidate can:

- **Identify** the basic concepts of analytical techniques
- **Describe** the classification of poisons
- **Differentiate** between properties of various polymers.

- **Analyze** the sign and symptoms of poisoning.
- **Review** the important provisions of The Poisons Act 1919, Explosives Act 1984 and Explosive Substances Act 1908.
- **Pedagogy:** - This course will be taught in the active –learning mode, featuring both lecture and discussions including presentations, different assignments and class tests which provide students abundant opportunity for learning and interaction.
- **Assessment/ Examination Scheme:**

Theory L/T (%)	Lab/Practical/Studio (%)	Total
100	0	100

Theory Assessment (L&T):

Components	CIA (30%)			ESE (70%)
	A	H	CT	
Weightage (%)	5	10	15	70

Lab/ Practical/ Studio Assessment: NA

Text & References:

Course Title: Applied Forensic Chemistry VI
Course Code:
Level: UG

Credit Distribution			
L	T	P	Total
4	0	3	7

Course Objective: - The objectives of the course:

- To understand the basic problems related to drug addiction
- To gain the knowledge about types of illicit liquors and alcoholic beverages
- To get aware about some evidences related to food adulteration.
- To understand the various provisions of NDPS Act 1985

Course Prerequisite: Basic knowledge of general chemistry and some background about analytical chemistry.

Course Contents:	Weightage (%)
Module I: Narcotic Drug and Psychotropic Substances <ul style="list-style-type: none"> ▪ Analysis, Tolerance, dependence, Problems of drug addiction, Identification of drug addict. ▪ Drug addicts and crimes ▪ Classification of drugs and Analytical techniques for identification of drugs. ▪ Types of Pharma drugs, Forensic Pharmacological studies, Ingestion ,absorption, distribution, metabolism and drug toxicity, ▪ Excretion of drugs. 	30%
Module II: Study of Analysis of Beverages <ul style="list-style-type: none"> ▪ Introduction and Definition of alcohol, illicit liquor, Alcoholic and nonalcoholic beverages ▪ Absorption, de-toxication and excretions of alcohol, problems in alcohol cases and difficulties in diagnosis ▪ Analytical techniques in the analysis of alcohol and other articles. Case study 	30%
Module III: MISCELLANEOUS <ul style="list-style-type: none"> ▪ Arson: chemistry, investigation and evaluation of clue material in the arson case. ▪ Food adulteration: Introduction, Prevention of food adulteration, analytical techniques for analysis of exhibits involved in food and other material cases. ▪ Relevant provision of:- Prevention of Food Adulteration Act 1954, Narcotic Drugs & Psychotropic Substances Act 1985 Prevention of Illicit Trafficking in NDPS Act 1985, Drugs Control Act 1940, Drugs & Cosmetics Act 1945. 	40%
Total	100%

Student Learning Outcomes: - At the completion of this course the candidate can:

- **Have** the knowledge about the narcotic and psychotropic substances.
- **Knowledge** about the analytical techniques used for the identification of drugs.
- **Information** about various laws of poisons and food adulteration.
- **Understand** the concept of arson and fire in forensic chemistry.

Pedagogy: - This course will be taught in the active –learning mode, featuring both lecture and discussions including presentations, different assignments and class tests which provide students abundant opportunity for learning and interaction.

Course Contents: - Lab/Practical
<ul style="list-style-type: none"> ▪ Determination of adulteration in food samples ▪ Determination of various adulterants in alcohol, by colour tests ▪ Chemical analysis of explosive materials.(Gun powder) ▪ Extraction methods of drugs, Poisons.

Assessment/ Examination Scheme:

Theory L/T (%)	Lab/Practical/Studio (%)	Total
100	100	100

Theory Assessment (L&T):

Components	CIA (30%)			ESE (70%)
	A	H	CT	
Weightage (%)	5	10	15	70

Lab/ Practical/ Studio Assessment: NA

Text & References:

Paper II - Applied Forensic Chemistry

Reference books

1. Instrumental Method of Chemical Analysis. Chatwal & Anand, Himalya Publication.
2. S. N. Tiwari, Analytical Toxicology, Govt. of India publications, New Delhi 1987
3. Brown P. R., Advance in Chromatography.
4. Introduction of Forensic Science in Crime Investigation by Dr. (Mrs.) R. Krishnamurthy.
5. Howard: Forensics Analysis by Gas Chromatography.
6. Yinon: Forensic Application of Mass Spectroscopy 1994.
7. Prakash M. et.al; Methods in Toxicology Anmol Publication, New Delhi (1998)
8. Parikh C.K; Text Book of Medical Jurisprudence Forensic Medicines and Toxicology. CBS Pub. New Delhi (1999)
9. Balraj S. Parmar et.al; Pesticide Formulation, CBS Publishers, New Delhi (2004)
10. Casarett & Doll Toxicology, The basic Science of Poisons
11. Curry A. S., Poison Detection in Human Organs 1976
12. Curry : Analytical Method in Human Toxicology 1986.
13. Lee and Gaensslem.: Advances in Forensic Science (Vol. 2) Instrumental Analysis.
14. Settle F. A.: Handbook of Instrumental Technique for Analytical Chemistry, Prentice Hall 1997.
15. Serope Kalpakjian, Steven R Schmid. "Manufacturing Engineering and Technology". International edition. 4th Ed. Prentice Hall, Inc. 2001. ISBN 0-13-017440-8.
16. Hans-J. Koslowski. "Dictionary of Man-made fibers". Second edition. Deutscher Fachverlag. 2009.
17. Borrow: Molecular Spectroscopy 1980.
18. Willard H. H. et. al : Instrumental Methods of Analysis 1974.
19. Moonesens A. A. et. al. : Scientific Evidence in Criminal Cases 1973.
20. Lundquist and Curry: Methods of Forensic Sciences 1963.
21. Holfmann, F. G., Hand book of drug and alcohol abuse.
22. Arena Poisoning, Chemistry Symptoms and treatment,
23. Analysis of Plant Poisons, Dr. M P Goutam.
24. Drug Abuse Handbook, Karch.s.
25. Constitution of India
26. Indian Evidence Act.
27. Criminal Procedure code.
28. Indian Penal Code.
29. Bare Acts with short notes on the following : Narcotic Drugs & Psychotropic Substances Act, Drugs & Cosmetics Act, Explosive Substances Act, Dowry Prohibition Act, Prevention of Food Adulteration Act, Prevention of Corruption Act, Arms Act, Wild Life Protection Act

Credit Distribution				
L	P	Pr	S	Total
8	4	4	1	17

Course Title: Advanced Forensic Toxicology

Course Code: MFS-402: Paper XXI

Level: PG

Course Objective: - The objectives of the course:

- To understand the types poisons depending on their origin.
- To know about the poisoning from particular poison
- To know about narcotic and psychotropic substances
- To interpret the toxicological findings.

