National Forensic Sciences University

An Institution of National Importance
(Ministry of Home Affairs, Government of India)
Gujarat Campus
Sector – 9, Gandhinagar, Gujarat – 382007

School of Forensic Science

B.Sc.-M.Sc. Forensic Science Program

(Syllabus, Teaching & Evaluation Schemes)
(W.E.F. Academic Year **2022**)

Teaching Scheme

Semester I

Sr. No.	Subject Code	Subject Name	L	T	P	C	TCH
1	UGFS S1-P1	Introduction to Forensic Science	3	0	0	3	3
2	UGFS S1-P2	Crime Scene Management	3	0	0	3	3
3	UGFS S1-P3	Crime and Society	3	0	0	3	3
4	UGFS S1-P4	General Physics-I	3	0	0	3	3
5	UGFS S1-P5	General Chemistry-I	3	0	0	3	3
6	UGFS S1-P6	General Biology-I	3	0	0	3	3
7	UGFS S1 SE -1	Skill Based Elective - I	2	0	0	2	2
8	UGFS S1-Pr1	Practical I	0	0	8	4	8
		Total Credit & Total Credit Hours				**24**	**28**

Semester II

Sr. No.	Subject Code	Subject Name	L	T	P	C	TCH
1	UGFS S2-P1	Criminal and Evidence Law	3	0	0	3	3
2	UGFS S2-P2	Fingerprint Science	3	0	0	3	3
3	UGFS S2-P3	Questioned Document	3	0	0	3	3
4	UGFS S2-P4	General Physics-II	3	0	0	3	3
5	UGFS S2-P5	General Chemistry-II	3	0	0	3	3
6	UGFS S2-P6	General Biology-II	3	0	0	3	3
7	UGFS S2 SE-2	Skill Based Elective - II	2	0	0	2	2
8	UGFS S2-Pr1	Practical II	0	0	8	4	8
		Total Credit & Total Credit Hours				**24**	**28**

Semester III

Sr. No.	Subject Code	Subject Name	L	T	P	C	TCH
1	UGFS S3-P1	Forensic Psychology	3	0	0	3	3
2	UGFS S3-P2	Forensic Chemistry-I	3	0	0	3	3
3	UGFS S3-P3	Forensic Physics-1	3	0	0	3	3
4	UGFS S3-P4	Basics of Computer & Biometrics	3	0	0	3	3
5	UGFS S3 CE-1	Core Elective – I (From Elective Group A)	2	0	0	2	2
7	UGFS S3 SE -3	Skill Based Elective - III	2	0	0	2	2
8	UGFS S3-Pr1	Practical III	0	0	8	4	8
		Total Credit & Total Credit Hours				**20**	**24**

Semester IV

Sr. No.	Subject Code	Subject Name	L	T	P	C	TCH
1	UGFS S4-P1	Forensic Medicine	3	0	0	3	3
2	UGFS S4-P2	Fundamentals of Forensic Toxicology	3	0	0	3	3
3	UGFS S4-P3	Forensic Ballistics	3	0	0	3	3
4	UGFS S4-P4	Forensic Biology and Wildlife Forensics	3	0	0	3	3
5	UGFS S4 CE-2	Core Elective – II (From Elective Group A)	2	0	0	2	2
6	UGFS S4 SE-3	Skill based Elective - IV	2	0	0	2	2
7	UGFS S4-Pr1	Practical IV	0	0	8	4	8
		Total Credit & Total Credit Hours				**20**	**24**

Semester V

Sr. No.	Subject Code	Subject Name	L	T	P	C	TCH
1	UGFS S5-P1	Forensic Anthropology	3	1	0	4	4
2	UGFS S5-P2	Digital Forensics and Cyber Law	3	1	0	4	4
3	UGFS S5-P3	Forensic Chemistry - II	3	1	0	4	4
4	UGFS S5-P4	Instrumental Techniques - I	3	1	0	4	4
5	UGFS S5 CE-3	Core Elective – III (From Elective Group A)	2	0	0	2	2
6	UGFS S5-Pr1	Practical - V	0	0	8	4	8
		Total Credit & Total Credit Hours				**22**	**26**

Semester VI

Sr. No.	Subject Code	Subject Name	L	T	P	C	TCH
1	UGFS S6-P1	Forensic Physics - II	3	1	0	4	4
2	UGFS S6-P2	Information Security Audit and Compliance	3	1	0	4	4
3	UGFS S6-P3	Basics of Immunology and Forensic Serology	3	1	0	4	4
4	UGFS S6-P4	Instrumental Techniques - II	3	1	0	4	4
5	UGFS S6 CE-4	Core Elective – IV (From Elective Group B)	2	0	0	2	2
6	UGFS S6-Pr1	Practical - VI	0	0	8	4	8
		Total Credit & Total Credit Hours				**22**	**26**

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\multicolumn{8}{c}{**SEMESTER –VII**}
\multicolumn{8}{c}{**Specialization-I: Forensic Physics and Ballistics**}
Sr. No.	Subject Code	Subject Name	L	T	P	C	TCH
1	UGFS S7-SP 1-P1	Lasers & Spectroscopy	3	1	0	4	4
2	UGFS S7-SP 1-P2	Advancement in Forensic Ballistics and Armour Material	3	1	0	4	4
3	UGFS S7-SP 1-P3	Audio and Video Analysis	3	1	0	4	4
4	UGFS S7-SP 1-P4	Research Methodology	3	1	0	4	4
5	UGFS S7 CE-5	Core Elective – V (From Elective Group B)	2	0	0	2	2
6	UGFS S7-SP 1-Pr1	Practical - VII	0	0	8	4	8
\multicolumn{6}{r}{**Total Credit & Total Credit Hours**}	**22**	**26**

