Syllabus (NEP-2020)
M.Sc. Forensic Science
Kumaun University, Nainital

Department of Forensic Science
Faculty of Biomedical Science
D.S.B. Campus, Kumaun University, Nainital

SYLLABUS
M.Sc. Forensic Science (NEP-2020)
D.S.B. Campus, Kumaun University, Nainital
KUMAUN UNIVERSITY, NAINITAL, UTTARAKHAND.

1.	**Name of the Programme**	M.Sc. Forensic Science
2.	**Type of Course (U.G./P.G.)**	Post Graduate
3.	**Duration of Course**	4 Semester (2 Year course) NEP-2020
4.	**Objectives of Course**	**To provide foundational and interdisciplinary knowledge** in core areas of Forensic Science through theory, practicals, and electives, preparing students for crime investigation and laboratory-based roles. **To develop specialization, research skills, and ethical values** through advanced coursework, hands-on training, and projects, enabling careers in forensic science, law enforcement, and academia.
5.	**Outcome of Course**	**Comprehensive Understanding of Forensic Science** Students will gain a strong foundation in the principles and diverse branches of Forensic Science, along with practical knowledge of the structure, functioning, and role of forensic laboratories in the criminal justice system. **Skill Development for Crime Investigation and Prevention** The course prepares trained professionals to support law enforcement agencies in crime scene investigation, evidence analysis, and legal procedures, aligning with the New Law of Evidence and fulfilling the growing demand for forensic experts. **Ethics, Justice, and Career Readiness** Emphasis is placed on ethical practices, moral responsibilities, and the societal impact of forensic science. Graduates will be equipped with the skills to contribute to justice delivery and public safety through advanced techniques such as DNA profiling and Chemical Analysis, opening career opportunities in government, private, and research sectors.
	Number of Proposed seats (Intake)	20 (Twenty)

1. Compulsory: DSC (**Discipline Specific Course**)- (4)
2. Choose three DSE (**Discipline Specific Electives**) (3x4) courses

OR

Choose two DSE- (2x4) and one GE **(Generic Electives)** (4) course

OR

Choose one DSE (4) and two GE (2x4) courses

(total = 12)

(Each DSC and DSE carries 4 Credits)

4x4= 16 credits

3. Dissertation on Major (4+2)

OR

Dissertation on Minor (4+2)

OR

Academic project/ Laboratory Training (4+2) = **06**

(Carries 06 Credits)

06 credits (From Semester I to III)

Total Credits= 22/ semester

Semester-IV

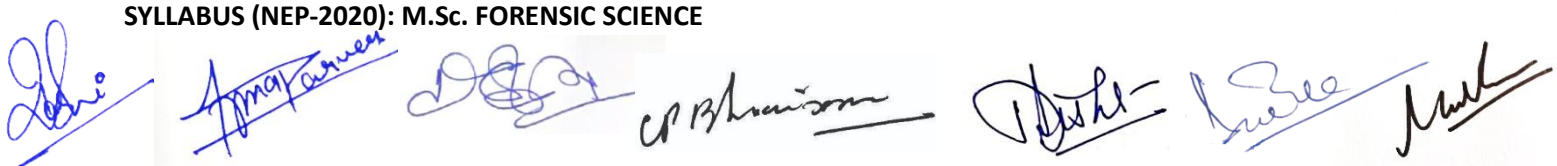
DSC (4 credit) + **Dissertation/Research work** aligned with the specialization (18 credit)

YEAR-I: SEMESTER I (ODD SEMESTER)

PAPER CODE	PAPER TITLE	TH+PR	Total Credits
DSC-1/T+P	**Fundamentals of Forensic Science**	**3+1**	**4**
DSE-1	Elementary Forensic Chemistry and Toxicology		4
DSE-2	Fundamentals of Forensic Physics		4
DSE-3	Basics of Criminology and Penology		4
DSE-4	Domains of Forensic Science		4
GE-1	Microscopy		4
GE-2	Analytical Techniques in Biology		4
GE-3	Basic Haematological Techniques		4
Project	Academic Project / Laboratory Training / Minor Dissertation		6
Total			**22**

The M.Sc. program will be divided into four semesters each being of six months duration. Each semester comprises of will be based on DSC (**Discipline Specific Course,** DSE (**Discipline Specific Electives**) and GE **(Generic Electives)** course. Each theoretical course will be divided into Internal Assessment of 20 marks and semester end examination of 80 marks.

Course: DSC	**Course Title:** Fundamentals of Forensic Science
Credits:4	**Discipline Specific Course**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**
Theory	
Unit	**Topic**
I	**Forensic science:** Definition and Scope of Forensic Science. History and evolution of forensic science, necessity and principles. Forensic science laboratories/institutions in India. Organizational Structure of a Forensic Science Laboratory/Institution. Functions and responsibilities of a forensic scientist Ethics in forensic science. **Nature of Evidence:** What is Evidence? Types of evidence, Levels of evidence, Basis of evidence; Transfer & Persistence, contamination, Identity, class and Individualization. Known and questioned items, Relationship and context, comparison of evidence, controls, Analysis of evidence: Controls, Analysis of evidence: Some preliminary considerations.
II	**Criminal Justice System:** Structure of Police, Police and Forensic Scientist relationship with reference to Crime Investigation, Modus Operandi and its role in Crime Record, maintenance of crime records, Prosecution and Judicial Organizations. Courts in India, Jurisdiction of courts in criminal cases and FIR. **BNS:** Legal Framework under New Criminal Codes – BNS, BNSS, and BSA: Historical evolution and structure of BNS, Key Offences Relevant to Forensic Science. Clause 101–109, Clause 113–121, Clause 73–83, Clause 176–186, Clause 198. Overview of BNSS structure and purpose, Role of police, magistrate, and courts in criminal investigation, **Clause 173**, **Clause 180**, **Clause 183–184**, **Clause 349–350**, **Clause 336.** Introduction to types of evidence (BSA): Oral, Documentary, Physical, Electronic. **Clause 2(g), Clause 22, Clause 39, Clause 61–65, Clause 71–74, C**omparison of handwriting, signatures, seals (Clause 73), Provisions related to Presumptions and Burden of Proof. Dowry Prohibition Act, Arms Act, Wildlife Protection Act, POCSO Act, THOTA, MTP Act and Surrogacy (Regulation) Act
III	**Crime:** Definition, types of crimes, causes of crime, Theories and prevention of crime, characteristics of criminals. **Crime Scene Management:** Types of crime scenes and their classification, Search methods, photography, documentation, sketching, Evidence recognition, collection, packaging, labeling, and chain of custody, Role of first responders and forensic team. **Forensic Videography and Photography:** Definition of forensic photography, camera functionality, varieties of camera lenses, crime scene and laboratory photography, ultraviolet and infrared photography, photomicrography, and macro



	photography. Digital photography, digital imaging, photogrammetry, and fundamental principles of videography and high-speed videography.

Suggested Readings:

1. Pazarena, Kessler, Watroba. 2022. Report Writing for Crime Scene Investigators. CRC Press
2. Rajeev Kumar. 2024. Indian Penal Code IPC. CBSPD Pvt. Ltd.
3. Rajeev Kumar. 2024. Indian Penal Code IEA. CBSPD Pvt. Ltd.
4. Rajeev Kumar. 2024. Criminal Procedure Code CrPC. CBSPD Pvt. Ltd.
5. Christopher D. Duncan. 2023. Advanced Crime Scene Photography. CBSPD Pvt. Ltd.
6. Henry Horeustein; Colour Photography -A working Manual, Little Brown Co. Boston (1995).
7. B.H.E. Jacobson, Ray GG Attridge; The Manual of Photography, Focal Press, London (1988).
8. Jahne B; Digital Image Processing, Heidelberg Springer (1996).
9. Workinson J; Art of Digital Video, Oxford Focal Press (1994).
10. Upton Kobre, Brill; Photography, Pearson Education, Inc (2006).
11. H.L. Blitzer and J. Jacobia; Forensic Digital Imaging and Photography, Academic Press (2002)
12. David R.Redsicker; The Practical Methodology of Forensic Photography- 2nd Ed. CRC Press LLC (2001)
13. R.E. Jacobson, S.F.Ray, G.G.Attridge, The Manual of Photography- Photographic and Digital Imaging, N.R. Oxford.
14. Scott, 'Photographic Evidence', Vol. I, Vol. II, & Vol. III
15. Boudreau JE, et al; Arson & Arson Investigation, Survey & Assessment National Institutes of Law Enforcement, U.S. Deptt Of Justice, U.S. Govt Printing Press
16. Harris H., Gaensslen R. &Lee H. (2007). An Introduction to Forensic Science. USA: McGraw-Hill Education.
17. Saferstein R. (2001). Forensic Science Handbook Vol. I. London: Prentice Hall

Course: DSE	**Course Title: Elementary Forensic Chemistry and Toxicology**
Credits:4	**Discipline Specific Electives**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**

Theory

Unit	Topic
I	**Introduction to Forensic Chemistry:** Scope and applications, screening (colour/ spot test), inorganic analysis. Detective dyes- cases and importance in trap cases. Arson Chemistry of fire, searching of fire scene, collection, preservation and examination of arson evidences. Forensic analysis of Fertilizers/ insecticides/ pesticides/ biocides.
II	**Forensic Toxicology:** Introduction, Overview of international organizations in forensic toxicology. Key areas and elements of forensic toxicology, applications, and scientific principles. Instrumentation and techniques used in analysis. Types of cases handled and the role of the forensic toxicologist. **Forensic Veterinary Toxicology:** Definition and scope; common toxicological cases and animal disease conditions in small and large animals.
III	**Entomo-toxicology:** Definition and Forensic utility; Environmental Forensic Toxicology: Introduction, principles and application, various pollutants, identification of biased environmental data, Forensic techniques in environmental litigation. **Clinical Toxicology:** Introduction and history of clinical toxicology, Toxidrome, Management of the poisoned or overdosed patient, Laboratory principles.

Suggested Readings:

1. Niesink, RJM; Toxicology- Principles and Applications, CRC Press, 1996.
2. Modi, JP, Textbook of Medical Jurisprudence & Toxicology, N.M. Tripathi Pub, 2001
3. Clark E.G.C; Isolation and Identification of drugs, Academic Press, London, 1986.
4. Sunshine I: Handbook of Analytical Toxicology, CRC Press, Costa Rica,1969.
5. Dr. P.C. Ignatius. 2022. Forensic Medicine & Toxicology Practical Guide & Exam Prep Manual. ELSEVIER
6. Ignatius. 2025. Textbook of Forensic Medicine and Toxicology. ELSEVIER
7. OP Murty. 2022. Textbook of Forensic Histopathology. CBSPD Pvt. Ltd.
8. Dr. P. Sharama, Dr. P. Pradeep Kumar. Basics of Immunology. Innovative Publication
9. Burger A. (2004). Medicinal Chemistry & Drug Discovery, 6 Vol Set, 6th Ed. NY: John Wiley & Sons.
10. Bassett M. (2004). Vogel's Textbook of Quantitative Chemical Analysis. England: Longman Essex.
11. Boudreau J.E. (1977). Arson & Arson Investigation, Survey & Assessment National Institute of Law Enforcement, U.S. Deptt.of Justice. USA: US Govt Printing Press.

12. Brean S. F. (1998). Vogel Textbook of Practical Organic Chemistry. Edinburg: Addison Wesley Longman.
13. Burger A. (1970). Medicinal Chemistry, Vol. II. NY: Wiley Inter science.
14. Dettean J. D. (2002). Kirk's Fire Investigation. N.J: Prentice Hall, Eaglewood Cliffs, w.e.f. 2005-2006.
15. Feigl (2005). Spot Test in Inorganic Analysis. New Delhi: Elsevier Pub.
16. Finar L. (2009). Organic Chemistry Vol. II. India: Pearson Education.
17. Molina D. K. (2009). Handbook of Forensic Toxicology for Medical Examiners. USA: CRC Press.
18. Curry A.S; Analytical Methods in Human Toxicology: Part II, CRC Press Ohio (1986)
19. Curry, A.S: Poison Detection in Human Organs, C Thomas Spring field CRC Press (1976)
20. Clark E.G.C: Isolation and Identification of drugs. Vol. I and Vol. 2, Academic Press (1986)
21. Laboratory Procedure Manual, Forensic Toxicology: Directorate of Forensic Science MHA Govt (2005)
22. Steward And Stolman: Toxicology Vol.1 and Vol. 2
23. Michel J D et al: Handbook of toxicology CRC Press Publ, USA (1995)
24. Casarett, L J and Doul John; Toxicology: The Basic Science of Poison, Macmillan Publ. Co. New York (1975)
25. Carvey R.H& Baselt R C; Introduction to Forensic Toxicology and Biochemicals Publ. Davis C.A (1981).