Course Prerequisite: - Basic knowledge of toxicology and drugs.

Course Contents:	Weightage (%)
<p>Module I: Food Poisons</p> <ul style="list-style-type: none"> • Introduction, Food poisoning due to chemical, bacterial and fungal, Sign and Symptoms of food poisoning. • Collection and preservation of evidence material, extraction and isolation, from food material, Biological material, detection and identification by colour test • Instrumental techniques • Food Adulteration: Food Adulteration Act, Various adulterants in household and food products, their detection 	25%
<p>Module II: Plant And Animal Poisons</p> <ul style="list-style-type: none"> • Plant Poisons: Classification and types of Plant Poisons: (<i>Datura</i>, <i>Abrus precatorious</i>, <i>Nerium oleander</i>, <i>Calotropis gigantea</i>, <i>Gloriosa superba</i>, Ergot, Mushroom etc.) • Extraction from viscera, blood, vomit etc. Fatal dose, fatal period, signs and symptoms, post mortem findings, detection (preliminary and confirmatory tests) and medico legal significance. • Animal Poisons: Classification and types of Animal Poisons (neurotoxin, myotoxin, cantharides, vasculotoxin, spider, snakes, scorpion, etc.) • Extraction from viscera, blood, vomit etc. Fatal dose, fatal period, signs and symptoms, post mortem findings, detection (preliminary and confirmatory tests) and medico legal significance 	25%
<p>Module III: Non-Volatile Organic Poisons</p> <ul style="list-style-type: none"> • Classification and types(alkaloids, sedatives, stimulants, hallucinogens, sominiferous, spinal, cardiac etc.) • Nature, extraction from viscera, blood, vomit etc. Fatal dose, fatal period, signs and symptoms, post mortem findings, medico legal significance and detection (preliminary and confirmatory tests) of • Asphyxiants • Carbon monoxide • Carbon dioxide • Hydrogen sulphide • Nitrous oxides, war gases, etc.) 	25%

Module IV: Narcotics and Psychotropic substances <ul style="list-style-type: none"> • Classification and types of Narcotics (cannabis, cocaine, opium etc.) and Psycotropic Substances (stimulants, hallucinogens, depressants, sedatives etc) • Nature, extraction from viscera, blood, vomit etc. Fatal dose, fatal period, signs and symptoms, post mortem findings, medico legal significance and detection (preliminary and confirmatory tests)of narcotic and psychotropic substances • Drugs and Cosmetic Act, NDPS Act, Control Substance Act. 	25%
Total	100%

Student Learning Outcomes: - At the completion of this course the candidate can:

- **Identify** the type of poisoning
- **Describe** signs and symptoms of poisoning
- **Differentiate** between plant and animal poisons
- **Analyze** and interpret the toxicological data.
- **Review** various analytical measures used in forensic analyses of these drugs.

Pedagogy: - This course will be taught in the active –learning mode, featuring both lecture and discussions including presentations, different assignments and class tests which provide students abundant opportunity for learning and interaction.

Course Title: Advanced Forensic Chemistry
Course Code: MFS-403: Paper XXII
Level: PG

Course Objective: - The objectives of the course:

- To understand the basic concepts of dyes and pigments
- To know about the types of illicit drugs
- To know about fertilizers and their analysis
- To interpret the toxicological findings of beverages and prohibited substances

Course Prerequisite: - Basic knowledge of dyes and pigments

Course Contents:	Weightage (%)
<p>Module I: Dyes and Pigments</p> <ul style="list-style-type: none"> • Different type of dyes, role of dyes in crime investigation, food colours (edible and nonedible dyes), dyes used in cosmetic and pharmaceutical. • Chemical analysis and instrumental methods of analysis of dyes. Analysis of trace evidence: cosmetics, dyes. • Trap related evidence materials, fibers, oils, fats, greases, industrial dusts, chemicals and plant material. • Pigments: Introductions, white pigments, Manufacturing process and properties of blue pigment, red pigment, green pigment, yellow pigment 	25%
<p>Module II: Illicit Drugs</p> <ul style="list-style-type: none"> • Illicit drug types, search of clandestine laboratory, precursors and their analysis, estimation of morphine in opium and heroin in smack. • Analysis of drugs in biological samples and their importance: Hair, urine, blood, viscera. • Methods of extraction of drugs/consultation of drugs. • Limitations of chemical analysis of drugs, report writing and interpretation of drugs. 	25%
<p>Module III: Fertilizers, Pesticides and Other Chemicals</p> <ul style="list-style-type: none"> • 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. Quantitative and qualitative forensic analysis of organic and inorganic fertilizers. • Analysis of pesticides, insecticides, metallic and non metallic products, consumer items such as gold, silver, tobacco, tea, sugars, salts, acids and alkalis etc. 	25%
<p>Module IV: Analysis of Beverages & Prohibited Substances</p> <ul style="list-style-type: none"> • Introduction of alcohol (ethyl alcohol, methyl alcohol) and illicit liquor • Extraction methods of alcohol(Distillation), Proof spirit, absorption, metabolism, de-toxification and excretion of alcohol, Analysis of alcohol by color tests, TLC, GC, GC-MS • Consequences of drunken driving, breath analysis by Breath Analyzer, Detection of alcohol in blood and urine, Alcohol and prohibition. • Analysis of Beverages: Analysis of alcoholic beverages as per BIS and PFA Act, • Detection and Determination of ethanol, furfural, organic acids, aldehydes, chloral hydrate, methanol and ethylene glycol in liquors by colour tests, TLC, GC and GC-MS methods • Case Studies 	25%
Total	100%

Student Learning Outcomes: - At the completion of this course the candidate can:

- **Identify** the basic concepts dyes and pigments
- **Describe** estimation of morphine in opium and heroin in smack.
- **Differentiate** between various types of fertilizers
- **Analyze** and interpret the toxicological data.
- **Review** various analytical techniques used in forensic analyses of these drugs.