**SEMESTER –VII**
**Specialization-II: Fingerprints and Questioned Documents**
Sr. No.	Subject Code	Subject Name	L	T	P	C	TCH
1	UGFS S7-SP 2-P1	Advanced Fingerprint Technologies	3	1	0	4	4
2	UGFS S7-SP 2-P2	Advances in Forensic Documents Examination	3	1	0	4	4
3	UGFS S7-SP 2-P3	Forensic Accounting and Auditing	3	1	0	4	4
4	UGFS S7-SP 2-P4	Research Methodology	3	1	0	4	4
5	UGFS S7 CE-5	Core Elective – V (From Elective Group B)	2	0	0	2	2
6	UGFS S7-SP 2-Pr1	Practical - VII	0	0	8	4	8
\multicolumn{6}{r}{**Total Credit & Total Credit Hours**}	**22**	**26**

**SEMESTER –VII**
**Specialization-III: Forensic Chemistry and Toxicology**
Sr. No.	Subject Code	Subject Name	L	T	P	C	TCH
1	UGFS S7-SP 3-P1	Forensic Pharmacy and Pharmacology of Controlled Drugs	3	1	0	4	4
2	UGFS S7-SP 3-P2	Advanced Forensic Toxicology	3	1	0	4	4
3	UGFS S7-SP 3-P3	Modern and Applied Analytical Forensic Chemistry	3	1	0	4	4
4	UGFS S7-SP 3-P4	Research Methodology	3	1	0	4	4
5	UGFS S7 CE-5	Core Elective – V (From Elective Group	2	0	0	2	2

6	UGFS S7-SP 3-Pr1	Practical - VII	0	0	8	4	8
		Total Credit & Total Credit Hours				**22**	**26**

SEMESTER –VII

Specialization-IV: Forensic Biology and Biotechnology

Sr. No.	Subject Code	Subject Name	L	T	P	C	TCH
1	UGFS S7-SP 4-P1	Fundamentals of Biological Chemistry	3	1	0	4	4
2	UGFS S7-SP 4-P2	Molecular Biology and rDNA technology	3	1	0	4	4
3	UGFS S7-SP 4-P3	Forensics Genomics and DNA Profiling	3	1	0	4	4
4	UGFS S7-SP 4-P4	Research Methodology	3	1	0	4	4
5	UGFS S7 CE-5	Core Elective – V (From Elective Group B)	2	0	0	2	2
6	UGFS S7-SP 4-Pr1	Practical - VII	0	0	8	4	8
		Total Credit & Total Credit Hours				**22**	**26**

SEMESTER –VII

Specialization-V: Cyber Forensic

Sr. No.	Subject Code	Subject Name	L	T	P	C	TCH
1	UGFS S7-SP 5-P1	Advanced Digital Forensics	3	1	0	4	4
2	UGFS S7-SP 5-P2	Mobile and Network Forensics	3	1	0	4	4
3	UGFS SVII-SP 5-P3	Vulnerability Assessment and Penetration Testing	3	1	0	4	4
4	UGFS S7-SP 5-P4	Research Methodology	3	1	0	4	4
5	UGFS S7 CE-5	Core Elective – V (From Elective Group B)	2	0	0	2	2
6	UGFS S7-SP 5-Pr1	Practical - VII	0	0	8	4	8
		Total Credit & Total Credit Hours				**22**	**26**

Semester-VIII

Sr. No.	Subject Code	Subject Name	L	T	P	C	TCH
1	UGFS S8-SP 1/2/3/4/5-Entern	Internship at Forensic Science Laboratory	0	0	48	24	4
		Total Credit & Total Credit Hours				**24**	**48**

Semester-IX

Sr. No.	Subject Code	Subject Name	L	T	P	C	TCH
1	PGFS S9-SP 1/2/3/4/5-P1	Ethics in Science Education and Research	2	0	0	2	4
2	PGFS S9-SP 1/2/3/4/5-P2	Open Seminar and Comprehensive Viva -I	0	0	6	3	6
3	PGFS S9-SP 1/2/3/4/5-P3	M.Sc. Project (To Be continued in 10th Semester)	0	0	24	12	24
		Total Credit & Total Credit Hours				**17**	**34**

Semester-X

Sr. No.	Subject Code	Subject Name	L	T	P	C	TCH
1	PGFS S10-SP 1/2/3/4/5-P1	Open Seminar and Comprehensive Viva -II	0	0	6	3	4
2	PGFS S10-SP 1/2/3/4/5-P2	M.Sc. Project	0	0	48	24	48
		Total Credit & Total Credit Hours				**27**	**52**

List of Core Elective – Group A (For Semester 3, 4 and 5)

Sl. No. 1 to 3 can be selected in ODD SEMESTER while Sl. No. 4 and 5 can be selected in EVEN SEMESTER

Sr. No.	Group A	Subject Code	Subject Name	L	T	P	Credits
1	Group A	CE-1-A	Anti-dope Forensics	2	0	0	2
2	Group A	CE-2-A	Incident Response and Management	2	0	0	2
3	Group A	CE-3-A	Multimedia Forensics	2	0	0	2
4	Group A	CE-4-A	Forensic Statistics	2	0	0	2
5	Group A	CE-5-A	Accident Investigations	2	0	0	2
6	Group A	CE-6-A	Immunology and Immunological Techniques	2	0	0	2

List of Core Elective – Group B (For Semester 6 and 7)

Sl. No. 1 to 3 can be selected in EVEN SEMESTER while Sl. No. 4 and 5 can be selected in ODD SEMESTER

Sl. No.	Group B	Code	Course Title	L	T	P	Credits
1	Group B	CE-1-B	Clinical Toxicology	2	0	0	2
2	Group B	CE-2-B	Forensic DNA Analysis	2	0	0	2
3	Group B	CE-3-B	Forensic Engineering	2	0	0	2
4	Group B	CE-4-B	Applied Cryptography	2	0	0	2
5	Group B	CE-5-B	Data Science & Artificial Intelligence	2	0	0	2
6	Group B	CE-6-B	Forensic Photography	2	0	0	2

List of Skill Based Elective – (From Semester 1 to 4)