Course: DSE	**Course Title: Fundamentals of Forensic Physics**
Credits:4	**Discipline Specific Electives**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**

Theory

Unit	Topic
I	**Introduction to Forensic Physics:** Nature, collection, preservation & forwarding of physical evidence for scientific examinations. **Forensic Engineering:** What is forensic engineering; Fire investigation; Industrial accidents; Traffic accident reconstruction; Transportation disaster investigation; Civil engineering investigation; Investigation report**. Building Materials-** Types of cement and their composition, Determination of adulterants, Analysis of Bitumen and road material, Analysis of cement mortar and cement concrete and stones. Forensic examination of electrical appliances/installations.
II	**Glass**-Types of glass and their composition, Glass fracture analysis, Laboratory exercises include refractive index measurements using immersion methods and classical chemical and physical methods of analysis. **Soil-** Formation and types of soil, Composition and color of soil, Forensic examination of soil, Interpretation of soil evidence. **Paints-** Types of paint and their composition, Forensic examination of paints, Interpretation of paint evidence. **Tool Marks**- Types of tool marks, Class characteristics and individual characteristics, Lifting of tool marks, Examination of Tool Marks.
III	**Forensic Speaker Identification:** Speaker Identification and Tape Authentication: Voice Production Theory, Speech Signal Processing and Pattern Recognition, Acoustic Parameters of Sound, Fourier Analysis, Frequency and Time Domain Representation of Speech Signal, Analogue to Digital Conversion-Sampling and Quantization, Fast Fourier Transform, Speech Enhancement, Authentication of Audio-Video Signal.

Suggested Readings:

1. Caddy, B; Forensic Examination of Glass and Paint Analysis and Interpretation, CRC Press, New York, 2001.
2. Shaw, D; Physics in the Prevention and Detection of Crime, Contem Phys. Vol.17, 1976.
3. Saferstein, R; Forensic Science Handbook. Vol. I, II, (Ed.), Prentice Hall, New Jersey, 1988.
4. Working Procedure Manual; Physics BPR&D Publication, 2000.
5. Neustein, A., & Patil, H. A. (2012). Forensic speaker recognition (Vol. 1). New York, United States: Springer.
6. Maher, R. C. (2018). Principles of forensic audio analysis (Vol. 34). Springer International Publishing.

7. F.W. Sears, M.W Zemansky, and H. D. Young; University Physics, Sixth Ed., Narosa;
8. Dennis Shaw; Physics in the Prevention and Detection of Crime, Contem Phys. Vol 7;
9. Philip Rose; Forensic Speaker Identification; Taylor and Francis Forensic Science Series, London
10. Bengold & Nelson Moryson- Speech and Audio signal processing; John Wiley & Sons, USA, Nickolls, L.C; Scientific Investigation of Crime, Bulterwest, London
11. Raymond C Murray & John C.F Tedrew; Forensic Geology; Prentice Hall, New Jersey
12. B. Caddy; Forensic Examination of glass and paints analysis and interpretation ISBN 0784 05749
13. Cossidy, M. J. Footwear Identification, Royal Canadian Mounted Police, Ontario, Canada.
14. Smith, B.C, Holland MM, Sweel, DL & Dizinno. A; DNA & Forensic Odontology, Manual of Forensic Odontology, Colorado Springs, USA.
15. Kasprzak, J; Possibilities of Cheiloscopy in Forensic Science.
16. Medlin H 0: Ear print Identification, Solve Crime Military Police Journal.
17. Lannarelli A V. Ear Identification, Forensic. Identification series, Paramount.
18. Bengold & Nelson Morgan; Speech and Audio Signal Processing; John Wiley and Sons, USA
19. Jenkins and White; Fundamentals of Optics; Mc Graw Hill; Fourth Ed, (I) James, S.H. And Nordby, J. J.; Forensic Science; An Introduction to Scientific and Investigative Techniques, CRC Press USA.
20. Ray D. Kent and Charles Read; Acoustic analysis of speech
21. Phil Rose & James R Robertson; Forensic speaker identification.
22. Allan Matchett, "CCTV for Security Professionals", Elsevier, Butterworth Heinemann, 2003.
23. Austerberg David; "The Technology of Video & Audio Streaming", Focal Press, 2013.B.
24. A.J. Fisher, D.R. Fisher; "Techniques of Crime Scene Investigation, 8th Edition", CRC Press London, 2012.
25. Banwell C.L& Elani M.M.C; "Fundamental of Molecular Spectroscopy", 4th Edition, Tata McGraw Hill Pub. Co., 1995.
26. Bodziak, W., "Footwear Impression Evidence", 2nd Ed. CRC Press, Boca Raton, Florida, 2000.
27. B.P. Saville; "Physical Testing of Textiles", The Textile Institute CRC Press and wood head Pub., 2000.
28. C.G.G. Aitkens and D. A. Stoney; "The Use of Statistics in Forensic Science", Ellis Harwood Limited, England 2011.
29. David A. Crown; "The Forensic Examination of Paints and Pigments", Taylor & Francis, NY, 2001.

30. C.G.G Aitkens and Franco Taroni; "Statistics and Evaluation of Evidence for Forensic Scientists", 2nd Edition, John Wiley & Sons, 2004.
31. David Lucy; "Introduction to Statistics for Forensic Scientists", John Wiley & Sons Ltd., London, 2005.
32. Dwight Bolinger et. al.; "Aspects of Language", Third Edition, Harcourt Brace Jovanovich College Publishers, USA, (1981).
33. E.R. Mengel; "Forensic Physics in 2002 year book", McGraw Hill Encyclopedia of Science & Technology.
34. Triggs C.M. Buckleton J.S. &Walsh S.J. (2004). Forensic DNA Evidence Interpretation. USA: CRC Press

Course: DSE	**Course Title: Basics of Criminology and Penology**
Credits:4	**Discipline Specific Electives**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**

Theory

Unit	**Topic**
I	Crime Scenario in India: Concept and Definition of Crime, Introduction to crime, Sociological aspects of crime and criminals in society. Types of crime and its causes: Property crimes, public order crimes, violent crimes, cybercrimes, juvenile delinquency, Society-Criminal interaction and various types of crimes in India.
II	Forensic Criminology: Introduction of Forensic Criminology, Control and Prevention of Crime in context with Organization, Industrialization, Family set up, Psychology. Procedures involved in detection of crime: Latest evidence-based research in detection and prevention of crime. Criminal Profiling: Definition, Need and Types, Forensic Scientific evidence, Crime and Psychopathology, Genetics and Crime, Serial murders, Modus Operand
III	Definition, Nature and Scope of Penology, Historical and Contemporary approach to penology, Theories of Punishment: Retributive, Reformative, Preventive and Deterrent. Forms of Punishment. Constitutionality of capital punishment.

Suggested Readings:

1. Rajeev Kumar. 2024. Indian Penal Code IPC. CBSPD Pvt. Ltd.
2. Rajeev Kumar. 2024. Indian Penal Code IEA. CBSPD Pvt. Ltd.
3. Rajeev Kumar. 2024. Criminal Procedure Code CrPC. CBSPD Pvt. Ltd.
4. Sutherland, Edwin H. & Donald R. Cressey. Principles of Criminology. Publisher: Rowman & Littlefield. 1947
5. Wayne Petherick, Brent E. Turvey, Claire E. Ferguson. Forensic Criminology & Criminal Profiling. Forensic Criminology (ed.). 2009
6. Brent E. Turvey. Criminal Profiling: An Introduction to Behavioral Evidence Analysis. 2011
7. CLP's Criminology & Penology with Victimology by N. V. Paranjape – 19th Edition 2023

Course: DSE	**Course Title: Domains of Forensic Science**
Credits:4	**Discipline Specific Electives**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**

Theory

Unit	Topic
I	**Introduction to Forensic Pathology:** Definition and scope of forensic pathology. Role of a forensic pathologist. Classification of death (natural, unnatural, accidental, suicidal, homicidal). Ethics and medico-legal responsibilities. **Death and its Medico-legal Aspects:** medico-legal examination, Postmortem examination: Types of autopsies, Objectives and procedure of medico-legal autopsy, External and internal examination, Collection and preservation of biological samples. Digitalization of Medico Legal Reporting i.e., MedLEaPR
II	**Forensic Anthropology**: Introduction of Forensic Anthropology, The human skeleton, Collection and Preservation of evidence. Determination of age, sex and stature from anthropological evidences. Gait pattern; Identification through Skull superimposition and facial reconstruction. Case studies. **Forensic Odontology:** Introduction, Structure and types of teeth, Dentition and dental formula, Dental diseases, Determination of age, sex and race from teeth, Forensic significance in identification, Role of teeth in mass disaster, Bite marks. Case Studies.
III	**Forensic Entomology:** Introduction: Insects and their Biology, Life cycles of insects, the classification of insects, collecting insects at a crime scene, rearing insects, calculating A PMI (Postmortem interval), case studies. **Forensic Serology:** Introduction to Forensic Serology, The composition of blood. Blood Typing/Grouping - The ABO system and its usefulness in forensic inquiry. Additional blood group antigens include Rh subtypes, MN, I, P, Kell, Duffy, Kidd, Lewis, Lutheran, and Bombay blood groups. Identification of other bodily fluids such as saliva, urine, semen, and vaginal secretions, along with their forensic importance. **Analysis:** Preliminary tests for blood (color tests – Benzidine, Kastle-Meyer, Leucomalachite green). Confirmatory tests (Takayama, Teichmann, immunochromatographic methods). ABO and Rh blood group typing; Saliva: Phadebas test, starch-iodine test etc.

Suggested Readings:

1. Pomara & Fineschi. 2021. Forensic and Clinical Forensic Autopsy. CRC Press.
2. Waugh Grant. 2023. Ross & Wilson Anatomy and Physiology. ELSEVIER

3. OP Murty. 2017. Operational Guidelines for Postmortem Examinations and Auditing. CBSPD Pvt. Ltd.
4. Chawla & Gupta. 2024 Medicolegal Autopsy Dissection Techniques. CBSPD Pvt. Ltd.
5. Stuart H. James, Paul E. Kish, T. Paulette Sutton. Principles of Bloodstain Pattern Analysis Theory and Practice. 2005
6. Verma. 2023. Bloodstain Pattern Analysis in Forensic Investigation. CBSPD Pvt. Ltd.
7. Forensic dentistry, Paul G. Stimson, Curtis A. Mertz
8. Forensic Dentistry, second edition, David R. Senn, Paul G. Stimson
9. Shanan S. Tobe. Forensic Serology. 2025

Course: GE	Course Title: Microscopy
Credits:4	Generic Electives
Max. Marks: As per Univ. rules	Min. Passing Marks: As per Univ. rules

Theory

Unit	Topic
I	**Basics of Microscopy and Optical Microscopes:** Introduction to microscopy: history and significance. Basic concepts: magnification, resolution, numerical aperture, contrast. Components and working of a compound microscope. Types of light microscopy: bright-field, dark-field, phase-contrast, fluorescence microscopy. Sample preparation techniques: staining, sectioning, mounting. Limitations of optical microscopy.
II	**Electron and Scanning Probe Microscopy:** Principles of SEM and TEM. Sample preparation for EM. Imaging and contrast mechanisms. Applications in biology, materials science, and nanotechnology. Introduction to AFM and STM. Operating principles and image interpretation. Applications in surface topography and molecular imaging.
III	**Advanced and Digital Microscopy Techniques:** Confocal Laser Scanning Microscopy (CLSM). Super-resolution. Digital image acquisition and processing. Application of Advanced and Digital Microscopy.

Suggested Readings:

1. Douglas B. Murphy, Michael W. Davidson. Fundamentals of Light Microscopy and Electronic Imaging. 2012
2. Jerome Mertz. Introduction to Optical Microscopy. 2019
3. Peter Török and Fu-Jen Kao. Optical Imaging and Microscopy. 2007
4. R.F. Egerton. Physical Principles of Electron Microscopy An Introduction to TEM, SEM, and AEM. 2016
5. Thomas, C & Woolnough, L. (2014). Understanding and using the light microscope. Milton Contact. Ltd.
6. Ritesh K Shukla, Neeti Kapoor, Ashish Badiye (2022). Forensic Microscopy, Truth Under the Lenses, 1st ed. CRC Press.
7. Plant micro-technique and microscopy: by SE Ruzin, -1999.
8. Freckelton, I. (Ed.). (2021). Forensic Analysis: Scientific and Medical Techniques and Evidence Under the Microscope. BoD–Books on Demand.