Pedagogy: - This course will be taught in the active –learning mode, featuring both lecture and discussions including presentations, different assignments and class tests which provide students abundant opportunity for learning and interaction.

Course Title: Forensic Pharmacology
Course Code: MFS-404: Paper XXIII
Level: PG

Course Objective: - The objectives of the course:

- To understand the basic concepts of toxicodynamics and toxicokinetics suitable for forensic science professionals.
- To know about the pharmaceutical drugs and their toxicology.
- To know about forensic pharmacognosy.
- To interpret the toxicological findings.

Course Prerequisite: - Basic knowledge of pharmaceutical chemistry and biology.

Course Contents:	Weightage (%)
<p>Module I: BASIC CONCEPTS</p> <p>Basic terms about pharmaceutical drugs, Routes of administration of a drug, absorption, distribution, metabolism and excretion of drugs, enzyme kinetics, elementary knowledge about plant drugs and ethnobotany</p>	20%
<p>Module II: Pharmaceutical Drugs</p> <p>Forensic toxicology of pharmaceutical drugs such as antidepressants, diuretics, antibiotics, antipyretics, antihistamines, hallucinatory drugs, etc.</p> <ul style="list-style-type: none"> ▪ nature, ▪ extraction from viscera, blood, vomit, etc., ▪ fatal dose, ▪ fatal period, ▪ signs and symptoms of poisoning, ▪ post mortem findings, ▪ medico legal significance, ▪ qualitative and quantitative analysis 	20%
<p>Module III: Pharmacodynamics</p> <ul style="list-style-type: none"> ▪ Drug-drug and drug-receptor interactions, ▪ signal transduction mechanism, ▪ agonists and antagonists ▪ allergic and idiosyncratic reactions, ▪ dose-effect relationship, ▪ teratogenesis and foetal toxicity 	20%
<p>Module IV: Pharmacokinetics</p> <ul style="list-style-type: none"> ▪ The ADME scheme, ▪ bioavailability and bioequivalence, ▪ evaluation of pharmacokinetic parameters, ▪ deciding multiple dosage regimen, ▪ blood-brain-barrier and placental filter 	20%
<p>Module V: Pharmacognosy</p> <ul style="list-style-type: none"> ▪ Definition and aim of pharmacognosy and plant drugs, ▪ natural, endogenous, exogenous and preparation-dependent plant drugs, ▪ preservation and storage of plant drugs, ▪ signs and symptoms of addiction, ▪ identification of drug addict, ▪ interpretation of drug or toxicological findings 	20%
Total	100%

Student Learning Outcomes: - At the completion of this course the candidate can:

- **Identify** the basic concepts of forensic pharmacy.
- **Describe** toxicodynamics and toxicokinetics of pharmaceutical drugs.
- **Differentiate** between various pharmaceutical and plant drugs.
- **Analyze** and interpret the toxicological data.
- **Review** various analytical measures used in forensic analyses of these drugs.

Pedagogy: - This course will be taught in the active –learning mode, featuring both lecture and discussions including presentations, different assignments and class tests which provide students abundant opportunity for learning and interaction.

Course Title: Forensic Analysis of Drugs
Course Code: Paper XXIV
Level: PG

Course Objective: - The objectives of the course:

- To understand the basic concepts of drug metabolism
- To know about the pharmaceutical drugs and their toxicology.
- To understand the classification of narcotic and psychotropic substances
- To interpret the toxicological findings
- To understand the methods for analysis of narcotic drugs

Course Prerequisite: - Basic knowledge of analytical techniques, narcotic drugs and related laws

Course Contents:	Weightage (%)
<p>Module I: Drugs, Other Chemicals & Related Laws</p> <ul style="list-style-type: none"> • Introduction, Pharma drugs (barbiturates, benzodiazepine & other pharma drugs), • Substance abuse, Drug abuse in sports & Date rape drugs: Introduction, common prohibited substances, analytical approach. • Forensic Pharmacological studies, Ingestion of drugs, absorption, distribution, metabolism, pathways of drug metabolism, drug metabolism and drug toxicity, excretion of drugs. • Detection of drugs on the basis of their Metabolic studies. • Solvent Abuse (chlorinated hydrocarbons, Aromatic hydrocarbons, alcohols, glycols, fuel and fuel additives): absorption, distribution, and metabolism, psychological & clinical effects. • Analysis: collection of sample, distillation & extraction, Analysis by GC, HPLC. • Legal Aspect:- Case Studies and Relevant Provisions of – The Drugs Control Act, 1940. The Drugs and Cosmetics Act, 1940. Etc. 	25%
<p>Module II: Narcotic and Psychotropic substances</p> <ul style="list-style-type: none"> • Classification of Drugs • Commonly encountered drugs: Narcotic drugs, depressants, stimulants, hallucinogens, designer drugs, club drugs, drugs of sports and precursors. • Field test, colour test, micro crystal test, thin layer chromatography. Performance Enhancing Drugs in sports. 	25%
<p>Module III: Analysis of Narcotic & Psychotropic drugs</p> <ul style="list-style-type: none"> • Opium (alkaloids, morphine, heroin and opioids) • Cannabis and its derivatives (Bhang, ganja, hashish (Charas) and Cocaine, • Depressants: Barbiturates, methaqualone, benzodiazepines • Stimulants: Methaquinolines, amphetamines and related derivatives, • Hallucinogens: LSD, Mushroom and Cactile, etc. 	25%
<p>Module IV: Miscellaneous</p> <ul style="list-style-type: none"> • Detection of common adulterants and determination of percentage purity in seized samples, detection identification, quantitation of drugs in pharmaceutical products. • Analysis of illicit drugs and search of clandestine laboratory, precursors and their analysis. • Estimation of morphine in opium and heroin in smack. • Analysis of drugs in biological samples and their importance: Hair, urine, blood, viscera, methods of extraction of drugs/consultation of drugs. • Limitation of chemical analysis of drugs. Report writing and interpretation of drugs. 	25%

<ul style="list-style-type: none"> • Court testimony in NDPS Act cases. Case studies and ground for acquittal and grant of bail. 	
Total	100%

Student Learning Outcomes: - At the completion of this course the candidate can:

- **Identify** the narcotic drugs
- **Describe** the drug metabolism
- **Differentiate** between symptoms of various narcotic drugs
- **Analyze** and interpret the toxicological data.
- **Review** various analytical methods used in forensic analyses of these narcotic drugs.