Sl. No.	Code	Course Title	L	T	P	Credits
1	SE-1	Communication Skills	2	0	0	2
2	SE-2	English	2	0	0	2
3	SE-3	Yoga and its benefits-I	2	0	0	2
4	SE-4	Yoga and its benefits-II	2	0	0	2

Total Credits: 222

L: Lecture **T:** Tutorial **P:** Practical **TCH:** Total Credit Hours

1 C = 1 Hour of Lecture / Tutorial and 1 C = 2 Hours of Practical / Project.

Syllabus

Semester I

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UGFS S1-P1: Introduction to Forensic Science

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme								
					Theory						Practical		
					Internal Exams				University Exams		University Exams (LPW)		Total
Th	**Tu**	**Pr**	**C**	**TCH**	TA-1 & TA-2		MSE						
					Marks	Hrs	Marks	Hrs	Marks	Hrs	Marks	Hrs	
3	0	0	3	3	25	00:45	50	01:30	100	03:00	-	-	200

* Note: TA-2 will be in form of assignments or workshops.

Learning Objectives

1. To help students learn basic principles of Forensic science
2. To learn about the development of forensic science
3. To learn about the organizational setup of Forensic Science
4. To understand about the various academic institutions and government agencies involved in criminal investigations.
5. To help students develop a basic understating about Forensic Science

MODULE -1 History and Basic principles of Forensic Science   Teaching Hours: 15 Hours

History of Development of Forensic Science in India. Functions of forensic science. Historical aspects of forensic science. Definitions and concepts in forensic sciences. Scope of forensic science. Various contemporary disciplines of forensic sciences and their applications in different approaches with theoretical concepts. Need of forensic science. Basic principles of forensic science.

MODULE-2 Functional aspects of Forensic Science   Teaching Hours: 15 Hours

Contemporary development in the academic and practices in forensic sciences-advantage of scientific investigations- Tools and Techniques in Forensic Science- Branches of forensic science. Forensic science in international perspectives, including set up of INTERPOL, and FBI. Duties of forensic scientists. Code of conduct for forensic scientists. Qualifications of forensic scientists. Data depiction. Report writing.

MODULE-3 Organizational setup in Forensic Science   Teaching Hours: 15 Hours

Academic institutions involvement- Organizational set up of Forensic Science Laboratories in India Hierarchical set up of Central Forensic Science Laboratories, State Forensic Science Laboratories, Government Examiners of Questioned Documents, Fingerprint Bureaus, National Crime Records Bureau, Police & Detective Training Schools, NIA, CCNTS, Bureau of Police

Research & Development, Directorate of Forensic Science and Mobile Crime Laboratories. Police Academies. National investigation agency and other agencies involved in the criminal investigations- agencies referred for the additional information and requisite examinations.

References and Suggested Readings:

1. B.B. Nanda and R.K. Tiwari, Forensic Science in India: A Vision for the Twenty First Century, Select Publishers, New Delhi (2001).
2. M.K. Bhasin and S. Nath, Role of Forensic Science in the New Millennium, University of Delhi, Delhi (2002).
3. S.H. James and J.J. Nordby, Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton (2005).
4. W.G. Eckert and R.K. Wright in Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (ED.), CRC Press, Boca Raton (1997).
5. R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004).
6. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's Techniques of Crime Scene Investigation, CRC Press, Boca Raton (2013).

UGFS S1-P2: Crime Scene Management & Criminal Profiling

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory					Practical		
					Internal Exams				University Exams	University Exams (LPW)		Total
Th	Tu	Pr	C	TCH	TA-1 & TA-2		MSE					
					Marks	Hrs	Marks	Hrs	Marks	Hrs	Marks	Hrs	
3	0	0	3	3	25	00:45	50	01:30	100	03:00	-	-	200

* Note: TA-2 will be in form of assignments or workshops.

Learning Objectives

1. To make students understand about the crime and its types.
2. To learn about the techniques behind management of different crime scenes.
3. To understand about the importance of evidences and its correct collection & handling.
4. To learn about the concept of chain of custody & its importance.

MODULE-I   Crime Scene Evidence   Teaching Hours: 15 Hours

Introduction to the crime scene, Types of crime scene, Evaluation and processing of crime scene, securing the scene of crime, documenting the crime scene: Note making, sketching

Searching techniques of Crime scene, Processing of physical evidence-discovering, recognizing and examination of physical evidences

Collection, Safety measures for evidence collection, Preservation, Packaging, sealing, labelling and forwarding of physical evidences, maintaining the chain of custody, Probative value of physical evidences, Reconstruction of scene of crime

Photography: Photography (Cameras-SLR &DSLR, lenses, filters, films, exposing, development & printing, different kinds of developers and fixers. Specialized photography-UV, IR, close up. Photography using scientific equipment, role of the first arriving officer at the crime scene, Digital Imaging of Crime Scene, 3-D scanning technique, videography of crime scene

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MODULE-2   Physical Evidences   Teaching Hours: 15 Hours

Introduction to physical evidences, Types of physical evidences, Classification and Role of physical evidences in Criminal Investigations & Trails.

Crime Detection Devices: UV, IR, X-Rays, their nature and applications, Detective Dyes, Neutron Radiography, Speed Detection Devices, Tools: Basic Kits, Investigator's Kit, Tools used in Mobile laboratory. Digital Imaging of Crime Scene, 3-D scanning technique, Tele forensic Technology for crime scene investigation, Information, Manpower, and logistics management of crime scene ,

Technology innovation in crime scene management, Case studies & report writing of crime scene visits. National and International scenario of crime scene management

MODULE-3	**Criminal Profiling**	**Teaching Hours: 15 Hours**

History of Profiling, Behavioural Evidence Analysis, Criminal motivation, Crime scene investigation, Victim profiling, Psychological Autopsy, Sexual Offences, Geographical Profiling, Criminal behaviour on the internet, Case studies.