Course: GE	**Course Title: Analytical Techniques in Biology**
Credits:4	**Generic Electives**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**

Theory

Unit	Topic
I	**Chromatographic Techniques:** General principles: partition coefficient, resolution, Rf value, Paper and Thin-Layer Chromatography (TLC), Gas Chromatography (GC), High-Performance Liquid Chromatography (HPLC). Applications in separation and purification of biomolecules
II	**Spectroscopic Techniques:** Principles of spectroscopy: absorbance, transmittance, Beer-Lambert law. UV-Visible Spectrophotometry: instrumentation, applications in protein/nucleic acid quantification. Atomic Absorption Spectroscopy (AAS). Infrared (IR) Spectroscopy: basic principles and applications in biomolecular analysis.
III	**Electrophoretic Techniques and Centrifugation:** Agarose Gel Electrophoresis: nucleic acid separation, Polyacrylamide Gel Electrophoresis (PAGE): SDS-PAGE and native PAGE, Capillary electrophoresis, Isoelectric Focusing (IEF), Gel documentation systems. Basic principles: sedimentation coefficient, relative centrifugal force (RCF). Types of centrifuges.

Suggested Readings

1. C.N. Nalini. 2024. Instrumental Methods of Analysis. Pharma Med press.
2. A. Braithwaite, J.F. Smith. Chromatographic Methods. 2012
3. Günter Gauglitz and David S. Moore. Handbook of Spectroscopy: Second, Enlarged Edition 2014
4. Jehuda Yinon (Editor). Advances in Forensic Applications of Mass Spectrometry
5. Jürgen H Gross. Mass Spectrometry A Textbook. 2017
6. Chukwuebuka Egbuna, Kingsley C. Patrick-Iwuanyanwu, Muhammad Ajmal Shah, Jonathan C. Ifemeje, Azhar Rasul (Editor). Analytical Techniques in Biosciences: From Basics to Applications. 2021
7. Biji T. Kurien, R. Hal Scofield. Electrophoretic Separation of Proteins Methods and Protocols. 2019
8. Willard, Merrit and Dean. (1974). Instrumental Methods of Analysis. USA: Van Nostrand.

Course: GE	**Course Title: Basic Haematological Techniques**
Credits:4	**Generic Electives**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**

Theory

Unit	Topic
I	Introduction to Heamatology and Blood Collection: Composition and functions of blood. Types of blood cells and their morphology. Blood collection techniques: venipuncture, capillary collection. Anticoagulants: types and uses (EDTA, heparin, citrate).
II	Basic Haematological Tests: Estimation of Bleeding time and Clotting time. Hemoglobin estimation. Total RBC, WBC, and platelet counts (manual methods). Safety, ethics, and biosafety in haematology labs.
III	Differential and Peripheral Blood Analysis: Preparation and staining of peripheral blood smear (Leishman/Giemsa). Identification of normal blood cells and common abnormalities. Reticulocyte count and absolute eosinophil count. Clinical significance of haematological parameters in anemia, infections, and leukemia.

Suggested Readings:

1. Shirish M Kawthalkar (2025). Essentials of Hematology. 4 th Ed. Jaypee Brothers Medical Publishers Pvt.
2. Valentin Villatoro & Michelle To. Laboratory Guide to Clinical Hematology.
3. The Islamic University of Gaza. PRACTICAL HEMATOLOGY. 2014
4. Praful B. Godkar and Darshan P. Godkar. Textbook of Medical Laboratory Technology. 2014
5. Bernadette F. Rodak, George A. Fritsma and Kathryn Doig. Hematology: Clinical Principles and Applications. 2002
6. Barbara A. Brown. Hematology: Principles and Procedures. 1993
7. A. Victor Hoffbrand, Pratima Chowdary, Graham P. Collins, Justin Loke. Hoffbrand's Essential Haematology (Essentials) 9th Edition.2024
8. Adam J. Mead, Michael A. Laffan, Graham P. Collins, Deborah Hay and A. Victor Hoffbrand. Hoffbrand's Postgraduate Haematology 8th Edition. 2025

LIST OF PRACTICAL:

Semester I: Foundations of Forensic Science

1. Demonstration of Locard's Exchange Principal
2. Analysis of Physical Evidence using microscope
3. To Observe and Identify Basic Biological Samples Used in Forensics-Saliva *(Starch Test)*
4. Thin Layer Chromatography (TLC) of Drugs/Pesticides
5. To Study Radial and Concentric Fracture Patterns in Glass for Determining Direction and Sequence of Force
6. Study Tool Marks on Surfaces, Match and Compare Them
7. Drafting and understanding of an FIR
8. To Construct/Reconstruct a Crime Scene Using Logical Analysis and Forensic Clues (Outdoor/Indoor Crime Scene)
9. Photography and videography of Crime Scene
10. Sketching of Indoor/Outdoor Crime Scene.
11. Mortuary Visit and observation of autopsy examination protocols.
12. Casuality visit- observing the techniques of DNA Sample collection.

YEAR-I: SEMESTER II (EVEN SEMESTER)

PAPER CODE	PAPER TITLE	TH+PR	Total Credits
DSC-2/T+P	**Instrumental Techniques in Forensic Science**	**3+1**	**4**
DSE-1	Forensic Ballistics and Explosives		4
DSE-2	Analysis of Forensic Dermatoglyphics and other impressions		4
DSE-3	Questioned Documents and Handwriting Analysis		4
DSE-4	Forensic Medicine, Human Anatomy & Physiology		4
GE-1	Forensic Entomology and Postmortem Interval Estimation		4
GE-2	Fundamentals of Toxicology		4
GE-3	Bioinstrumentation		4
GE-4	Environmental Studies		4
Project	Academic Project / Laboratory Training / Minor Dissertation		6
Total		**22**	

The M.Sc. program will be divided into four semesters each being of six months duration. Each semester comprises of will be based on DSC (Discipline Specific Course, DSE (Discipline Specific Electives) and GE (Generic Electives) course. Each theoretical course will be divided into Internal Assessment of 20 marks and semester end examination of 80 marks.

Course: DSC	**Course Title:** Instrumental Techniques in Forensic Science
Credits:4	**Discipline Specific Course**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**

Theory

Unit	Topic
I	**Basics to Instrumental Techniques:** Accuracy, Precision, Signal to noise ratio, Sensitivity and detection limit, sources of noise, Instrument calibration, Qualitative and quantitative, Destructive and Non-Destructive methods of analysis. **Scientific Calculations:** SI units, scientific notation, significant figures, logarithms. Percentage Calculations: % w/v, % v/v, % w/w in reagent and sample prep. Molarity, Molality, and Normality: Definitions, calculations, and inter-conversions. Dilution & Concentration Techniques: Serial dilution, ppm, ppb, $C_1V_1 = C_2V_2$. Standard Solution Preparation: Primary and secondary standards.
II	**Spectroscopic Techniques:** UV-Visible Spectrophotometry: Principle, instrumentation, Beer-Lambert law, applications in drug and biological fluid analysis, Infrared (IR) Spectroscopy: Functional group identification, forensic applications (fibers, drugs), Atomic Absorption Spectroscopy (AAS): Detection of metals (e.g., arsenic, lead, mercury) in toxicology, Flame Photometry: Sodium, potassium, lithium estimation in body fluids, Fourier Transform Infrared (FTIR).**Chromatographic Techniques:** Thin Layer Chromatography (TLC): Principle, mobile/stationary phase, Rf value, analysis of drugs and inks, Gas Chromatography (GC): Instrumentation, detectors (FID, ECD, TCD), forensic applications in arson and toxicology, High Performance Liquid Chromatography (HPLC): Components, types of columns, forensic use in drug analysis, Affinity Chromatography, Ion-Exchange Chromatography, Molecular Sieve Chromatography.
III	**Mass Spectrometry**, Ion sources, types of mass analyzers, Molecular mass spectra, Interpretation of mass spectra, Applications of mass spectrometry; Atomic mass spectrometry, inductively coupled plasma Mass spectrometry (ICP-MS). **Hyphenated techniques:** GC-FTIR, GC-MS, LC-MS and MS-MS, CE-MS.

Suggested Readings:

1. C.N. Nalini. 2024. Instrumental Methods of Analysis. Pharma Med Press.
2. A. Braithwaite, J.F. Smith. Chromatographic Methods. 2012
3. Günter Gauglitz and David S. Moore. Handbook of Spectroscopy: Second, Enlarged Edition 2014
4. Jehuda Yinon (Editor). Advances in Forensic Applications of Mass Spectrometry
5. Jürgen H Gross. Mass Spectrometry A Textbook. 2017
6. Chukwuebuka Egbuna, Kingsley C. Patrick-Iwuanyanwu, Muhammad Ajmal Shah,

Jonathan C. Ifemeje, Azhar Rasul (Editor). Analytical Techniques in Biosciences: From Basics to Applications. 2021

7. Biji T. Kurien, R. Hal Scofield. Electrophoretic Separation of Proteins Methods and Protocols. 2019
8. Douglas Skoog, F. Holler, Stanley Crouch. Principles of Instrumental Analysis 7th Edition.2017
9. Deepak Rawtani, Chaudhery Mustansar Hussain. Modern Forensic Tools and Devices: Trends in Criminal Investigation. 2023
10. Silverman; Organic Chemistry of Drug Design & Drug Action, Elserier Pub. New Delhi
11. Abraham Burger; Medicinal Chemistry & Drug Discovery, 6 Vol Set, 6th Ed John Wiley & Sons, NY.

Course: DSE	**Course Title: Forensic Ballistics and Explosives**
Credits:4	**Discipline Specific Electives**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**

Theory

Unit	Topic
I	**Forensic Ballistics:** Definition and scope, Types of evidences associated, History and mechanism of Muzzleloaders (Match lock, Wheel lock, Flint lock firearms), Briefs of Pinfire, Rimfire and Centrefire systems of firearms. **Different parameters of classification of firearms:** Introduction to Shotgun, Revolver, Pistol, Rifle and Country Made/ Improvised Firearms. Proof Marks of Weapons.
II	**Firearm Ammunition:** Ammunition Components of Shotgun and Rifled. firearm cartridges, Headstamp Markings on Ammunition. **Internal Ballistics:** Definition, Shapes and manner of Propellant burning, Muzzle velocity and Factors affecting muzzle velocity. **External Ballistics:** Definition- Bullet Trajectory and factors affecting bullet flight. **Wound Ballistics:** Definition of wound ballistics, Ballistic aspect of firearm injuries, significance of studying cavitations in body, Bullet Entry/Exit Hole Identification, Evaluation of Accident, Suicide, Homicide firearm injuries.
III	**Range of Firing determination:** Introduction and methods of estimation. **Gunshot Residue:** Introduction and methods of analysis. **Bullet and Cartridges matching:** Class and individual characteristics on bullet and cartridge case for comparing and matching with suspected firearm. Briefs of NIBIN and IBIS.

Suggested Readings:

1. Arms Acts, 1959 and Arms Rule, 1962.
2. Working procedure Manual: Ballistics, DFS New Delhi, Publication, 2005.
3. Gunther & Gunther, 1935: The Identification of Firearms, Wouldies, New York.
4. Jauhri, M. 1980: Monograpnh on Forensic Ballistics, Govt. of India Publication, New Delhi.
5. Burrad, 1951: The Identification of Firearms and Forensic Ballistics.
6. Julian S. Hatcher, Frank J. Jury, Jac Weller Major. Firearms Investigation, Identification, and Evidence, 2006.
7. Vincent J.M. Di Maio. Gunshot Wounds: Practical Aspects of Firearms, Ballistics, and Forensic Techniques, 3rd edition, CRC Press 2015.
8. Heard, B.J; “Handbook of Firearms and Ballistics”, John Wiley, England, 1997.
9. Sellier, K.G. et al; “Wound Ballistics and the Scientific Background”, Elsevier Pub. Co., London, 1994.
10. Jauhari M; “Identification of Firearms, Ammunition, & Firearms Injuries”, BPR&D,

New Delhi.
11. Schooeble, A.J. and Exline, L.D; "Current methods in Forensic Gunshot Residue Analysis", CRC Press, NY,2000.
12. Beyer, J.C. (Ed); "Wound Ballistics", USPrinting Office, Washington, 1962.
13. Wilber; "Ballistic Science for the Law Enforcement Officer", Charles C. Thomas, USA, 1977.
14. Whelen; "Small arms Design and Ballistics", Vol II, Small arms Technical Publishing Company, USA, 1946.
15. Julian S. Hatcher; "Hatcher's Notebook", The Telegraph Press, Pennsylvania, USA, 1966.
16. L V. Hogg; The Cartridges Guide - A Small Arms Ammunition Identification Manual; The Stackpole Co., Harrisburg, P A.
17. Gary J. Ordog, Management of Gunshot Wounds, Elsevier, New York.
18. TA, Warlow; Firearms, The Law and Forensic Ballistics; Taylor and Francis, Landon;
19. B.R. Sharma. Firearms in Criminal Investigation & Trials, Universal Law Publishing 2017.
20. J. Howard Mathews; Charles C. Thomas, Firearms Identification, Vols 1,2, & 3; Spring-field, Illinois.