Pedagogy: - This course will be taught in the active –learning mode, featuring both lecture and discussions including presentations, different assignments and class tests which provide students abundant opportunity for learning and interaction.

MFS 406: Practical XIV (Special: Forensic Chemistry & Toxicology)

Hrs/week- 12, Marks-100

1. M.P, B.P and flash point determination.
2. To perform Colour test and UV-Visible Spectrophotometry of pesticide, insecticides.
3. Analysis of dye and pigments by using TLC technique.
4. Analysis of phenolphthalein in trap cases by UV-Visible.
5. Analysis of phenolphthalein in trap cases by TLC And HPLC.
6. Analysis of alcohol content in sample by derivatization into known organic compounds and its analysis by GC.
7. Analysis of alcohol content in sample by derivatization into known organic compounds and its analysis by GCMS, HPLC
8. Determination of Mercury in biological materials by spectrophotometry.
9. Analysis of animal Poisons using TLC.
10. Analysis of Plant poisons using TLC.
11. To study the separation of metal ions by paper chromatography.
12. Determination of alcohol in blood and urine sample. .
13. Analysis of blood, urine, stomach wash in emergency cases of poisoning.
14. Comparison of fibres by chemical analysis, TLC/HPTLC/ FTIR.
15. Gas chromatography analysis of Ganja and Charas.
16. Analysis of food material in case of food poisoning by chemical, microscopic and instrumental techniques.
17. Analysis of viscera in case of food poisoning by chemical, microscopic and instrumental techniques.
18. Interpretation of given spectral data of various compounds.
19. Estimation of paints and pigments by UV Spectrophotometry/FTIR.
20. Comparison of polythene films by IR spectrophotometry.
21. Analysis of viscera for volatile Organic and inorganic poisons.
22. Analysis of non- metallic (anionic) poisons in viscera.
23. Analysis of viscera for organochloro, organophosphoro, carbamates and pyrethroids by colour test TLC/HPTLC and UV-visible spectrometry method.
24. UV-Vis Spectrophotometric, GC and GC-MS analysis of barbiturates.
25. Detection of metallic poisons in viscera and food stuff.
26. Detection and identification of pesticide in a given formulation, TLC.
27. Interpretation of given spectral data of various compounds. Determination of poisonous metals in biological materials by AAS.
28. Extraction, Systematic identification of Narcotic Drugs and Psychotropic substances (opiates, cannabis and barbiturates, benzodiazepines and amphetamines) by spot colour tests
29. Analysis of Na and K contents in soil sample by Flame Photometry.
30. GC-MS, HPLC analysis of explosive residues.
31. Detection of adulteration in oils and fats by chemical analysis and TLC/ HPTLC.
32. Detection and identification of metallic poisons in viscera and food material by chemical test and instrumental technique.

33. Systematic extraction, and identification and non-volatile drugs and poisons by various techniques.

MFS-407: Project Work (Specialization)

Hrs/week- 10 Marks-100

Description

This course covers the application of analytical chemistry within the field of forensic science. Students learn the fundamental principles behind the analyses of chemical and physical evidence for drugs, combustion and arson, colorants, documents, and fibres. Qualitative analysis is presented by examining the chemical details of presumptive testing from a mechanistic approach. An analytical chemistry perspective is used to explain modern laboratory instrumentation and proper statistical treatment of collected data for quantitative analysis. An overview of chemical toxicology is covered with an emphasis on understanding biochemical pathways and pharmacokinetics.

MFS-408: Seminar- IV, 2 h /week, Marks: 25

Seminar of 30 minutes duration will be a part of internal assessment for 20 marks (1 credit). Seminar should be delivered by the student under the guidance of concerned teacher on the topic allotted by the teacher. The topic will be related to the syllabus. Marks will be allotted by a group of teachers.

Assessment/ Examination Scheme:

Theory L/T (%)	Lab/Practical/Studio (%)	Total
100	100	100

Theory Assessment (L&T):

Components	CIA (30%)			ESE (70%)
	A	H	CT	
Weightage (%)	5	10	15	70

References:

1. B. R. Sharma: Forensic Science in Criminal Investigation and Trials, Fourth Edition, Universal Law Publishing
2. Modi's: Medical Jurisprudence & Toxicology, M. M. Trirathi Press Ltd. Allahabad, 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. H. H. Woulsard, et al : Instrumental Methods of Analysis, 1974.
7. A.A. Moonesens et al : Scientific Evidence in Criminal Cases, 1973.
8. Lundquist and Curry: Methods of Forensic Science, 1963.
9. Lee and Gaensslen: Advances in Forensic Science, (Vol. 2) Instrumental Analysis.
10. Borrow: Molecular Spectroscopy, 1980.
11. Spectroscopy of Organic compounds by P. S. Kalsi.