References and Suggested Readings:

1. J.Walls; Forensic Science-An Introduction to Scientific Crime Detection 2nd Ed.,Universal, 1st Indian Reprint (2002).
2. Richard Saferstein; Criminalistics-An Introduction to Forensic Science 5th Ed., Prentice Hall (1995).
3. Jay A.Siegel, Pekka J Saukko and Geoffrey C. Kooupfer; Encyclopedia of Forensic Science, Academic Press (2000).
4. E.R.Mengel; Forensic Physics in 2002 year book, McGraw hill Encyclopedia of Science & Technology.
5. 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
6. M. Byrd, Crime Scene Evidence: A Guide to the Recovery and Collection of Physical Evidence, CRC Press, Boca Raton (2001).
7. T.J. Gardener and T.M. Anderson, Criminal Evidence, 4th Ed., Wadsworth, Belmont (2001).
8. S.H. James and J.J. Nordby, Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton (2005).
9. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's, Techniques of Crime Scene Investigation, CRC Press, Boca Raton (2013).

UGFS S1-P3: Crime & Society

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory					Practical		
					Internal Exams				University Exams	University Exams (LPW)		Total
Th	**Tu**	**Pr**	**C**	**TCH**	TA-1 & TA-2		MSE					
					Marks	Hrs	Marks	Hrs	Marks	Hrs	Marks	Hrs
3	0	0	3	3	25	00:45	50	01:30	100	03:00	-	-	200

* Note: TA-2 will be in form of assignments or workshops.

Learning Objectives:

After studying this paper the students will know:

1. The importance of criminology.
2. The causes of criminal behavior.
3. The significance of criminal profiling to mitigate crime.
4. The consequences of crime in society.
5. The elements of criminal justice system.

MODULE-I	Crime	Teaching Hours: 15 Hours

Introduction to Crime, Essentials of Crime (Actus reus and mens rea), Causes and consequences of crime, Crimes against Property and Person. Types of crime- traditional crimes, modern crimes white collar crimes, Economic crimes, Political crime, Cyber-crime, Terrorism and Insurgency, Crime and Politics. Hate crimes, Transnational crimes; Offences in CrPC and IPC; Media, technology and crime; Juvenile Delinquency; Social change and crime; Psychological disorders and criminality; Situational crime prevention. Types of criminals- Adult offenders, children in conflict with law, recidivists, Violent offenders, occupational offenders; Criminal Profiling.

MODULE-2	Fundamentals of Criminology & Victimology	Teaching Hours: 15 Hours

Criminology Definition, aim and scope. Schools of Criminology. Criminology and other social sciences; Criminological Theories: Pre-classical, Classical, Neo-classical, Positivist; Causation of crime - Psychological theories of crime, sociological theories of crime, Biological theories of crime; Feminist Criminology. Crime Prevention, Modus Operandi, Criminal profiling. Basic concepts of Victimology.

MODULE-3	Criminal Justice System	Teaching Hours: 15 Hours

Broad components of criminal justice system. Structure of Criminal Justice System in India; Role of Legislature and Law making; Coordination among Criminal Justice System, Policing styles and

principles. Police's power of investigation. Compoundable and Non-compoundable offences; Investigation of Crimes; Complaint, F. I. R. Arrest, Search, Seizure, Police Custody, Role of prosecution, judiciary- Judicial Remand and Bail; Types of Evidence, Admissibility of Confession, Dying declaration, Filing of criminal charges. Community policing. Policing a heterogeneous society. Correctional measures and rehabilitation of offenders. Human rights and criminal justice system in India.

References and suggested Readings:

1. Ahuja ,Ram. (2000). *Criminology*. Rawat Publication
2. Barnes, H. E. & Teeters, N. K. (1959). *New horizons in criminology*. (2nd ed.). New York, NY: Prentice-Hall.
3. Beccaria, Cesare. (1764). *On Crimes and Punishments*. Richard Davies, Cambridge University Press.
4. Bonnie, S. Fisher & Steven, P. La.,(2010). *Encyclopedia of Victimology and Crime Prevention*. SAGE Publications, Inc.
5. David, Kauzlarich and Hugh D. Barlow. (2009) *Introduction to criminology* (9th ed.) Rowman&Littlefield Publishers.
6. John, Martyn Chamberlain.(2015). *Criminological Theory in Context: An Introduction*. SAGE Publications Ltd . Southampton University
7. Paranjape, N.V. (2009). *Criminology and Penology*. Central Law Publications.
8. Reid, Sue Titus. (2006). *Crime and Criminology*. Mc. Graw Hill.
9. Sutherland ,E. H. and Cressey, Donald. (1992), *Principles of Criminology*. (11thed). Lanham, Md.: Alta Mira Press
10. Tappan, Paul. (1960). *Crime, Justice ,and Correction*. McGraw-Hill Book Company ,Inc. New york ,Toronto, London.
11. Viano, Emilio.(1987). *Crime and its Victims*. Hemisphere Publishing Corporation, New York
12. Kocsis, RN (2006) *Criminal Profiling- Principles and Practices*. Humana Press, New Jersey
13. Roger G. Dunham (Author), Geoffrey P. Alpert (Author), Kyle D. McLean (2015). *Critical Issues in Policing: Contemporary Readings*. Waveland Press
14. N. Prabha Unnithan (2013). *Crime and Justice in India*. Sage Publications
15. H.R. Bhardwaj (2019). *The Criminal Justice system in India*. Konark Publishers Pvt Ltd
16. Adam Sutton, Adrian Cherney, Rob White, Garner Clancey. (2021) *Crime Prevention 3ed- Principles, Perspectives and Practices*. Cambridge University Press
17. Manish Dwivedi (2011) *Juvenile Justice System in India*. Adhyayan Publishers & Distributors.
18. S.H. James and J.J. Nordby, *Forensic Science: An Introduction to Scientific and Investigative Techniques*, 2nd Edition, CRC Press, Boca Raton (2005).
19. D.E. Zulawski and D.E. Wicklander, *Practical Aspects of Interview and Interrogation*, CRC Press, Boca Raton (2002).
20. R. Saferstein, *Criminalistics*, 8th Edition, Prentice Hall, New Jersey (2004).
21. J.L. Jackson and E. Barkley, *Offender Profiling: Theory, Research and Practice*, Wiley, Chichester (1997).
22. R. Gupta, *Sexual Harassment at Workplace,* LexisNexis, Gurgaon (2014).