Course: DSE	**Course Title: Analysis of Forensic Dermatoglyphics and Other impressions**
Credits:4	**Discipline Specific Electives**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**

Theory

Unit	Topic
I	**Fingerprints in General:** Dactylography, Dermatoglyphics, and Dactyloscopy, basis for the science of fingerprints, Friction Ridge Skin, Morphogenesis of Friction Ridge Skin, Primary Dermal Ridge Development, Definition of fingerprint, History of Fingerprint Identification, Fingerprint as forensic Evidence, Visible Fingermarks, Latent Fingermarks, **Classification of Fingerprints for Comparison purposes:** Pattern area, Core, Delta, Type lines, Poroscopy, edgeoscopy, ridge characteristics, Fingerprint Pattern Types. Ten Digit and Single Digit fingerprint classification.
II	**Methods of Taking Fingerprints:** From living and dead persons, preserving and lifting of fingerprints. Comparison Protocols: Class and individual characteristics (Galton's details), different ridge characteristics, Standards of proof, Automatic Fingerprint Identification System (AFIS), Poroscopy and Edgeoscopy.
III	**Fingerprint Developing Methods**: Chemistry of latent fingerprint residue, factor contributing to latent fingerprints, Methods of Development of latent fingerprints using conventional methods–Powdering (Black and grey, fluorescent and magnetic), Fuming method, Vacuum Metal Deposition (VMD) Method, Chemical method, Reagent chemistry and formulations, Sequential Treatment and Enhancement., Photography of fingerprints, Digital Transmission. Other Impressions: Foot Prints, Shoe Prints, Tire Marks, their Preservation & Casting, Comparison, Skid marks. **Report Writing & Court Room Testimony:** Evidence and testimony in court, Information required by the Forensic expert, Components of Forensic Reports, Preparation of Report, Presenting findings in a Report format.

Suggested Readings:

1. Daluz. 2020. Fundamentals of Fingerprint Analysis. CRC Press.
2. Pazarena, Kessler, Watroba. 2022. **Report Writing for Crime Scene Investigators**. CRC Press
3. Saferstein, R. (1990) Criminalistics, Prentice Hall, New York.
4. David R. Ashbaugh (1999) Quantitative and Qualitative Friction Ridge Analysis, CRC Press.
5. E. Roland Menzel (1999) Fingerprint Detection with Lasers, 2nd Ed., Marcel Dekker,

Inc. USA.

6. James F. Cowger (1993) Friction Ridge skin, CRC Press London.
7. Mehta, M.K (1980) Identification of Thumb Impression & Cross Examination of Finger Prints, N.M. Tripathi Pub. Bombay.
8. Moenssens (1975) Finger Prints Techniques, Chitton Book Co. Philadelphia, NY.
9. Chatterjee S.K. (1981) Speculation in Finger Print Identification, Jantralekha Printing Works, Kolkata.
10. Cowger, James F (1993) Friction ridge skin- Comparison and Identification of fingerprints, CRC Press, NY.
11. J A Siegel, P.J Saukko (2000) Encyclopedia of Forensic Sciences Vol. I, II and III, Acad. Press.

Course: DSE	**Course Title: Questioned Document and Handwriting Analysis**
Credits:4	**Discipline Specific Electives**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**

Theory

Unit	Topic
I	**Questioned Document:** Definition, Importance, Classification and Preliminary Examination of questioned documents. Handwriting: Definition, Scripts, Development, Systems of Writing, Instruments and Appliances of handwriting expert. **Handwriting Characteristics:** General Characteristics, Individual Characteristics, Development of Individuality in Handwriting Comparison of Handwriting: Natural Variations, Fundamental Divergences. **Forgeries:** Forgery and its types and characteristics, identification and examination of forgeries. **Decipherment of secret indented and charred documents:** Preservation of documents, Examination of seal and other mechanical impressions, examination of sequence of intersecting of strokes. Standards for Comparison and Disguise etc.
II	**Age of Document & Alterations:** Determination of Age of Document-Absolute/relative Age, Indented and Invisible Writings, Alterations in the document: erasures, additions, overwriting and obliterations. **Comparison of type written/printed matter:** Working of typewriter, Printing and Machine Defects, alterations in typed text, various type of typewriting devices- check writing machines, electronic typewriter and proportional spacing typewriter. **Comparison of Printed matter:** Various Printing Processes. **Currency Note Examination:** Identifying features of fake and genuine Indian currency notes.
III	**Overview of forensic accounting,** the fraud triangle, and further fraud hypotheses. Fraudster description and Analysis, Fraud prevention, Money laundering and its classifications. Legislation pertaining to money laundering, comprehension of business information and financial reporting systems, accounting and auditing standards and procedures, evidence collection and investigative methodologies, and litigation processes. Analysis of financial documents. Whistleblowers and legislation for their safeguarding, Concepts of warning signals, associated case studies. **Report Writing & Court Room Testimony:** Evidence and testimony in court, Information required by the Forensic expert, Components of Forensic Reports, Preparation of Report, Presenting findings in a Report format.

Suggested Readings:

1. Huber, A. R. and Headrick, A.M. (1999) Handwriting Identification: Facts and Fundamentals CRC LLC
2. Ellen, D (1997) The scientific examination of Documents, Methods and techniques. 2nd ed., Taylor & Francis Ltd.
3. Morris (2000) Forensic Handwriting Identification (fundamental concepts and Principles)

4. Harrison, W.R. (1966) Suspect Documents & their Scientific Examination, Sweet & Maxwell Ltd., London.
5. Hilton, O (1982) The Scientific Examination of Questioned Document, Elsevier North Holland Inc., New Yor
6. Mehta, M. K. (1970) The identification of Handwriting & Cross Examination of Experts, N.M. Tripathi, Allahabad
7. Saxena's: Saxena's Law & Techniques Relating to Finger Prints, Foot Prints & Detection of Forgery, Central Law Agency, Allahabad (Ed. A.K. Singla).
8. Osborn, A. S. (1929) Questioned Documents, Boyd Printing Co., Chicago.
9. Saferstein, R. (1990) Criminalistics, Prentice Hall, New York.
10. Ordway Hilton; Scientific Examination of Questioned Documents. Revised Edition, Elsevier, NY (1982).
11. Albert S Osborn; The Problem of Proof, 2nd Ed., Universal Law Pub. Delhi (1998)
12. Charles C. Thomas; I.S.Q.D. Identification System for Questioned Documents, Billy Prior Bates Springfield, Illinois, USA (1971)
13. Wilson R. Harrison; Suspect Documents Their Scientific Examination, Universal Law Pub. Delhi Indian Reprint (2001)
14. Kurtz Sheila; Graphotypes a new Plant on Handwriting Analysis, Crown Pub. Inc., USA (1983)
15. Levinson Jay; Questioned Documents, Acad Press, London (2001)
16. Mcmenamin Gerald R, Forensic Linguistics-Advances in Forensic Stylistics, CRC Press, Washington Dc
17. Roy A Huber, AM Headrick, Handwriting Identification-Facts & Fundamental, CRC Press (1999)
18. Andrea Mc Nichol, Jeffrey A Nelson; Handwriting Analysis Putting it to work for you, Jaico Books, Delhi (1994)
19. Vacca John R; Computer Forensics- Computer crime scene Investigation, Firewall Medial, An imprint of Laxmi Pub (2002)
20. Casey Eoghan; Handbook of computer crime Investigation, Forensic Tools & Technology- Academic Press (2002)
21. Madinger J & Zalopany AR; (1999) -Money Laundering- CRC Press
22. Manning CA;(1999) -Financial Investigation & Forensic Accounting- CRC Press.
23. Brewster, F., Contested Documents and Forgeries, The Book Co. Ltd., Calcutta, 1932.
24. Quirke AJ; Forged Anonymous & Suspect Documents- 1930, Reorge Rontledge & Sons Ltd, London.
25. Katherine M Koppenhaver, CDE-Forensic Document Examination- Humana Press.
26. Jan Seaman Kelly & Brian S Lindblom-Scientific Examination of Questioned Documents-Taylor Francis Group London and New York.
27. Malcom Coulthard & Alison Johnson-An Introduction to Forensic Linguistics-Taylor & Francis Group London and New York. Mitchell, C.A. Inks: Their Composition and Manufacture. Including Methods of Examination and a Full List of British Patents, 4th ed., Charles Griffin & Co., Ltd., London, 1937.

28. Brunelle, L.R. and Reed, R.W. Forensic Examination of Ink and Paper, Charles C Thomas, Springfield, IL, 1984
29. Herbertson, G., Rubber Stamp Examination: A guide for Forensic Document Examiners, Wide Line Publishing, Colorado Springs, C/o, 1997.
30. Doherty, P., "Classification of Ink Jet Printers and Inks," Journal of the American Society of Questioned Documents Examiners.
31. Scott, Charles C., Photographic Evidence: Preparation and presentation, 2nd ed., West Publishing Co., St. Paul, MN.
32. Harrison, W.R., Forgery Detection a Practical Guide, Sweet and Maxwell, London, 1964.
33. Baker, J. Newton, Law of Disputed and Forged Documents, The Michie Co., Charlottesville, VA, 1955
34. Allean, M "Foundations of Forensic Documents Analysis – Theory & Practice", 2016.
35. Bradford, R.R. and Bradford, R.B. "Introduction to Handwriting Examination and Identification", 1992.
36. Typewriting Identification ISQT ---- Bates, Billy Prior
37. Ames on Forgery – D.T. Ames
38. The detection of Forgery—Douglas Blackburn.
39. Jane A. Lewis, Forensic Document Examination (Fundamental and Current Trends) , Academic Press, (2014).
40. Heidi H. Harralson. Larry S. Miller, Huber and Headrick's, Handwriting Identification (Fact and Fundamentals), CRC Press (2018).

Course: DSE	**Course Title: Forensic Medicine, Human Anatomy & Physiology**
Credits:4	**Discipline Specific Electives**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**
Theory	
Unit	**Topic**
I	**Death:** Causes manner and mode of death, Signs of death and changes after death. Somatic death, molecular death, early changes after death - Algor mortis, rigor mortis, cadaveric spasm, heat stiffening, cold stiffening, changes in blood, chemical changes in cerebrospinal fluid, changes in vitreous humour, post mortem lividity, fluidity of blood. Late changes – putrefaction- external and internal changes. Adipocere, mummification, gastric content and bladder content and time of death from growth of hair and nails. Destruction of body and tissues by maggots and other insects, rodents, fish and crabs, moulds. Sudden death, post-mortem demonstration of myocardial infarction Medico legal aspects of death- Asphyxia, syncope, coma, death by starvation, drowning, hanging and strangulation. Causes and mechanism of traumatic death, manner of death. Classification of traumatic deaths.
II	**Mechanical Injuries:** Abrasions, Bruises, Lacerations, Incised wounds, Stab wounds, Firearm injuries, Defence injuries, fabricated injuries. Traffic accident injuries: vehicular injuries, railway injuries and aircraft injuries. Thermal injuries: Burn and scalds, Lightning, Electricity, Explosions. Chemical trauma. Injuries. Accidental, self-inflicted, or inflicted by others. Ante -mortem and post-mortem, artificial injuries and aging of injuries. Fractures, Dislocations Secondary causes of death. regional injuries-wound of the scalp- incised, contusions, lacerations, firearm injuries.
III	**Structure and function of the major organ systems:** digestive, respiratory, endocrine, nervous, excretory, reproductive, cardiovascular and neuromuscular. Microorganism responsible for food poisoning. Times of digestion of foods. Collection, preservation and forwarding of samples – vomit, stool, stomach wash and residual food etc. **Cell structure and function:** Membrane structure, lipids, proteins and carbohydrates in cell membranes. Role of cell membrane in transport of material into and out of the cell. Cell organelles, cytoskeleton, projections from cell Page 18 of 48 membrane

Suggested Readings:

1. Ross & Wilson anatomy and physiology in health and illness 14th edition
2. Essential forensic biology by Alen Gunn 2nd edition
3. Fundamentals of anatomy and physiology global edition 11th edition
4. Principles of anatomy and physiology by Gerard J. Tortora
5. Anatomy and Physiology (C284) Book by Jonathan Fisher: Vinod Publication
6. Parikh C.K. (1972). Forensic Medicine and Toxicology. India: Medical Publications.
7. Poison C.J., Gee D.J. & Knight B., (1985). Forensic Medicine. UK: Pergamon Press.