12. W. Kemp, Organic Spectroscopy, 2nd Ed., Macmillan Pub., 1987.
13. D.L. Pavia, G. M. Lampman and G.S. Kriz: Introduction to Spectroscopy, 2008
14. F.A. Settle: Handbook of Instrumental Techniques for Analytical Chemistry, Prentice Hall, 1997.
15. Lurie and Witturer : High Performance Liquid chromatography in Forensic Chemistry,1983.
16. P.R. Brown and E. Bruksha: Advances in Chromatography, Vol. 42, 2003.
17. Howard: Forensic Analysis by Gas Chromatography
18. D. Graham: The use of X-ray Techniques in Forensic Investigation, 1973.
19. B.K. Sharma: Industrial Chemistry, Goel Publishing House, Meerut.
20. R.A. Day and A.L. Underwood, Quantitative Analysis, 6th Ed., Prentice Hall of India Pvt. Ltd (1993).
21. G.D. Christian, Analytical Chemistry, 6th Ed., John Wiley & Sons (2001).
22. Basic Concepts of Analytical Chemistry by S.M. Khopkar.
23. B. Levine: Principles of Forensic Toxicology, 3rd Ed., AACCC Press, 2010.
24. K.N. Rao: Forensic Toxicology, CRC Press, 2012.
25. M.G. Carlin and J.R. Dean: Forensic applications of Gas Chromatography, CRC Press, 2013.
26. S. Bayne and M. Carlin: Forensic applications of High Performance Liquid chromatography, CRC Press, 2010.
27. Curry: Analytical Methods in Human Toxicology, Part II, 1986.
28. C.D. Klaassan: Casarett & Doull's Toxicology: The Basic Science of Poisons, 7th Ed. McGraw Hill.
29. A.S. Curry: Poison Detection in Human Organs, 1976.
30. Arena Poisoning: Chemistry, Symptoms and Treatment.
31. B. R. Sharma: Forensic Science in Criminal Investigation & Trials, 2003.
32. G. B. Clark: Systematic Quality Management, Practical Laboratory Management Series, 1995.
33. Turner : Drugs & Poisons.
34. Samford : Poisons Their Isolation Identification.
35. Dubois and Celling: Textbook of Toxicology.
36. R. C. Froede: The Laboratory Management of the Medico-Legal, Specimen Analytical Chemical Laboratory Sciences.
37. Gurudip R. Chatwal, Sham K. Anand: Instrumental Methods of Chemical Analysis, First Edition Reprint 2010, Himalaya Publication.
38. Skoog, Holler, Crouch: Instrumental Analysis, India Edition, 2009.
39. Willard, Merritt, Dean, Settle: Instrumental Method of Analysis, Seventh Edition.
40. M. N. Gleason and et. Al.: Clinical Toxicology of Commercial products.
41. DFS –Working Procedure Manual Chemistry, Explosives and Narcotics.
42. Feigl: Spot Test in Organic Analysis, Elsevier Pub., New Delhi (2005)
43. Jehuda Yinon: Forensic and Environmental Detection of Explosives
44. Yinon Jitrin: Modern Methods & Application in Analysis of Explosives, John Wiley & Sons England (1993)
45. M. M. Houck & J.A. Siegel: Fundamentals of Forensic Science, Academic Press, London, 2006.

46. N.C. Asthana and Nirmal Anjali: The Ultimate Book Of Explosives, Bombs and I E Ds, Pointer Publishers (2008).
47. T. Suceska: Test Methods for Explosives, Springer (1995).
48. D. K. Molina: Handbook of Forensic Toxicology for Medical Examiners, CRC Press, 2009.
49. T. Altug: Introduction of Toxicology and Food, CRC Press, 2012.
50. Clarke's Analytical Forensic Toxicology by A. Negrusz and G. Cooper, 2nd Ed., Pharmaceutical Press, 2013.

Suggested Readings for Practical:

1. Illustrated guide to home forensic science experiments by Rober B. Thompson and Barbara F. Thompson
2. Laboratory Procedure Manual, Forensic Toxicology, 2005.
3. Spot test in Organic Chemistry by Feigl.
4. M D Cole: The Analysis Of Drugs Of Abuse: An Instruct ion Manual
5. Curry A.S: Analytical Methods in Human Toxicology, Part II, CRC Press Ohio (1986).
6. E. Stahl: Thin Layer Chromatography: A Laboratory Handbook.
7. Clerk's Analysis of Drugs & Poisons VOL.-I & II by Clerke
8. Marie P. Kautsky: Steroid analysis by HPLC
9. Ballantyne B: General and Applied Toxicology Vol-1-3 2nd Ed., Macmillan, NY (2000)
10. C.E. Meloan, R.E. James, R. Saferstein, Criminalistics: An Introduction to Forensic Science, Lab Manual, Seventh Edition, Prentice-Hall, Upper Saddle River, 2001.
11. Laboratory Procedure Manual of Forensic Toxicology, 2005.
12. Clerke: Clerk's Analysis of Drugs & Poisons, Vol.-I & II
13. A. Keith Furr: CRC Handbook of Laboratory Safety, 5th Ed.
14. R. Meyer, J. Kohler and A. Homburg: Explosive, 4th Ed., Wiley-VCH pub.
15. J. J. Lentini: Scientific protocols for fire investigation
16. H. Jork, W. Funk, W. Fischer and H. Wimmer: Thin layer chromatography reagents and detection methods, Vol. 1-3, VCH Publication.
17. Vogel's Text Book of Practical Organic Chemistry by A.I. Vogel, A.R. Tatchell, B.S. Furniss, A.J. Hannaford, P.W.G. Smith, 5th Ed.

Credit Distribution			
L	T	P	Total
2	0	2	4

Course Title: Forensic Chemistry & Toxicology
Course Code: MFS 104: Paper IV
Level: PG

Course Objective: - The objectives of the course:

- To understand the methods for analysis of alcoholic beverages and drugs
- To understand the important provisions of Drugs and Cosmetic Act, Excise Act, NDPS Act
- To understand the role of forensic toxicologist and
- To interpret the toxicological findings.
- To understand the various methods used for the extraction and isolation of poisons.