UGFS S1-P4: General Physics-I

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory					Practical		
					Internal Exams				University Exams	University Exams (LPW)		Total
Th	**Tu**	**Pr**	**C**	**TCH**	TA-1 & TA-2		MSE					
					Marks	**Hrs**	**Marks**	**Hrs**	**Marks**	**Hrs**	**Marks**	**Hrs**	
3	0	0	3	3	25	00:45	50	01:30	100	03:00	-	-	200

* Note: TA-2 will be in form of assignments or workshops.

Learning Objectives

1. To learn about the various laws of motion.
2. To make students understand about the waves and its properties.
3. To build concept about the various aspects of radioactivity and atomic structure.

MODULE-I	Mechanics	Teaching Hours: 15 Hours

Laws of motion: Motion and its physical interpretation, Newton's law of motion, Law of conservation of linear momentum and its applications. Static and kinetic friction, laws of friction. Circular motion: Centripetal and Centrifugal force, Projectile motions and its application.

Simple Harmonic Motion and Elasticity: Simple Harmonic Oscillations. Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy and their time-average values. Elastic and inelastic collisions between particles. Elasticity, stress, strain, and Relation between the Elastic constants.

MODULE-2	Thermal Physics	Teaching Hours: 15 Hours

First Law of Thermodynamics: Thermodynamic Variables, Thermodynamic Equilibrium, Zeroth Law of Thermodynamics & Concept of Temperature, Concept of Work & Heat, State Functions, First Law of Thermodynamics and its differential form, Internal Energy, various thermodynamic processes, Relation between CP and CV, Work Done during Isothermal and Adiabatic Processes.

Second Law of Thermodynamics: Reversible and Irreversible process with examples. Conversion of Work into Heat and Heat into Work. Heat Engines. Carnot engine & efficiency, Kelvin-Planck and Clausius Statements. Concept of entropy.

Kinetic theory of gases and Theory of Radiation: Real and Ideal gas, Maxwell-Boltzmann Law of Distribution of velocities. Mean, RMS and Most Probable Speeds. Mean Free Path. Blackbody radiation, Spectral distribution, Concept of Energy Density, Derivation of Planck's law, Wien's distribution law, Rayleigh-Jeans Law, Stefan Boltzmann Law and Wien's displacement.

MODULE-3	Wave and Optics	Teaching Hours: 15 Hours

Wave: Wave motion, Wave equation, longitudinal and transverse waves, Plane Progressive (Travelling) Waves, Nature and properties of electromagnetic waves, Speed of sound wave in different media and their properties, Velocity of Transverse Vibrations of Stretched Strings, Newton's hypothesis, Laplace correction in speed of sound.

Optics: Electromagnetic spectrum, Interference, Reflection, refraction polarization and diffraction of light. Young's double slit experiment, Refractive index and total internal reflection of light. Microscopes and astronomical telescopes (reflecting and refracting) and their magnifying powers. Physical and Chromatic aberrations.

Reference books:

1. NCERT Physics Part 1 And part 2.
2. An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
3. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
4. Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
5. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
6. Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, Tata McGraw-Hill.
7. The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.
8. Optics, Ajoy Ghatak, 2008, Tata McGraw Hill.

UGFS S1-P5: General Chemistry-I

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory					Practical		
					Internal Exams				University Exams	University Exams (LPW)		Total
Th	Tu	Pr	C	TCH	TA-1 & TA-2		MSE					
					Marks	Hrs	Marks	Hrs	Marks	Hrs	Marks	Hrs	
3	0	0	3	3	25	00:45	50	01:30	100	03:00	-	-	200

* Note: TA-2 will be in form of assignments or workshops.

Learning objectives:

1. To learn about different bonding theories.
2. To learn about Structure of ionic solids.
3. To learn about periodic trends.
4. To learn about basics of organic chemistry.
5. To learn about basics of physical chemistry.

MODULE-I	Structure and Bonding	Teaching Hours: 15 Hours

Atomic Structure: Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrodinger wave equation; H atom; Radial and angular wave functions. Quantum numbers and their significance, Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations, Variation of orbital energy with atomic number, Molecular orbital theory and shapes of s, p, d and f Orbitals.

Chemical Bonding: VB and MO approach of H_2 molecule; MO treatment of homonuclear and heteronuclear (CO & NO) diatomic molecules; Concept of HOMO and LUMO. VSEPR theory; Structure of simple molecules and ions of main group elements

Ionic Solids: Close packing, Radius ratio rule and crystal coordination number. Examples of MX and MX2 type ionic solids (NaCl and TiO_2)

Metallic Bonding: theories of bonding in metals; Free electron, VB and Band theories.

Weak Interactions: Hydrogen bonding and van der Waal's interactions

Periodic trends and properties: Size, Ionization Energy, Electron Affinity, Electronegativity, Lattice and Hydration Energies, Use of redox potential and reaction feasibility.

MODULE-2	Basics of Organic Chemistry	Teaching Hours: 15 Hours

Organic Compounds: Classification, and Nomenclature, Hybridization, Shapes of molecules, Influence of hybridization on bond properties. Optical Isomerism: Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Racemic mixture and resolution. Chemistry of

aliphatic, aromatic hydrocarbons and Cycloalkanes. Aromaticity and Huckel rule - A general concept. Molecular orbital picture of benzene.

MODULE-3	Basics of Physical Chemistry	Teaching Hours: 15 Hours

Gaseous State: Kinetic theory of gases, ideal gas laws based on kinetic theory. Collision in a gas-mean free path, collision diameter, collision number. Behaviour of real gases - the van der Waal's equation.