8. Rao N.G. (2010). Textbook of Forensic Medicine &Toxicology. India: Jaypee Brothers Medical Publishers (P) Ltd.
9. Reddy K.S.N. (2014). Forensic Medicine. India: Jaypee Brothers.
10. Simpsen K. & Knight B. (1996). Forensic Medicine. UK: Taylor & Francis
11. Aggrawal A. (2016). Textbook of Forensic Medicine and Toxicology. India: Avichal Publishing Company.
12. Bardale R. (2011). Principles of Forensic Medicine & toxicology. India: Jaypee Brothers Medical Publishers (P) Ltd.
13. Biswas G. (2012). Review of Forensic Medicine and toxicology, 2nd Edition. India: Jaypee Brothers Medical Publishers (P).
14. Catanese C.A. (2009). Color Atlas of Forensic Medicine and Pathology. USA: CRC Press.
15. James J.P. & Simpson's S.K. (2014). Forensic Medicine. USA: CRC Press.
16. Krishan V. (2014). Textbook of Forensic Medicine & Toxicology: Principles & Practice. UK: Elsevier Health Sciences.

Course: GE	**Course Title: Forensic Entomology and Postmortem Interval Estimation**
Credits:4	**Discipline Specific Electives**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**
Theory	
Unit	**Topic**
I	**Introduction to Forensic Entomology:** Definition, history, and scope. **Biology and Taxonomy of Forensic Insects:** Morphology and life cycles of forensically important insects. **Orders: Diptera:** Calliphoridae (blow flies), Sarcophagidae (flesh flies), Muscidae, etc. **Orders: Coleoptera:** Dermestidae and Silphidae. Insect succession and decomposition stages (fresh, bloat, active/advanced decay, dry/remains) Ecological factors influencing colonization.
II	**Postmortem Interval (PMI) Estimation:** Use of insect development (maggot age) for PMI estimation, Insect succession-based estimation, Degree-day/hour models and accumulated degree hours (ADH), Factors affecting insect development: temperature, burial, drugs, toxins. Interpretation and limitations in PMI estimation.
III	**Crime Scene and Laboratory Procedures:** Collection of entomological evidence from crime scenes and cadavers, Preservation, rearing, and identification techniques, Documentation and chain of custody, Role of entomological evidence in court. **Recent trends**: Molecular entomology, DNA barcoding, geographic profiling. Case Study.

Suggested Readings:

1. UN Prasad. 20 Forensic Medicine Under Indian System of Medicine (Ayurveda). CBS Publishers & Distributors Pvt. Ltd.
2. Jason H. Byrd and James L. Castner. Forensic Entomology: The Utility of Arthropods in Legal Investigations. 2009
3. D.B. Tembhare. Modern Entomology. 2015
4. Dorothy Gennard. Forensic Entomology: An Introduction. 2012
5. David B. Rivers and Gregory A. Dahlem. The Science of Forensic Entomology 2nd Edition. 2022

Course: GE	**Course Title: Fundamentals of Toxicology**
Credits:4	**Generic Electives**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**

Theory

Unit	Topic
I	**Introduction Toxicology:** Definition, scope, and history. Definitions: Toxin, Toxicant, Poison, Xenobiotic. Scope and application in forensic Science. Dose Response Relationship: LC50, LD50, ED50, EC50; routes of Exposure and their effect. Introduction to NDPS Act.
II	**Toxicokinetic and Toxicodynamic:** Absorption, Distribution, Metabolism, Excretion (ADME), Biotransformation and detoxification mechanisms, Factors affecting toxicity (age, sex, genetics, nutrition, etc.), Mechanisms of cellular toxicity and target organ effects.
III	Basics of Pharmacokinetics and Toxicokinetics, Administration, liberation, and absorption of toxicants, Prevention of absorption from the gastrointestinal tract, Distribution and Metabolism of Toxicants in the body, Elimination of toxicants, Enhancement of elimination of toxicants, Types of Antidotes in poisoning cases. **Therapeutic Drug Monitoring:** Introduction, Therapeutic and toxic concentrations of some forensic related substances, Criteria to assess the clinical value of drug monitoring, Methods of analysis.

Suggested Readings:

1. Ashutosh Kar. 2019. Essentials of Biopharmaceutics and Pharmacokinetics. CBSPD Pvt. Ltd.
2. Dr. P.C. Ignatius. 2022. Forensic Medicine & Toxicology Practical Guide & Exam Prep Manual. ELSEVIER
3. Ignatius. 2025. Textbook of Forensic Medicine and Toxicology. ELSEVIER
4. Modi's (1988) Medical Jurisprudence & Toxicology, M. M. Trirathi Press Ltd. Allahabad.
5. Curry (1986) Analytical Methods in Human Toxicology, Part II.
6. A Siegel, P.J Saukko (2000) Encyclopaedia of Forensic Sciences Vol. I, II and III, Acad. Press.
7. Casarett & Doll Toxicology (2003) The Basic Science of poisons.
8. MaThew E. Johll (2009) Investigating Chemistry: A Forensic Science Perspective.
9. JJ Fenton (2002) Toxicology A Case-Oriented Approach

Course: GE	**Course Title: Bioinstrumentation**
Credits:4	**Generic Electives**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**

Theory

Unit	Topic
I	Definition and scope of bioinstrumentation **Basic Lab Equipment:** Incubators, water baths, magnetic stirrers, Autoclaves, laminar airflow cabinets, pH Meters, Conductivity Meters. Applications in biochemical analysis. **Microscopy:** Light, Phase Contrast, Fluorescence, Confocal Microscopy, Stereo zoom Microscopy, Image acquisition and analysis tools
II	**Centrifugation:** Low-speed, High-speed, Ultracentrifugation, Rotor types and biological sample handling. **Chromatographic Techniques:** HPLC, GC, Ion-exchange, and Affinity Chromatography. **Mass Spectrometry (MS):** Principle and Instrumentation, Hyphenated Techniques (LC-MS and GC-MS)
III	**Spectrophotometry & Fluorometry:** UV-Vis Spectrophotometer (for DNA/RNA quantification) **Electrophoresis Techniques:** Agarose gel electrophoresis (DNA/RNA separation), SDS-PAGE. **PCR and Real-Time PCR:** Thermal cycler: principle, types, applications, qPCR instrumentation and data interpretation.

Suggested Readings:

1. **C.N. Nalini. 2024. Instrumental Methods of Analysis. Pharma Med Press.**
2. A. Braithwaite, J.F. Smith.Chromatographic Methods. 2012
3. Günter Gauglitz and David S. Moore. Handbook of Spectroscopy: Second, Enlarged Edition 2014
4. Jehuda Yinon (Editor). Advances in Forensic Applications of Mass Spectrometry
5. Jürgen H Gross. Mass Spectrometry A Textbook. 2017
6. Chukwuebuka Egbuna, Kingsley C. Patrick-Iwuanyanwu, Muhammad Ajmal Shah, Jonathan C. Ifemeje, Azhar Rasul (Editor). Analytical Techniques in Biosciences: From Basics to Applications. 2021
7. Biji T. Kurien, R. Hal Scofield. Electrophoretic Separation of Proteins Methods and Protocols. 2019
8. Hirak Ranjan Dash, Pankaj Shrivastava and Surajit Das. Principles and Practices of DNA Analysis: A Laboratory Manual for Forensic DNA Typing. 2020
9. Lucília Domingues. PCR Methods and Protocols. 2023

10. Chapmen J.R. (1993). Practical Organic Mass spectrometry, A Guide for Chemical and Biochemical Analysis. New York: Wiley.
11. Harris H., Gaensslen R. &Lee H. (2007). An Introduction to Forensic Science. USA: McGraw-Hill Education
12. Jarris, K.E., Gray A.L. &Hock R.S. (1992). EDS; handbook of Inductively Coupled Plasma Mass Spectrometry; Glasgow: Blockie.
13. Lindsay, S. (1992). High Performance Liquid Chromatography. New York: Wiley.
14. Maclaffrty F.W. &Turecek F. (1993). Interpretation of Mass spectra; USA: Mill Valley, C A Univ. Science Books.
15. Robards K. Jackson P.E. & Haddad P.A. (2012). Principles and Practice of Modern Chromatographic Methods. Germany: Elsevier pub.
16. Shrivastava & Shrivastava. (1991). Introduction to Chromatography. India: S. Chand.
17. Smith and Bogusz M. (2007). Handbook of Analytical Separation. Germany: Elsevier Pub.
18. Srivastava M. (2010). High-Performance Thin-Layer Chromatography (HPTLC). Germany: Springer Science & Business Media.
19. Stahl E. (2013). Thin Layer Chromatography. Germany: Springer Science & Business Media.

Course: GE	**Course Title: Environmental Studies**
Credits:4	**Generic Electives**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**
Theory	
Unit	**Topic**
I	**F**undamentals of environmental biology and ecology. Structure and function of ecosystems, energy flow, food chains and food webs, ecological pyramids, biogeochemical cycles (carbon, nitrogen, phosphorus), and ecological succession. Basic concepts of population ecology and community interactions are also introduced.
II	Biodiversity and environmental pollution. Types and importance of biodiversity, threats to biodiversity, and conservation strategies (in-situ and ex-situ). Various forms of pollution-air, water, soil, and noise-their sources, effects, and control measures.
III	Global environmental issues and sustainable development. Climate change, global warming, ozone depletion, desertification, and international environmental agreements. Role of environmental biotechnology in conservation, including bioremediation, green technologies, genetically modified organisms, and biosafety concerns.

Suggested Readings:

1. William Cunningham and Mary Cunningham. Principles of Environmental Science: Inquiry and Applications 7th Edition. 2012
2. D K Asthana. Environment: Problems and Solutionsbooks. 2001
3. Daniel J. Sherman and David R. Montgomery. Environmental Science and Sustainability. 2020

LIST OF PRACTICAL

Semester II: Forensic Tools and Techniques

1. Hands-on Operating of Advanced analytical tools used in Forensic Analysis.
2. Visualize Surface Morphology of Evidence Using Stereomicroscope
3. Analyze and Characterize Morphology, Structure and Patterns of Botanical Evidence (Pollen, leaves etc.)
4. Conduct Insect Succession and Decomposition Study to Determine PMI (Using any model organism)
5. Collection and Preservation of Insects Using Different Collection Methods
6. Examination and Analysis of Ammunition Markings
7. Identify Types of Gunpowder (Black Powder, Smokeless Powder, Semi-Smokeless Powder)
8. Understanding and Application of Various Methods for Lifting Latent Fingerprints from Different Surfaces
9. Classify Fingerprints Systematically Using any major Classification System
10. Examine and Analyze Currency Notes Using Different Tests and Features (Visual Inspection, UV Light, Microscope)
11. Document Analysis using Online Software.
12. Photomicrography of Documents using Stereo-zoom Microscope.
13. Collection of samples for Toxicological analysis and chain of custody

YEAR-II: SEMESTER-III (ODD SEMESTER)

PAPER CODE	PAPER TITLE	TH+PR	Total Credits
DSC-3/T+P	**Human Physiology**	**3+1**	**4**
Specialization-1	**Forensic Chemistry and Toxicology**		
DSE-1	Advanced Forensic Chemistry and Toxicology		4
DSE-2	Forensic Pharmaceutical and Narcotic Analysis		4
DSE-3	Analytical Techniques in Forensic Chemistry		4
DSE-4	Chemical Warfare Agents and Explosives		4
Specialization-2	**Forensic Biology and DNA**		
DSE-5	Forensic Biology and Biological Techniques		4
DSE-6	Forensic Serology and Body Fluid Analysis		4
DSE-7	Molecular Biology Techniques in Forensic Science		4
DSE-8	Advanced Forensic Genomics		4
General Elective (GE)	**Can be elected by any Student**		
GE-1	AI in Forensic Science		4
GE-2	Biostatistics		4
GE-3	ICT Tools in Biological Research		4
Project	Academic Project / Laboratory Training/ Minor Dissertation		6
Total			**22**

The M.Sc. program will be divided into four semesters each being of six months duration. Each semester comprises of will be based on DSC (Discipline Specific Course, DSE (Discipline Specific Electives) and GE (Generic Electives) course. Each theoretical course will be divided into Internal Assessment of 20 marks and semester end examination of 80 marks.