Course Prerequisite: - Basic knowledge of analytical chemistry and toxicology

Course Contents:	Weightage (%)
<p>Module I: Chemical analysis of beverages and drugs</p> <ul style="list-style-type: none"> • Introduction, types of cases/exhibits, preliminary screening, presumptive test, inorganic analysis, micro-chemical methods of analysis. • Examination procedures involving standard methods and instrumental techniques. • Analysis of beverages: alcoholic and non alcoholic, country made liquor, illicit liquor. • Drugs of abuse: introduction, classification, drugs of abuse in sports, narcotics drugs and psychotropic substances, designer drugs and their forensic examination • Drugs and Cosmetic Act, Excise Act, NDPS Act. 	35%
<p>Module II: Poisons</p> <ul style="list-style-type: none"> • Definition, dosage, administration, Classification, action & factors modifying its action. • Collection and preservation of toxicological exhibits in fatal and survival cases, signs and symptoms of poisoning, mode of action and its effect on vital functions, medico-legal and post mortem examination report/finding studies, • Specific analysis plan/ approach to toxicological examination of poisoning samples. The role of drug recognition expert. • Drugs of Abuse, Signs and symptoms of addiction, Interpreting drug findings, Functions and roles of toxicologists in a forensic science lab. Significance of toxicological findings. 	30%
<p>Module III: Extraction and isolation methods in toxicology</p> <ul style="list-style-type: none"> • Techniques used in toxicology. Extraction, Isolation and clean-up procedures from biological samples: using conventional as well as modern techniques such as solid phase micro-extraction techniques. • Separation of poisons and drugs using chromatographic and electrophoretic techniques, identification and estimation of poisons and drugs using chromatography. • Spectrophotometric and other instrumental methods, significance of analytical studies with respect to Forensic examination. 	35%
Total	100%

Student Learning Outcomes: - At the completion of this course the candidate can:

- **Identify** the common signs and symptoms of poisoning
- **Describe** the methods for analysis of beverages
- **Differentiate** between chemical and instrumental methods of analysis of poisons
- **Analyze** and interpret the spectrophotometric data in poisoning cases.
- **Review** various analytical techniques used in forensic analyses of these drugs and poisons.

Pedagogy: - This course will be taught in the active –learning mode, featuring both lecture and discussions including presentations, different assignments and class tests which provide students abundant opportunity for learning and interaction.

Course Contents: - Lab/Practical

1. Analysis of alcoholic liquor as per BIS specifications.
2. Determination of methanol and ethanol in alcoholic liquors.(wet test, GC,TLC) (2)
3. Analysis of gasoline as per BIS specifications.
4. Estimation of ethyl alcohol in blood sample by wet test, colour test, TLC, GC-MS.(2)
5. Analysis of viscera (simulated sample) for organo-chloro /organo-phosphorus pesticides by TLC.(2)
6. Adulteration of vegetable oils by colour test, GC & HPLC.(2)
7. Systematic analysis of pharmaceutical products as per IPC specification by using HPLC.(2)
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)
10. Analysis of fire arson samples (extraction, spot test, GC, GC-MS) (2)
11. Extraction, Isolation and clean-up procedures from biological samples.(2)
12. Analysis of pesticides by colour test and instrumental technique.

Assessment/ Examination Scheme:

Theory L/T (%)	Lab/Practical/Studio (%)	Total
100	100	100

Theory Assessment (L&T):

Components	CIA (30%)			ESE (70%)
	A	H	CT	
Weightage (%)	5	10	15	70

Credit Distribution			
L	T	P	Total
2	0	0	2

Course Title: Forensic Chemistry & Toxicology
Course Code: MFS-204: Paper XII
Level: PG

Course Objective: - The objectives of the course:

- To know the chemistry of fire and arson.
- To distinguish between fire and arson
- To understand the nature and classification of explosives.
- To interpret the effect of blast wave on the structures
- To understand adulteration in food, cement, petroleum etc.

Course Prerequisite: - Basic knowledge of analytical chemistry and toxicology

Course Contents:	Weightage (%)
Module I: Arson <ul style="list-style-type: none"> • Arson: Fire, chemistry and physics of fire behaviour, elements of life cycle of fire, types of fire, Room fire sequence, direction of fire, incendiary devices, fire extinguishers, • Analysis of fire/arson crime scene, establishing the origin of fire, patterns and surface effects of char, Accidental fire causes. • Crime scene investigation & management of evidences on a fire/arson crime scene. 	35%
Module II: Explosives <ul style="list-style-type: none"> • Nature, Classification, Composition and characteristics of Explosive, pyrotechnics, IEDs, Commonly used Explosive devices, Explosion process and affects, types of hazard, effect of blast wave on structures, human etc. • Crime scene management in explosive cases, post-blast residue collection, Reconstruction of sequence of events, Evaluation and assessment of scene of Explosion. • Systematic examination of explosives and explosion residues in the laboratory using chemical and instrumental techniques in the laboratory and interpretation of results, Explosives Act. 	35%
Module III: Other Chemical Evidences <ul style="list-style-type: none"> • Adulterants in • food and food products, • cement, • petroleum products, • Pharmaceutical products, medicines, • Beverages. 	30%
Total	100%

Student Learning Outcomes: - At the completion of this course the candidate can:

- **Identify** the explosives and explosion residues
- **Describe** the methods of adulteration in food, cement, petroleum etc.
- **Differentiate** between fire and arson

- **Analyze** the evidences at the fire and arson crime scene.
- **Review** various analytical techniques for the analysis of explosion residues

Pedagogy: - This course will be taught in the active –learning mode, featuring both lecture and discussions including presentations, different assignments and class tests which provide students abundant opportunity for learning and interaction.