Liquid State: Surface tension of liquids - capillary action, experimental determination of surface tension, temperature effect on surface tension. Viscosity of liquids, experimental determination of viscosity coefficient, its variation with temperature.

Thermodynamics: Enthalpy, heat changes at constant volume and constant pressure, heat capacities (CV, CP) and their relationship for ideal gases. Thermodynamic quantities (w, q, ΔU, ΔH) for isothermal and adiabatic reversible expansion of ideal gases and their comparison. Change in internal energy (ΔU) and enthalpy (ΔH) of chemical reactions, relation between ΔU and ΔH, variation of heat of reaction with temperature (Kirchhoff's equation).

Reference Books:

1. Basic Inorganic Chemistry, F. A Cotton, G. Wilkinson, and Paul L. Gaus, 3rd Edition (1995), John Wiley & Sons, New York.
2. Concise Inorganic Chemistry, J. D. Lee, 5th Edition (1996), Chapman & Hall, London.
3. Physical Chemistry, P. Atkins and J. De Paul, 8th Edition (2006), International Student Edition, Oxford University Press.
4. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
5. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications 1962.
6. Vogel, A.I. A Textbook of Quantitative Inorganic Analysis, ELBS.
7. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd.(Pearson Education).
8. Physical Chemistry, P. C. Rakshit, 5th Edition (1988), 4th Reprint (1997), Sarat Book House, Calcutta.
9. Principles of Physical Chemistry, B. R. Puri, L. R. Sharma, and M. S. Pathania, 37th Edition (1998), Shoban Lal Nagin Chand & Co., Jalandhar.
10. Physical Chemistry, K. J. Laidler and J. M. Meiser, 3rd Edition, Houghton Mifflin Comp., New York, International Edition (1999).

UGFS S1-P6: General Biology-I

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme								
					Theory						Practical		
					Internal Exams				University Exams		University Exams (LPW)		Total
Th	Tu	Pr	C	TCH	TA-1 & TA-2		MSE						
					Marks	Hrs	Marks	Hrs	Marks	Hrs	Marks	Hrs	
3	0	0	3	3	25	00:45	50	01:30	100	03:00	-	-	200

* Note: TA-2 will be in form of assignments or workshops.
Learning Objectives:

1. Understanding of Cell structure and function
2. Knowledge of Microbial world
3. Conceptualisation of various aspects of genetics

MODULE-I	Cellular Organisation	Teaching Hours: 15 Hours

Cell and cellular organelles, The cell theory, Prokaryotic and Eukaryotic cells, Eukaryotic sub-cellular components: Nucleus, chromosomes, plasma membrane, endoplasmic reticulum, lysosomes, peroxisomes, Golgi apparatus, mitochondria, chloroplast, cytoskeleton. Cell cycle and its control; Cell division-amitosis, mitosis and meiosis.

MODULE-2	Introduction to Microbiology	Teaching Hours: 15 Hours

Bacteria: General characteristics, cell structure of bacteria and their components, Classification of bacteria (Outline), mode of nutrition, mycoplasma, archaebacteria, cyanobacteria. Fungi: General characteristics and classification Viruses: General characteristics and classification.

MODULE-3	Basic of Genetics	Teaching Hours: 15 Hours

Introduction to genetics, pre-Mendelian, Mendelian and non-Mendelian inheritance, genetic linkage, recombination and crossing over, chromosomal basis of inheritance, mutations and mutagenesis, genetic basis of sex determination, extra-nuclear inheritance, exchange of genetic material-Conjugation, Transformation and Transduction.

References and Suggested Readings:

1. Nelson DL, Cox MM (2017) Lehninger Principles of Biochemistry, 7th Edition. W. H. Freeman
2. Stryer L, Berg JM, Tymoczko JL. Gatto GJ. (2015) Biochemistry, 8th Edition. W. H. Freeman
3. Voet DV, Voet JG. (2011) Biochemistry, Wiley
4. Pelczar Mi J., Chan, E.C.S., Krieg, NR, (2009). Microbiology, McGraw-Hill publisher
5. Satyanarayana U, (2013), Biochemistry Elsevier
6. Snustad DP, Simmons MJ. (2015) Principles of Genetics, 7th Edition , Wiley.
7. Albertis B, Jhonson A, Lewis L, Morgan D, Raff M, Roberts K, Emeritus, Walter P (2014) Molecular Biology of the Cell. 6th Edition, Garland Science

UGFS S1-SE-1: Communication skill

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme								
					Theory						Practical		
					Internal Exams				University Exams		University Exams (LPW)		Total
Th	**Tu**	**Pr**	**C**	**TCH**	TA-1 & TA-2		MSE		Marks	Hrs	Marks	Hrs	
					Marks	**Hrs**	**Marks**	**Hrs**					
2	0	0	2	2	25	00:45	50	01:30	100	03:00	-	-	200

* Note: TA-2 will be in form of assignments or workshops.

Learning Objectives:

1. To learn about importance of communication
2. To learn about the techniques to face interview, do group discussions, etc.

MODULE-I	Importance and process of Communication	Teaching Hours: 15 Hours

Verbal and Non-verbal process of Communication, How to face an interview, Group Discussion, How plan and conduct the Interviewer, importance of body language and gesture in interview, eye contact and appearance during interview process.

MODULE-2	Different skills and its importance	Teaching Hours: 15 Hours

Listening, Developing Reading Skills, Developing Conversational skills, Technical Writing skills.

References and Suggested Readings:

1. Sreevalsan, MC; Spoken English, Vikash Publishing House, New Delhi.
2. Communication Skills; Sanjay Kumar, Pushphate, Oxford.
3. Krishna Mohan, Meera Banarjee, Developing Communication Skills.
4. Frank O' Connor, Phonetics, Pengiun.
5. Business Correspondence and Report Writing- Sharma and Krishna Mohan- Tata Mgraw.