Course: DSC	**Course Title: Human Physiology**
Credits:4	**Discipline Specific Course**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**

Theory

Unit	Topic
I	**Introduction to Human Physiology and Nervous System:** Introduction to human physiology: Definition, scope, and relevance in forensic science. Overview of cells, tissues, and homeostasis. Central and Peripheral Nervous System**,** Structure and functions of brain and spinal cord**,** Nerve impulse transmission and reflex action**.** Sensory physiology: Eye and ear structure and functions (for forensic relevance in trauma and disability assessment)
II	**Cardiovascular, Respiratory, and Muscular Systems: Cardiovascular System:** Structure and function of heart and blood vessels**,** Blood circulation and blood pressure**,** Forensic aspects: Cause of death, cardiac arrest, hemorrhage**. Respiratory System:** Mechanics of breathing, gas exchange. Transport of oxygen and carbon dioxide**.** Forensic importance in cases of asphyxia, drowning, and poisoning. **Muscular System:** Types of muscles, structure, and mechanism of contraction**.** Rigor mortis and its forensic significance.
III	**Digestive, Excretory, Endocrine, and Reproductive Systems: Digestive System:** Organs and functions, digestion and absorption of nutrients**,** Forensic relevance: Toxins, stomach contents in postmortem analysis. **Excretory System:** Kidney function, urine formation, and composition**,** Forensic toxicology: Detection of poisons and drugs in urine**. Endocrine System:** Major glands and hormones, hormonal regulation**,** Forensic importance: Hormonal imbalances, diabetes, and stress markers**. Reproductive System:** Male and female reproductive anatomy and physiology**.** Forensic applications: Sexual assault, paternity testing, semen analysis

Suggested Readings

1. Iwasa & Marshall. 2020Karp's Cell & Molecular Biology. Willey
2. Waugh Grant. 2023. Ross & Wilson Anatomy and Physiology. ELSEVIER
3. Verma and Agarwal 2009. Molecular Biology. S. Chand.
4. Dr. P. Sharama, Dr. P. Pradeep Kumar. **Basics of Immunology.** Innovative Publication
5. Agarwal, Srivastava, Kumar. 1978. **Animal Physiology and Biochemistry**. S. Chand
6. Dr. P. Sharama, Dr. P. Pradeep Kumar. **Basics of Immunology.** Innovative Publication

Specialization-1 Forensic Chemistry and Toxicology

Course: DSE	**Course Title: Advanced Forensic Chemistry and Toxicology**
Credits:4	**Discipline Specific Electives**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**
Theory	
Unit	**Topic**
I	Introduction to Forensic Chemistry: Definition and scope, Introduction to Narcotic drugs, Depressants, stimulants, Hallucinogens their Active components and method of analysis, Designer Drugs & Anabolic steroids, Analytical methods of analysis of IMFL, Country made and Illicit liquor, Denatured spirits and their analysis.
II	Petroleum Products and Edible oil: Analysis of petroleum products Diesel. Analysis of traces of petroleum products in forensic exhibits. Comparison of petroleum products. Adulteration of petroleum products. Edible oil and their adulterants
III	Cases Involving Arson: Chemistry of fire. Fire scene patterns. Location of point of ignition. Recognition of type of fire. Searching the fire scene. Collection and preservation of arson evidence. Analysis of fire debris. Analysis of ignitable liquid residue. Scientific investigation and evaluation of clue materials. Information from smoke staining. Identification of corrosive acid in Vitriol Throwing (Vitriolage) cases.

Suggested Readings:

1. Ignatius. 2025. Textbook of Forensic Medicine and Toxicology. ELSEVIER
2. OP Murty. 2022. Textbook of Forensic Histopathology. CBSPD Pvt. Ltd.
3. Ashutosh Kar. 2019. Essentials of Biopharmaceutics and Pharmacokinetics. CBSPD Pvt. Ltd.
4. Khan, JaVed I., Ho, Mat H. Analytical Methods in Forensic Chemistry. New York: Working
5. Procedure Manua Chemistry/Toxicology/Explosives/Narcotics, DFS Pub. New Delhi.
6. Mathew E. Johll (2009) Investigating Chemistry: A Forensic Science Perspective
7. Suzanne Bell (2009) Drugs, Poisons, and Chemistry.
8. DFS Manuals of Forensic Chemistry and Narcotics.
9. A Naquest (1984) legal chemistry. a guide to the detection of poisons, examination of tea, stains, etc.
10. E. Stahl (1969) Thin Layer Chromatography: A Laboratory Handbook.

11. D A Skoog, D.M. West, F.J. Holler; Analytical Chemistry – An Introduction, 7th Ed. Saunders College Pub, Philadelphia, USA
12. Maudham Bassett et al; Voget's Textbook of Quantitative Chemical Analysis, 6th Ed. Longman Essex
13. Brean S. Furniss et al; A. I. Vogel Textbook of Practical Organic Chemistry, Addison Wesley Longman, Edinburg.

Course: DSE	**Course Title: Forensic Pharmaceutical and Narcotic Analysis**
Credits:4	**Discipline Specific Electives**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**
Theory	
Unit	**Topic**
I	Forensic Pharmacology: Introductory Toxicokinetic: Overall Drug Disposition, Absorption, Toxicokinetics and Bioavailability, First-Pass Metabolism, Distribution, Free and Bound Drugs Elimination. Biotransformation: Phase-I and Phase-II reactions. Detection of poison on the basis of their metabolic studies, Some Examples of Applied Biotransformation Knowledge of Codeine, Morphine, Amphetamine Benzodiazepines etc.
II	Drugs of Abuse: Introduction and classification of Drugs of Abuse (Narcotics, Stimulants, Depressant and hallucinogens), Status of Drug abused in India, Introduction to Club drugs and Drug abuse in Sports, Drugs as Evidence.
III	Introduction and brief analysis of Phenolphthalein in Trap case, Petroleum adulteration. Illicit liquors and Arson and Explosives. Field and laboratory tests of drugs of abuse. Instrumental methods of analysis, collection, preservation and transportation of drug evidences.

Suggested Readings:

1. Ashutosh Kar. 2019. Essentials of Biopharmaceutics and Pharmacokinetics. CBSPD Pvt. Ltd.
2. DFS Manuals of Forensic Chemistry and Narcotics.
3. Working Procedure Manua Chemistry/Toxicology/Explosives/Narcotics, DFS, MHA. New Delhi.
4. Clark E.G.C; Isolation and Identification of drugs, Academic Press, London, 1986.
5. Sunshine I; Year book of Toxicology, CRC Press Series, USA.
6. Michael J. Deverlanko et al: Hand Book of Toxicology CRC Press, USA.
7. Parikh C.K; Text Book of Medical Jurisprudence Forensic Medicines and Toxicology. CBS Pub. New Delhi.
8. Balraj S. Parmar et al; Pesticide Formulation, CBS Publishers, New Delhi.
9. Working Procedure Manual – Chemistry, Explosives and Narcotics (2000). India: BPR&D Pub and DFSS publication on its web site.

Course: DSE	**Course Title: Analytical Techniques in Forensic Chemistry**
Credits:4	**Discipline Specific Electives**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**

Theory

Unit	**Topic**
I	**Analytical Techniques in Forensic Chemistry:** Introduction to analytical chemistry and its significance in forensic science. Classification of techniques into qualitative and quantitative methods. Importance of proper sample collection, preservation, and preparation to ensure evidence integrity.
II	**Chromatographic and Spectroscopic Techniques:** Principles, instrumentation, and forensic applications of Thin Layer Chromatography (TLC), Gas Chromatography (GC), and High-Performance Liquid Chromatography (HPLC). Spectroscopic methods including UV-Visible, Infrared (IR), Atomic Absorption Spectroscopy (AAS), and Mass Spectrometry (MS), Neutron Activation Analysis X – rays and X-ray based techniques and Neutron Activation Analysis used for detection of drugs, poisons, explosives, and trace evidence.
III	**Advanced Instrumentation and Applications:** Overview of hyphenated techniques like GC-MS and LC-MS/MS, and their use in analysing complex forensic matrices such as biological fluids and explosive residues. Introduction to electrochemical and thermal analysis methods. Validation, quality control, and interpretation of analytical data. Legal admissibility of results and the role of forensic experts in court proceedings.

Suggested Readings:

1. C.N. Nalini. 2024. Instrumental Methods of Analysis. Pharma Med press.
2. Feigl, F; Spot Test in Inorganic Analysis, Elsevier Publ. New Delhi, 2005.
3. Curry A.S; Analytical Methods in Human Toxicology: Part II, CRC Press Ohio, 1986.
4. Curry, A.S: Poison Detection in Human Organs, C Thomas Spring field, CRC Press, Costa Rica, 1976.
5. Clark E.G.C; Isolation and Identification of drugs, Academic Press, London, 1986.
6. Sunshine I: Handbook of Analytical Toxicology, CRC Press, Costa Rica,1969.
7. Rosalind Wolstenholme, Sue Jickells, Shari Forbes. 2021. Analytical Techniques in Forensic Science. pp. 464. Wiley.
8. Ho, M. H. (Ed.). (1990). Analytical methods in forensic chemistry. Ellis Horwood Limited.
9. Kennedy, Thomas J., Christian, Jr., Donnell Basic Principles of Forensic Chemistry, Springer.
10. Khan, J. I., Kennedy, T. J., & Christian, D. R. (2012). Basic principles of forensic chemistry (pp. 191-206). New York: Humana Press.

11. Morrison R.T. & Boyd R.N. (2003). Organic Chemistry, 6th Ed. India: Prentice Hall.
12. Silverman (2005). Organic Chemistry of Drug Design & Drug action. New Delhi: Elsevier Pub.
13. Skoog D.A. West D.M. & Holler F.J. (2000). Analytical Chemistry – An Introduction. USA: Saunders College Pub.
14. Watson C.A. (1994). Official and standardized Methods of Analysis. UK: Royal Society of Chemistry.
15. Working Procedure Manual – Chemistry, Explosives and Narcotics (2000). India: BPR&D Pub and DFSS publication on its web site.

Course: DSE	**Course Title: Chemical Warfare Agents and Explosives**
Credits:4	**Discipline Specific Electives**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**

Theory

Unit	**Topic**
I	Introduction to chemical warfare agents and their classification (nerve, blister, blood, choking, and incapacitating agents). Mechanism of action, symptoms of exposure, and methods of detection and decontamination. Toxicological effects on humans and animals, with emphasis on forensic identification and response. Legal regulations and international conventions including the Chemical Weapons Convention (CWC).
II	Definition and history of explosives, including legal definition under the Indian Explosives Act. Basic chemistry, redox reactions, and gas laws related to deflagration and detonation. Classification and characteristics of high and low explosives, dust and gas explosions, BLEVE, and effects of blast waves on structures and humans. Overview of pyrotechnics. **Improvised Explosive Devices (IEDs):** Definition, components, initiation systems, and types (e.g., Molotov cocktail, pipe bomb, VBIED, CBRN). Methods for detection of hidden explosives.
III	Bomb Scene: Specific approach to scene of explosion, Reconstruction of sequence of events, Evaluation and assessment of scene of explosion, Analysis of Explosive: Pre-blast and Post blast residue collection, Systematic examination of explosives and explosion residues in the laboratory using chemical and instrumental techniques and interpretation of results.