Assessment/ Examination Scheme:

Theory L/T (%)	Lab/Practical/Studio (%)	Total
100	0	100

Theory Assessment (L&T):

Components	CIA (30%)			ESE (70%)
	A	H	CT	
Weightage (%)	5	10	15	70

References:

1. Curry A.S; Analytical Methods in Human Toxicology, Part II, CRC Press Ohio (1986)
2. Krishnamurthy, R., Introduction to Forensic Science in Crime Investigation, 2011, Selective & Scientific Books, New Delhi.
3. Clark, E.G.C.; Isolation and Identification of Drugs, Vol. I and Vol. II, Academic Press, (1986).
4. Sunshine I; Year book of Toxicology, CRC Press Series, USA (1989 – 93).
5. Michael J. Deverlanko etal; Hand Book of Toxicology CRC Press, USA (1995)
6. Prakash M. etal; Methods in Toxicology Anmol Publication, New Delhi (1998)
7. Parikh C.K; Text Book of Medical Jurisprudence Forensic Medicines and Toxicology. CBS Pub. New Delhi (1999)
8. Balraj S. Parmar etal; Pesticide Formulation, CBS Publishers, New Delhi (2004)
9. Reiss C etal; Advance in Molecular Toxicology, Utrecht,Netherlands (1998)
10. Morgan B.J.T; Statistics in Toxicology, Clarendon Press, Oxford (1996)
11. Jorg Rombke etal; Applied & Ecotoxicology Lewis publishers NY (1995)
12. Shayne C.Gad etal; Acute Toxicology Testing Academic Press California USA (1998)
13. Chadha PV; Hand Book of Forensic Medicine and Toxicology, Jaypee Brothers New Delhi (2004) Semester-II FS-10832
14. Turner Paul; Recent Advances in Pharmacology & Toxicology, Churchill Livingstone, Elenburgh (1989)
15. Modi, Jaisingh P; Textbook of Medical jurisprudence & Toxicology, M.M. Tripathi Pub. (2001)
16. Cravey R.H, Baselt, R.C; Introduction to Forensic Toxicology, Biochemical Pub. Davis C A (1981)
17. Working Procedure Manual - Toxicology, BPR&D Publication (2000)
18. Ballantyne B; General and Applied Toxicology Vol-1-3 2nd Ed., Macmillan, NY (2000)
19. Gossel T.A; Principles of Clinical Toxicology 3rd Ed., Roven, NY (1994)
20. Gossel S S; Handbook of Highly Toxic Materials handling and Management, Marcel Dekker NY (1995)
21. Niesink RJM; Toxicology- Principles and Applications, CRC Press (1996).

Practical References:

1. Practical Organic chemistry; J.B. COHEN
2. Spot test in Organic chemistry; Feigl
3. Handbook of Organic Analysis; Clark H.T.
4. Practical Organic chemistry; Vogel
5. Identification of Organic; G.G. Neave, Heilbran

6. Quantitative inorganic analysis; vogel
7. The Merck index; Stetchar & others
8. Organic Electronic spectral data; Vol.-I; Mortiman Kamlet
9. Organic Electronic spectral data; Vol.-III; Mortiman Kamlet
10. Inorganic Semi micro qualitative analysis; Griffin & Plunky
11. Food Adulteration & we; V.C.Sane
- 12Peerson's Chem. Analysis of food; H.Egan, Kirk
13. Vogel's Book of Macro & Semi micro qualitative inorganic Analysis; G.Svehla
14. Explosive (4th Rev.Ed); J.Kohler, Redolf)
15. Clerk's Analysis of Drugs & Poisons VOL.-I & II; Clerke
16. Handbook of Laboratory Safety; A.Keith. Furr.
17. Development & Validation of Analytical Methods; Christopher, M.Riley, Thomas W
18. Petroleum solvents & Their functions & Handling; Esso Standard Estern inc.
19. Scientific protocols for fire investigation; John J. Lentini
20. Tech.Handbook of Oil Fat & waxes; Weston
- 21.Steroid analysis by HPLC; Marie P. Kautsky
22. TLC VOL.-II; Jork, Funk & Others
23. Medical Jurisprudence; J. P. Modi

Credit Distribution				
L	T	P	S	Total
4	0	4	1	9

Course Title: - Advanced Forensic Toxicology-I
Course Code: MFS-302: Paper XVIII
Level: PG

Course Objective: - The objectives of the course:

- To understand the classification of poisons
- To understand the various methods for isolation and extraction of poisons
- To understand the common signs and symptoms of poisoning
- To interpret the toxicological findings of volatile poisons

Course Prerequisite: - Basic knowledge of toxicology and analytical chemistry

Course Contents:	Weightage (%)
<p>Module I: Poisons</p> <ul style="list-style-type: none"> • Classification and Types of Poisons: Metallic, Inorganic, Organic, Volatile, Animal, Plant Insecticides, Pesticides, etc. • Their nature, Use, Administration, Fatal dose, fatal period, Symptoms, some common Antidotes Post-mortem findings, Collection and preservation of viscera and other samples 	25%
<p>Module II: Isolation and different methods of extraction</p> <ul style="list-style-type: none"> • Different methods of extraction for poisons from viscera: Solvent extraction, distillation /steam distillation, micro diffusion, dialysis, dry ashing, wet digestion, modified star-otto method, ammonium sulphate method. • Residue levels, toxic levels and therapeutic levels, fatal levels of commonly encountered poisons in blood, urine and tissues. • Extraction of poisons from blood, urine, stomach washes and vomits, food material and toxicological analysis of decomposed materials. • Interpretation of toxicological finding and preparation of reports, limitation of method and trouble shooting in toxicological analysis, disposal of analysis samples, some interesting and their importance in view of specific approach in examination. 	25%
<p>Module III: Volatile Poisons</p> <ul style="list-style-type: none"> • Nature, use, administrations, symptoms, post-mortem findings, fatal dose, fatal period, isolation, detection, qualitative and quantitative estimation of: Acetone, Ether, Oxalic Acid, Phenols, Camphor, Chloral Hydrate, Chloroform, Acetaldehyde Methyl alcohol, ethyl alcohol, illicit liquor, country-made liquor, etc. • Analysis by color tests, chromatographic techniques (TLC, FTIR, NMR, GC, GC-MS, etc.) 	25%

<p>Module IV: Metallic and Non-metallic Poisons</p> <ul style="list-style-type: none"> • Nature, use, administrations, symptoms, postmortem findings, fatal dose, fatal period, isolation, detection, qualitative and quantitative estimation of metallic poisons including: Lead, Copper, Mercury, Arsenic, Barium, Selenium, Magnesium, Aluminium etc. • Non-metallic poisons including: chlorine, bromine, iodine, phosphorus etc. Nature, use, administrations, symptoms, post-mortem findings, fatal dose, fatal period, isolation, detection, qualitative and quantitative estimation. • Analysis by color tests, AAS, FTIR etc 	<p>25%</p>
<p>Total</p>	<p>100%</p>

Student Learning Outcomes: - At the completion of this course the candidate can:

- **Identify** the common signs and symptoms of poisoning
- **Describe** the methods for isolation and extraction of poisons
- **Differentiate** between metallic and non metallic poisons
- **Analyze** and interpret the data of toxicological analysis
- **Review** various analytical methods used toxicology

Pedagogy: - This course will be taught in the active –learning mode, featuring both lecture and discussions including presentations, different assignments and class tests which provide students abundant opportunity for learning and interaction.