UGFS S1-Pr1: Practical-1

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory					Practical		
					Internal Exams				University Exams	University Exams (LPW)		Total
Th	**Tu**	**Pr**	**C**	**TCH**	TA-1 & TA-2		MSE					
					Marks	**Hrs**	**Marks**	**Hrs**	**Marks**	**Hrs**	**Marks**	**Hrs**	
0	0	8	4	8							100	6:00	100

* Note: TA-2 will be in form of assignments or workshops.

Learning Objectives:

At the end of course, students will be gaining the hands on training in the following courses;

MODULE-I	Introduction to Forensic Science

1. To study the history of crime cases from forensic science perspective.
2. To write report on different type of crime cases.
3. To review how the Central Fingerprint Bureau, New Delhi, coordinates the working of State Fingerprint Bureaus.
4. To examine the list of projects undertaken by the Bureau of Police Research and Development and suggest the thrust areas of research in Police Science.
5. To compare the code of conduct prescribed by different establishments for forensic scientists.

MODULE-2	Crime Scene Management

1. To prepare a report on evaluation of crime scene.
2. To establish chain of custody and note taking at crime scene.
3. To reconstruct an indoor crime scene.
4. To reconstruct an outdoor crime scene.
5. Collection, Packaging and Preservation of the evidences.

MODULE-3	Crime & Society

1. To review crime cases where criminal profiling assisted the police to apprehend the accused.
2. To evaluate how rising standards of living affect crime rate.
3. To review the recommendations on modernization of police stations and evaluate how far these have been carried out in different police stations.
4. To prepare a report on interrogation cells and suggest improvements.

MODULE-4	General Physics-I

1. To determine force, velocity and acceleration of moving object.
2. To determine angle of minimum deviation for a given prism by plotting a graph between angle of incidence and angle of deviation
3. To find the refractive index of a liquid by using convex lens and plane mirror.
4. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton's disc method.
5. To study the variation of Thermo Electric EMF with temperature using the thermocouple using the kit.

MODULE-5   **General Chemistry-I**

1. Determination of anions by chemical tests
2. Determination of cations of group 0, 1, & 2 by chemical tests.
3. Determination of melting point of organic solids.
4. Determination of viscosity of sugar solution
5. Determination of effect of temperature on viscosity of solution.

MODULE-6   **General Biology-I**

1. Visualization of animal cells under microscope
2. Visualization of bacterial cells under microscope
3. Visualization of mitosis in plant cell
4. Isolation of bacteria from soil/water sample
5. Mendelian inheritance using seeds of different colour/sizes of any plant

Semester II

SCHOOL OF FORENSIC SCIENCES

B.Sc.–M.Sc. Forensic Sciences

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(Ministry of Home Affairs, Government of India)

UGFS S2-P1: Criminal and Evidence Law

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme								
					Theory						Practical		
					Internal Exams				University Exams		University Exams (LPW)		Total
Th	Tu	Pr	C	TCH	TA-1 & TA-2		MSE						
					Marks	Hrs	Marks	Hrs	Marks	Hrs	Marks	Hrs	
3	0	0	3	3	25	00:45	50	01:30	100	03:00	-	-	200

* Note: TA-2 will be in form of assignments or workshops.

Learning Objectives:

1. To develop concepts about law and legal procedures, courts, IPC, CrPC & IEA.
2. To learn about police, police organizations at national & international levels.
3. To learn about NDPS Act, Explosives Act, Environment Protection Act, etc.

MODULE-1	Law	Teaching Hours: 15 Hours

Definition of Law, Court, Judge, Basic Terminology in Law, Introduction to Criminal Procedure Code, FIR, Difference between civil and Criminal Justice, Object of Punishment, Kinds of Punishment, Primary and Sanctioning Rights Primary and Secondary functions of Court of Law. Law to Combat Crime-Classification – civil, criminal cases. Essential elements of criminal law. Constitution and hierarchy of criminal courts.

Criminal Procedure Code. Cognizable and non-cognizable offences. Bailable and nonbailable offences. Sentences which the court of Chief Judicial Magistrate may pass.

Laws specific to Forensic Science: Indian Penal Code pertaining to offences against persons – Sections 121A, 299, 300, 302, 304A, 304B, 307, 309, 319, 320, 324, 326, 351, 354, 359, 362.Sections 375 & 377 and their amendments.

Indian Evidence Act – Evidence and rules of relevancy in brief. Expert witness. Cross examination and re-examination of witnesses. Sections 32, 45, 46, 47, 57, 58, 60, 73, 135, 136, 137, 138, 141. CrPC – Sections 291,291A, 292 & 293 in the code of criminal procedure.

MODULE-2	Police Science	Teaching Hours: 15 Hours

Definition and scope----Police organization under central government: general information about their structure and function BPR&D, CBI, IB, RAW, NCRB, NICFS, NPA, UT Police Force International Police Organization: INTERPOLE- history, structure general and special notices State Police organization: general organization of police at state and range level. Police organization at district level.

MODULE-3   Acts Relating to Socio-economic and Environmental Crimes   Teaching Hours: 15 Hours

Narcotic Drugs and Psychotropic Substances Act. Essential Commodity Act. Drugs and Cosmetics Act. Explosive Substances Act. Arms Act. Dowry Prohibition Act. Prevention of Food Adulteration Act. Prevention of Corruption Act. Wildlife Protection Act. I.T. Act. Environment Protection Act. Untouchability Offences Act

References and Suggested Readings:

1. D.A. Bronstein, Law for the Expert Witness, CRC Press, Boca Raton (1999).
2. Vipa P. Sarthi, Law of Evidence, 6th Edition, Eastern Book Co., Lucknow (2006).
3. A.S. Pillia, Criminal Law, 6th Edition, N.M. TripathiPvt Ltd., Mumbai (1983).
4. R.C. Nigam, Law of Crimes in India, Volume I, Asia Publishing House, New Delhi (1965).
5. (Chief Justice) M. Monir, Law of Evidence, 6th Edition, Universal Law Publishing Co. Pvt. Ltd., New Delhi (2002).