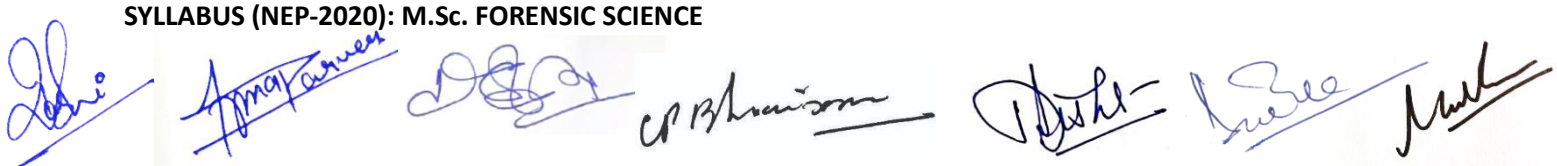
Suggested Readings:

1. DFS -Working Procedure Manual- Chemistry, Explosives.
2. Jehuda Yinon; Forensic and Environmental Detection of Explosives.
3. Yinon Jitrin (1993) Modern Methods & Application in Analysis of Explosives, John Wiley & Sons, England.
4. J A Siegel, P.J Saukko (2000) Encyclopedia of Forensic Sciences Vol. I, II and III, Acad. Press.
5. Khan, Javed I., Ho, Mat H. Analytical Methods in Forensic Chemistry. New York: Working Procedure Manua Chemistry/Toxicology/Explosives/Narcotics, DFS Pub. New Delhi.

SEMESTER III: LIST OF PRACTICAL

Specialization-I: Forensic Chemistry and Toxicology

1. Detection of Metallic Poisons Using Color Tests
2. Estimation of Alcohol Content in Blood/ urine
3. Visual and Microscopic Screening test of content (Model Based)
4. Collection and Identification of Poisonous Mushrooms
5. Demonstration of Collection preservation and Packaging of Toxicological Evidences
6. Presumptive Color Tests for Narcotics and Drugs of Abuse
7. TLC Analysis of Common Pharmaceutical Drugs
8. UV-Visible Spectrophotometric Estimation of a Drug (e.g., Paracetamol)
9. Demonstration of Fourier Transform Infrared Spectroscopy (FTIR-ATR)
10. Simulated Analysis of Gunshot Residue (GSR)



Specialization-2 Forensic Biology and DNA

Course: DSE	**Course Title: Forensic Biology and Biological Techniques**
Credits:4	**Discipline Specific Electives**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**
Theory	
Unit	**Topic**
I	**Forensic Biology:** Introduction and Scope of Forensic biology. **Biological Evidences:** Nature and classification of biological evidence found at crime scenes, including blood, saliva, semen, hair, bones, and tissue. Collection, preservation, and documentation of biological samples following chain of custody protocols.
II	**Forensic Botany:** Various forms of botanical origin evidences like - wood, timber varieties, seeds and leaves, their identification and matching. Study and identification of pollen grains; Identification of starch grains; Paper pulp identification. **Diatoms Examination:** Introduction to Diatoms, Types and Structure of Diatoms, Importance and examination of Diatoms in Forensic Science.
III	**Toxic Plants and Mushrooms:** Toxic principles of plants and their forensic significance - Identification of poisonous plants and mushrooms of India. **Hair examination:** Morphological, anatomical and microscopic examination of hair. Comparison of Human and Animal Hair through microscope. Characteristics of hair to determine the species origin, race and sex.

Suggested Readings:

1. Jane Schober, Richard Li and Sue Norman. FORENSIC BIOLOGY Paperback – Import, 30 June 2021
2. Avinash Puri, Nithyanandam Mahalakshmi, Tanya Chauhan, Alka Mishra and Preeti Bhatnagar. Fundamentals of Forensic Biology Textbook.2024
3. Alan Gunn. Essential Forensic Biology 3rd Edition. 2019
4. Arenas in Forensic Biology. Jalindar S. Ambhore, Arun D. Ghuge and Sandeep G. Sangle. 2021.
5. M. S. Pollanen. Forensic Diatomology and Drowning. 1997
6. Munish Kumar Mishra. Diatom and Forensic Science. 2019
7. Jane H Bock and David O. Norris. Forensic Plant Science 1st Edition. 2015
8. Heather Miller Coyle. Forensic Botany Principles and Applications to Criminal Casework. 2024

9. David W. Hall, Jason H. Byrd. Forensic Botany: A Practical Guide. 2012

10. Alan Kolok. Modern Poisons: A Brief Introduction to Contemporary Toxicology. 2016

11. Lewis S. Nelson, M.D. Michael J. Balick. Handbook of Poisonous and Injurious Plants. 2020

12. Ram Nath Chopra. Poisonous Plants of India. 1949

13. C ALAGESA BOOPATHI. Medicinal & Poisonous Plants of India. 2019.

14. Pascal Kintz, Alberto Salomone and Marco Vincenti. Hair Analysis in Clinical and Forensic Toxicology. 2015

Course: DSE	**Course Title: Forensic Serology and Body Fluid Analysis**
Credits:4	**Discipline Specific Electives**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**
Theory	
Unit	**Topic**
I	**Introduction to Forensic Serology and Biological Fluids:** Introduction to Serology and its Scope in Forensics, Nature and Composition of Biological Fluids, Safety Protocols and Biological Hazard Handling, Collection, Preservation, and Packaging of Biological Evidence, Preliminary and Presumptive Tests for Biological Fluids. Microscopic and Spectroscopic Analysis Techniques.
II	**Blood and Bloodstain Pattern Analysis:** Composition and Properties of Blood, Species Determination and Blood Grouping (ABO, Rh, MN, Secretor Status), Serological Tests for Blood Identification (Kastle-Meyer, Hemastix, Luminol, Takayama, Teichmann), DNA Extraction Basics from Bloodstains, Bloodstain Pattern Analysis: Types, Mechanisms, and Interpretation, Legal and Evidentiary Value of Blood Evidence
III	**Other Body Fluids and Forensic Applications:** Identification of Semen: Acid Phosphatase Test, PSA, and Microscopic Examination; Detection of Saliva: Phadebas Test, Amylase Activity; Identification of Urine, Sweat, and Vomit: Biochemical and Chemical Markers; Detection of Vaginal and Menstrual Secretions; Emerging Techniques: Immunochromatographic, ELISA, and mRNA Profiling, Case Studies and Expert Testimony in Serological Evidence

Suggested Readings:

1. Verma. 2023. Bloodstain Pattern Analysis in Forensic Investigation. CBSPD Pvt. Ltd.
2. Stuart H. James, Paul E. Kish, T. Paulette Sutton. Principles of Bloodstain Pattern Analysis Theory and Practice. 2005
3. Shanan S. Tobe. Forensic Serology. 2025
4. Li, Richard. Forensic biology. 2008
5. Kathy Mirakovits and Jay A Siegel. Forensic Science The Basics, Fourth Edition. 2021
6. Robertson, J; DNA in forensic science, Ellis Horwood Ltd., (1990)
7. Easteal, Simon; DNA profiling, Harwood academic Publishers, (1993)
8. Epplen, Jorg T.; DNA profiling and DNA fingerprinting, Birkhauser Verlage, (1999)
9. Alcamo, I Edward; DNA technology, Harcourt Academic Press, (1999).
10. Rudin, Norah; An Introduction to Forensic DNA Analysis, CRC Leviw Publishers, (2002)

11. Inman, Keith; An Introduction to Forensic DNA Analysis, CRC Press, (1997)
12. Herrmann, Bernd; Ancient DNA, Springer Publishing Co., (1994)
13. Vij, Krishan; Basics of DNA and Evidentiary Issues, Jaypee Brothers, (2004)
14. Kobiinsky, Lawrence; DNA, John Wiley & Sons, (2005)
15. Glover, D.M.; DNA Cloning 4: Mammalian systems, IRL Press, (1995)
16. Nickoloff, Jac A; DNA Damage and repair, Humana Press, (1998)
17. Newton, David E.; DNA Evidence and Forensic Science, Viva books private limited, (2010)

Course: DSE	**Course Title: Molecular Biology Techniques in Forensic Science**
Credits:4	**Discipline Specific Electives**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**
Theory	
Unit	**Topic**
I	**Molecular Biology Foundations for Forensics** The central dogma of molecular biology: DNA replication, transcription, translation, gene regulation, and mutations. Basic molecular tools such as plasmids, vectors, restriction enzymes.
II	**Core Molecular Techniques in Forensic Analysis** Laboratory techniques: DNA extraction, polymerase chain reaction (PCR), real-time PCR, reverse transcription PCR (RT-PCR), gel electrophoresis, and blotting techniques (Southern, Northern, and Western). Molecular markers relevant in forensics (e.g., STRs, SNPs).
III	**Advanced Applications and Emerging Technologies** Focuses on the application of molecular biology in forensic investigations, including human identification, microbial forensics, wildlife crime analysis, and forensic toxicogenomics. DNA microarrays, and Next-Generation Sequencing (NGS). Ethical, legal, and regulatory aspects of using molecular biology evidence in the justice system are also discussed.

Suggested Readings:

1. Iwasa & Marshall. 2020. Karp's Cell & Molecular Biology. Willey
2. Verma and Agarwal 2009. Molecular Biology. S. Chand.
3. Watson James D., Baker Tania A., Bell Stephen P., Gann Alexander, Levine Michael, Losick Richard. Molecular Biology of the Gene. 2013
4. Gerald Karp, Janet Iwasa, Wallace Marshall. Karp's Cell and Molecular Biology. 2015
5. Jocelyn E. Krebs. Elliott S. Goldstein and Stephen T. Kilpatrick. Lewin's Essential Genes. 2012
6. Gardner, Simmons, Snustad. Principles of Genetics. 2005
7. Jaiprakash G. Shewale. Forensic DNA Analysis: Current Practices and Emerging Technologies 1st Edition. 2013
8. John M. Butler. Fundamentals of Forensic DNA Typing. 2009

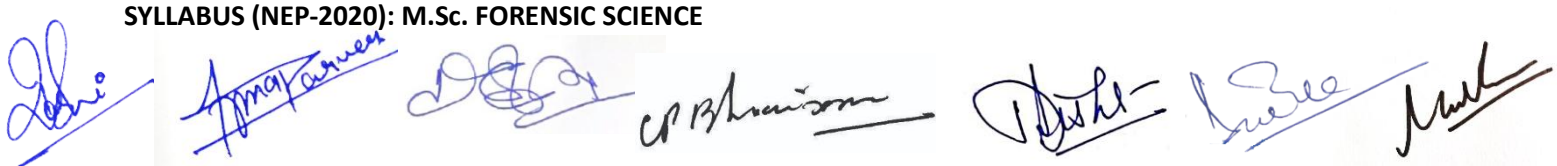
Course: DSE	**Course Title: Advanced Forensic Genomic**
Credits:4	**Discipline Specific Electives**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**

Theory

Unit	Topic
I	Fundamentals of Forensic Genomics: Human genome organization: nuclear vs mitochondrial DNA, Types of genetic markers: STRs, SNPs, VNTRs, Y-STRs, X-STRs, and mtDNA, DNA extraction methods from forensic samples, Quantification and quality assessment of DNA
II	Genomic Technologies and Bioinformatics in Forensics: The form of biological information, Databases-Format and Annotation: Conventions for database indexing and specification of search terms, common sequence file formats, annotated sequence databases - primary sequence databases, organism specific databases, Data – Access, Retrieval and Submission: Standard search engines; Data retrieval tools- Entrez, Submission of (new and revised) data, data submission tools, Sequence Similarity Searches: Local v/s global, Distance metrics. FASTA, BLAST and other variants of BLAST, Multiple Sequence Alignment
III	Forensic Applications, Ethics, and Legal Aspects: Application of genomics in crime scene investigation and human identification, Familial searching and investigative genetic genealogy, Wildlife forensics and disaster victim identification (DVI), Legal admissibility of DNA evidence (Daubert/Frye standards), Ethical issues: privacy, consent, data sharing, DNA databanking, National and international regulations (e.g., GDPR, INTERPOL guidelines), Biomedical Waste management, Case studies: wrongful convictions, cold case resolutions.

Suggested Readings:

1. Jaiprakash G. Shewale. Forensic DNA Analysis: Current Practices and Emerging Technologies 1st Edition. 2013
2. John M. Butler. Fundamentals of Forensic DNA Typing. 2009
3. Niels Morling. Advances in Forensic Genetics. 2022
4. Hirak Ranjan Dash, Kelly M. Elkins, Noora Rashid Al-Snan. Advances in Forensic Biology and Genetics. 2025
5. Suzanne Bell and John M. Butler. Understanding Forensic DNA. 2022
6. Jason Payne-James, Roger Byard. Forensic and Legal Medicine Clinical and Pathological Aspects. 2023
7. Amit Kumar. SpringerBriefs in Forensic and Medical Bioinformatics (Book Searies by Springer Nature)
8. Arthur M. Lesk. Introduction to Bioinformatics. 2002
9. Bruce R. Donald. Algorithms in Structural Molecular Biology. 2011
10. Pavel Pevzner and Ron Shamir. Bioinformatics for Biologists. 2011



Semester III: List of Practical

Specialization-II: Forensic Biology and DNA

1. Demonstration of Analysis of Blood Stain Patterns.
2. Identification and Analysis of Blood
3. Identification and Analysis of Saliva
4. Identification and Analysis of Semen/Urine
5. Analysis of Blood patterns using Luminol (Photo Luminescent)
6. Microscopic Examination of Human and Animal Hair
7. Blood Grouping Using ABO and Rh Systems
8. DNA Extraction from Buccal Cells or Blood Samples
9. Polymerase Chain Reaction (PCR) Amplification of an Isolated DNA
10. Electrophoretic Analysis of DNA (Agarose Gel Electrophoresis).
11. Basic Bioinformatic tools and their use in Forensic analysis.