Course Title: - Advanced Forensic Chemistry-I
Course Code: MFS 303: Paper- XIX
Level: PG

Course Objective: - The objectives of the course:

- To understand the chemistry of fire and arson
- To distinguish between fire and arson
- To understand the effects of explosion on surrounding
- To interpret the findings of analysis of petroleum products

Course Prerequisite: - Basic knowledge of chemistry of fire, explosives, cement and petroleum products

Course Contents:	Weightage (%)
<p>Module I: Arson and Fire</p> <ul style="list-style-type: none"> • Chemistry of fire, difference between Arson and Fire, Material and Chemicals use in initiating fire and arson. Direction of fire, origin of fire, Pattern followed by Fire, Fire triangle. • Examination of scene of fire/arson recognition and collection of evidence, packing, labeling and forwarding of exhibits. • Methods of extraction from exhibit- direct extraction, distillation and micro diffusion methods, analysis of arson exhibits by instrumentation techniques. • Methods of Investigating an Arson Scene. 	25%
<p>Module II: Explosives</p> <ul style="list-style-type: none"> • Introduction, Chemistry of explosives, Temperature of chemical explosion, Force and pressure of explosion, Kinetics of explosive reactions. • Types of explosives (primary & secondary explosives) Differentiation between High and Low Explosives. Development of explosives : Black powder, Nitro Cellulose, Nitro Glycerin, Dynamite, Ammonium nitrate, Commercial explosives (permitted explosives, ANFO and slurry explosives), Military explosives (picric acid, tetry TNT, Nitro guanidine, PETN, RDX, HMX and polymer bonded explosives), IEDs. • Post Blast Investigation: Bombs, Crude bombs, Home-made bombs, Improvised Explosive Devices (IEDs), Molotov Cocktail, Disposal of bombs, Explosions effects • Role of Forensic Scientist in Post blast investigation, Collection of samples, Color tests, TLC & Instrumentation Techniques. Technical report frame work, Evaluation and assessment of explosion site and reconstruction of sequence of events. 	25%
<p>Module III: Petroleum Products</p> <ul style="list-style-type: none"> • Petroleum Products, Adulterants, Detection of adulterants of gasoline, diesel and engine oils. • Analysis of residues in forensic exhibits, recycled engine oils, dyes of petrol and kerosene, engine oils. • Gas chromatography analysis of petrol, kerosene, diesel and other solvents. • Detection of adulteration by Flash point, boiling point, ignition method and distillation method 	25%
<p>Module IV: Cement</p> <ul style="list-style-type: none"> • Cement, Concrete and Mortar: Chemical compositions Portland cement, and other type of cements and building materials. • Methods of sampling of cements, mortar and concrete Common adulterant of cement and their detection. 	25%

<ul style="list-style-type: none"> • Methods of analysis- Physical analysis- microscopic examination, Ignition tests, Sieve test, Density Gradient test Chemical analysis of cement, mortar and concrete, Instrumental analysis of by TGA, DTA, ICP, AAS and XRD, etc.. • Case Studies like Structural Failures, etc. 	
Total	100%

Student Learning Outcomes: - At the completion of this course the candidate can:

- **Identify** the fire patterns and room fire sequence
- **Describe** the methods for collection of explosion residues
- **Differentiate** between high and low explosives
- **Analyze** and interpret the data of adulteration petroleum products.
- **Review** various analytical methods for analysis of cement

Pedagogy: - This course will be taught in the active –learning mode, featuring both lecture and discussions including presentations, different assignments and class tests which provide students abundant opportunity for learning and interaction.

MFS-304: Practical X (Special: Practical Forensic Chemistry & Toxicology)

Hrs/week-10 Marks-100

Candidate should complete minimum 80% of the total no. of practical.

1. M.P, B.P and flash point determination.
2. TLC, GC and GC-MS separation of anabolic steroids.
3. TLC, UV-Visible, HPLC Analysis of phenolphthalein in trap cases.
4. Analysis of alcohol content in sample by derivatization into known organic compounds and its analysis by GC, GCMS, HPLC.
5. Determination of Mercury in biological materials by spectrophotometry.
6. Analysis of animal and insect toxins. (2)
7. To study the separation of metal ions by paper chromatography. (2)
8. TLC, GC analysis of barbiturates, benzodiazepine and amphetamines.
9. Detection and identification of pesticide in a given formulation by colour test, TLC and UVvisible spectrometer
10. Detection of metallic poisons (arsenic and mercury) in food stuff (simulated samples). (2 Nos.)
11. Detection and identification of pesticide in a given formulation by colour test, TLC and UVvisible spectrometer.
12. Spectrophotometric/ Colorimetric determination of metal ions. (2)
13. Spectrophotometric/ Colorimetric determination of non- metal ions. (2)
14. Extraction of different metals from viscera, urine, blood and other biological samples (6)
15. Estimation of paints and pigments by spectrophotometry (UV, FTIR, etc) (2 Nos.)
16. Comparison of polythene films by IR spectrophotometry.
17. Separation of sample of forensic interest by column chromatography as a separation technique. (4 Nos.)
18. Analysis of viscera for volatile poisons (Organic and Inorganic). (2 Nos.)
19. Analysis of non- metallic (anionic) poisons in viscera. (2 Nos.)

Assessment/ Examination Scheme:

Theory L/T (%)	Lab/Practical/Studio (%)	Total
100	100	100

Theory Assessment (L&T):

Components	CIA (30%)			ESE (70%)
	A	H	CT	
Weightage (%)	5	10	15	70

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