Course: GE	**Course Title: AI in Forensic Science**
Credits:4	**Generic Electives**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**

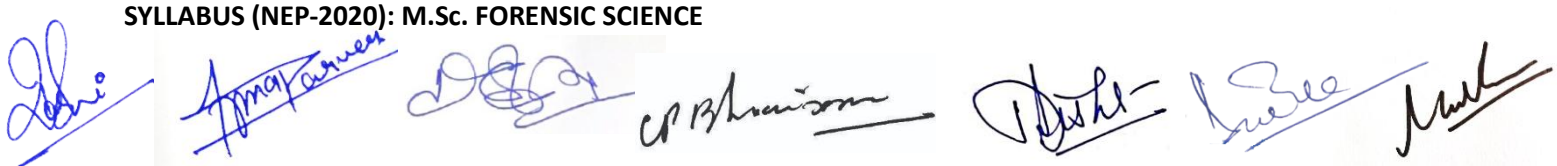
Theory

Unit	Topic
I	**Introduction to AI and Its Relevance in Forensic Science:** Basics of Artificial Intelligence (AI): Definitions, History, and Scope. Branches of AI: Machine Learning, Deep Learning, Computer Vision, Natural Language Processing. Introduction to Forensic Science and its Key Disciplines. Role of AI in Modern Forensics: Overview and Applications. Benefits and Challenges of Using AI in Forensics.
II	**Applications of AI in Different Forensic Domains** Digital Forensics: AI in cybercrime investigation, email fraud detection, and data recovery. Image and Video Analysis: Face recognition, gait analysis, object detection. Fingerprint and Biometric Analysis: Automated fingerprint identification systems (AFIS). Voice and Speech Recognition: AI in speaker identification and verification. Crime Pattern Analysis: Predictive policing, crime mapping using AI tools.
III	**Case Studies, Tools, and Future Directions** Case studies demonstrating successful AI applications in forensic investigations. Introduction to AI tools used in forensic science: IBM Watson, OpenCV, TensorFlow (basic overview). Ethical, Legal, and Privacy Issues in AI-based forensic analysis. Future scope: AI in courtroom procedures, lie detection, and forensic psychology. Project Work/Assignment: Mini case analysis using AI-based approaches (report or presentation).

Suggested Readings:

1. Zeno Geradts (Editor), Katrin Franke. Artificial Intelligence (AI) in Forensic Sciences Share Icon. 2023
2. Kavita Saini, Swaroop S. Sonone, Mahipal Singh Sankhla, Naveen Kumar. Artificial Intelligence in Forensic Science an Emerging Technology in Criminal Investigation Systems. 2024
3. Bolle R.M., Connell J.H., Pankanti S., Ratha N.K. and Senior A.W. (2004), Guide to Biometrics, Springer publications.
4. Goyal R.M. and Pawar M.S. (1994), Computer crimes- concept, control and prevention, Sysman Computer Pvt. Ltd.
5. Jain A.K., Flynn P. and Ross A.A. (2008), Handbook of Biometrics Springer Publications, Springer.

6. Joakim Kävrestad. Guide to Digital Forensics: A Concise and Practical Introduction, Springer 2017.
7. John D.W. and Nicholas M.O. (2002), Biometrics: Identity Assurance in the Information age, McGraw Hill.
8. Robert Moore. Cybercrime: Investigating -High-Technology Computer Crime, 2nd edition, Routledge 2015
9. Special Report, Forensic Examination of Digital Evidence: A Guide for Law Enforcement, NIJ Publication.
10. Sridhar S. (2011), Digital Image Processing, Oxford University Press.
11. Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software 1st Edition by Michael Sikorski.
12. Network Forensics: Tracking Hackers through Cyberspace 1st Edition by Sherri Davidoff.
13. The Art of Memory Forensics: Detecting Malware and Threats in Windows, Linux, and Mac Memory1st Edition by Michael Hale Ligh (Author), Andrew Case (Author), Jamie Levy (Author), AAron Walters (Author)
14. Cyber Forensics: A Field Manual for Collecting, Examining, and Preserving Book by Albert J. Marcella.



Course: GE	**Course Title: Biostatistics**
Credits:4	**Generic Electives**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**

Theory

Unit	Topic
I	**Fundamentals of Biostatistics:** Introduction to Biostatistics: Scope and Applications in Life Sciences, Types of Data: Qualitative and Quantitative, Discrete and Continuous, Data Collection Methods: Sampling Techniques, Bias, and Sample Size, Classification, Tabulation, and Graphical Presentation of Data (Bar, Pie, Histogram, Line Chart), Measures of Central Tendency: Mean, Median, Mode, Measures of Dispersion: Range, Variance, Standard Deviation, Coefficient of Variation.
II	**Probability, Distributions, and Hypothesis Testing:** Basics of Probability and Its Biological Applications, Probability Distributions: Binomial, Poisson, and Normal Distributions; Hypothesis Testing: Null and Alternate Hypothesis, p-value, Confidence Interval, Parametric Tests: t-test (One Sample, Two Sample, Paired), ANOVA, Non-Parametric Tests: Chi-Square Test.
III	**Correlation, Regression, and Statistical Tools in Research:** Correlation: Pearson's and Spearman's Correlation Coefficient, Regression Analysis: Simple Linear and Multiple Regression, Designing Biological Experiments: Randomization, Replication, and Control, Introduction to Bio-statistical Software: SPSS, Excel; Data Interpretation, Result Validation, and Error Analysis in Research, Graphical Presentation and Statistical Reporting in Research Papers.

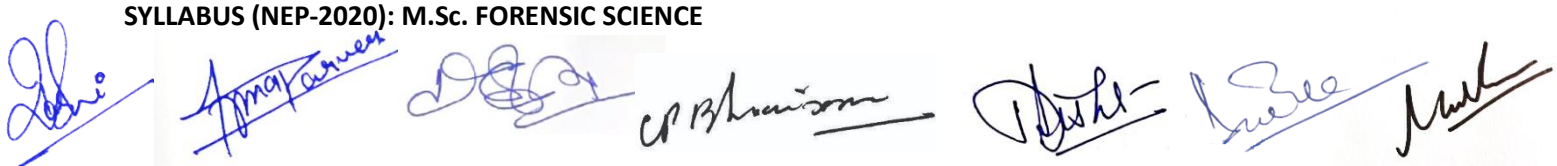
Suggested Readings:

1. Stanton A. Glantz. Primer of Biostatistics.2011
2. Mahajan. Methods in Biostatistics. 2004
3. V.B. Rastogi. Fundamentals of Biostatistics.2009
4. Statistics in Biology, (1967) Vol. 1: Bliss, C.I.K. McGraw Hill, New York.
5. Practical Statistics for experimental biologist (1985): Wardlaw, A.C.
6. Statistical Methods in Biology (2000): Bailey, N.T. J. English Univ. Press.
7. Biostatistics - 7th Edition: Daniel
8. Fundamental of Biostatistics: Khan
9. Bio-statistical Methods: Lachin
10. Statistics for Biologist (1974): Campbell R.C. Cambridge.

Course: GE	**Course Title: ICT Tools in Biological Research**
Credits: 4	**Generic Electives**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**
Theory	
Unit	**Topic**
I	**Fundamentals of ICT and Research Methodology:** Overview of ICT and its importance in research. Types of research: Qualitative, quantitative, and mixed methods. Introduction to research ethics and plagiarism. Role of ICT in literature review, data collection, and dissemination. Use of online academic databases: Google Scholar, PubMed, Scopus, Web of Science.
II	**ICT Tools for Data Handling and Analysis:** Word processing and document formatting tools (MS Word, LaTeX basics). Spreadsheet software (Excel/Google Sheets) for data entry and basic analysis**.** Statistical tools: Introduction to SPSS, R (basics), or Python (data handling)**.** Reference management tools: Mendeley, Zotero, EndNote.
III	**Presentation, Collaboration, and Publishing Tools:** Creating effective presentations using PowerPoint, Canva etc. Online collaboration tools: Google Workspace (Docs, Slides, Drive), MS Teams, Zoom**.** MS Power point for creating graphs, tables, and charts for research presentation**.** Introduction to plagiarism checking tools: Turnitin, Grammarly**.** Understanding open access, DOI, and impact factor**.** ICT tools for preparing research proposals, reports, and publications

Suggested Readings:

1. Hidefumi Sawai (2011). Biological Functions for Information and Communication Technologies: Theory and Inspiration, 2011th Edition, Springer.
2. Anol Bhattacharjee, Brian Fitzgerald (2012). Shaping the Future of ICT Research: Methods and Approaches. Springer.
3. Kutub Thakur, Al-Sakib Khan Pathan, Sadia Ismat. Emerging ICT Technologies and Cybersecurity. Springer International Publishing AG



Year-II: Semester IV (EVEN SEMESTER)

PAPER CODE	PAPER TITLE	TH+PR	Total Credits
DSC-4	Research Methodology and Intellectual Property Rights (IPR)		4
Dissertation/Research Project	Topic aligned with Major Specialization		18
Total			**22**

Course: DSC	**Course Title: Research Methodology and Intellectual Property Rights (IPR)**
Credits:4	**Discipline Specific Course**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**

Theory

Unit	Topic
I	**Fundamentals of Research Methodology** **Introduction to Research:** Meaning, objectives, and types of research (basic, applied, qualitative, quantitative). **Research Process:** Problem identification, literature review, formulation of hypothesis, objectives. **Research Design:** Types (descriptive, exploratory, experimental), variables, sampling techniques. **Data Collection:** Primary and secondary sources, tools (questionnaire, interviews, observation). **Data Analysis:** Statistical tools (mean, median, standard deviation, t-test), use of software (Excel/SPSS/R). **Report Writing:** Structure of a thesis/dissertation/research article, referencing styles (APA, MLA, Vancouver).
II	**Introduction to Intellectual Property Rights (IPR)** **Concept of IPR:** Definition, objectives, importance in research and innovation. **Types of IPR: Patents** – criteria, process, examples in biological sciences. **Copyright** – literary, artistic, and software protection. **Trademarks & Trade Secrets** – scope and relevance. **Designs & Geographical Indications (GI)** – examples from India. **IPR in Academia and Industry:** Technology transfer, licensing, commercialization of research.
III	**IPR Protection and Ethics in Research** **Patent Filing Process in India & Abroad:** Indian Patent Act, WIPO, PCT. **IP Management:** Role of patent offices, innovation cells, and IPR cells in academic institutions. **Research Ethics and Plagiarism:** Fabrication, falsification, ethical clearance, plagiarism software. **Case Studies:** Notable patent cases, traditional knowledge protection (e.g., turmeric, neem). **IPR in the Digital Era:** Open-source licensing, Creative Commons, digital rights management (DRM).

Suggested Readings:

1. C.R. Kothari and Gaurav Garg. Research Methodology Paperback – Address Book, 1

September 2019
2. Gunawan Widjaja, Thiruma Valavan. A, Charudatta Dattatraya Bele and Meera K L. Fundamentals of Research Methodology and IPR 2020
3. Shivaprasad H. Research Methodology & Intellectual Property Rights. 2024
4. Research Methodology Tools and Techniques: H.C Purohit
5. Research Methodology: An Introduction: Wayne Dean Goddard, Stuart Melville
6. Research Methodology in the Medical and Biological Sciences: Petter Laake (Author) Haakon
7. Breien Benestad (Author) Bjorn Reino Olsen (Editor)
8. Research Methodology for Biological Science: N Gurumani
9. Research Methodology- C.H. Chaudhary, RBSA Publication
10. Research Methodology: An Introduction - Wayne Goddard & Stuart Melville

Course: Dissertation	**Course Title: Dissertation on Topic aligned with major Specialization**
Credits: 18	
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**