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UGFS S2-P2: Fingerprint Science

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme								
					Theory						Practical		
					Internal Exams				University Exams		University Exams (LPW)		Total
Th	Tu	Pr	C	TCH	TA-1 & TA-2		MSE						
					Marks	Hrs	Marks	Hrs	Marks	Hrs	Marks	Hrs	
3	0	0	3	3	25	00:45	50	01:30	100	03:00	-	-	200

* Note: TA-2 will be in form of assignments or workshops.

Learning Objectives:

1. To learn about fingerprint science, its development and various aspects.
2. To learn about various classification systems of fingerprints.
3. To learn about development and analysis of fingerprint by various physical and chemical methods.

MODULE-1	History and Basics of Fingerprints	Teaching Hours: 15 Hours

History of Fingerprint Science, main function of Fingerprint bureau, main function of Fingerprint bureau, Development of Fingerprint Science, Composition of sweat and secretion of sweat, Pattern types & Ridge characteristics, Ridge tracing, Ridge counting.

MODULE-2	Classification Methods of Fingerprints	Teaching Hours: 15 Hours

Various systems for Fingerprint classification, Henry classification system, numerical value, symbol, primary classification, secondary classification, sub-secondary classification and final classification, NCIC classification, AFIS classification.

MODULE-3	Development and Analysis of Fingerprint	Teaching Hours: 15 Hours

Development, Identification & Presentation of Fingerprint, Known prints & Rolled impressions, Direct or Inked prints, Development of Latent Prints & Lifting techniques, Physical & chemical Methods: Powder techniques & Various chemical techniques, Processing of Post developed prints. Finger print comparison & Identification, Introduction to AFIS.

References and Suggested Readings:

1. David R. Ashbaugh; Quantitative and Qualitative Friction Ridge Analysis, CRC Press

2. E. Roland Menzel; Fingerprint Detection, with Lasers, Second edition; Marcel, Dekker, Inc. USA.
3. James F. Cowger; Friction Ridge skin CRC Press London.
4. Mehta, M.K: Identification of Thumb Impression & Cross Examination of Finger Prints, N. M. Tripathi (P) Ltd, Bombay.
5. Moenssens: Finger Prints Techniques, Chitton Book Co. Philadelphia, New York.
6. Chatterjee S.K., Speculation in Finger print identification, Jantralekha, Printing Works, Kolkata.
7. Cowger, James F: Friction ridge skin: Comparison and Identification of Fingerprints; CRC Press, Boca Raton, New York.

UGFS S2-P3: Questioned Document

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme								
					Theory						Practical		
					Internal Exams				University Exams		University Exams (LPW)		Total
					TA-1 & TA-2		MSE						
Th	Tu	Pr	C	TCH	Marks	Hrs	Marks	Hrs	Marks	Hrs	Marks	Hrs	
3	0	0	3	3	25	00:45	50	01:30	100	03:00	-	-	200

* Note: TA-2 will be in form of assignments or workshops.

Learning Objectives:

1. To learn about questioned documents, various tools for its examination and age of document.
2. To learn about fundamentals of handwritings, printed documents, and their comparison.
3. To learn about various alterations used in documents.
4. To learn about charred documents and its examination.
5. To learn about Examination of Counterfeit Indian Currency Notes, Passports, Visas, stamp pads, credit card, visa, seal and other mechanical impressions.

MODULE-1   Basics of Questioned Document   Teaching Hours: 15 Hours

Definition of Questioned Document, Types of Questioned Document, Preliminary Examination of Questioned Document. Basic Tools Needed for Forensic Document Examination- Ultraviolet, Visible, Infrared, and Fluorescence Spectroscopy, Photomicrography, Microphotography, Visible Spectral Comparator, Electrostatic Detection Apparatus. Determining the Age and Relative Age of Documents.

MODULE-2   Fundamentals of Questioned Document   Teaching Hours: 15 Hours

Comparison of Handwriting, Determination of sequence of strokes, Development of Individuality in Handwriting, Natural Variations and Fundamental Divergences in Handwriting, Class & Individual Characteristics.

Merits and Demerits of Exemplar and Non-Exemplar Samples During Comparison of Handwriting. Standards for Comparison of Handwriting, Comparison of Paper, Ink, Printed Documents, Typed Documents, Xeroxed Documents.

MODULE-3   Examination of Questioned Document   Teaching Hours: 15 Hours

Alterations in Documents, Including Erasures, Additions, Over-Writing, and Obliterations. Indented and Invisible Writings. Charred Documents. Examination of Counterfeit Indian Currency Notes, Passports, Visas, stamp pads, credit card, visa, seal and other mechanical impressions.

References and Suggested Readings:

1. Hardless H.R. (1988). Disputed Documents, Handwriting and Thumbs –Print Identification, Profusely Illustrated. India: Low Book Co.
2. Rev. ED.; Ordway Hilton; Scientific Examination. I of Questioned Documents, Elsevier, NewYork.
3. Charles C. Thomas, I.S.Q.D. Identification System for Questioned Documents; Billy PriorBates Springfield, Illinois, USA.
4. Wilson R. Harrison; Suspect Documents -Their Scientific Examination; Universal LawPublishing, Delhi.
5. Hard less, H.R: Disputed Documents, handwriting and thumbs -print identification: profuselyillustrated, Low Book Co., Allahabad.
6. Morris, Ron, N: Forensic handwriting identification, Acad Press, London.
7. Kurtz Sheila: Graphotypes a new plant on handwriting, analysis, Crown Publishers Inc., USA.
8. Lerinson Jay; Questioned Documents, Acad Press, London.

UGFS S2-P4: General Physics-II

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory						Practical	
					Internal Exams				University Exams		University Exams (LPW)		Total
Th	**Tu**	**Pr**	**C**	**TCH**	TA-1 & TA-2		MSE						
					Marks	**Hrs**	**Marks**	**Hrs**	**Marks**	**Hrs**	**Marks**	**Hrs**	
3	0	0	3	3	25	00:45	50	01:30	100	03:00	-	-	200

* Note: TA-2 will be in form of assignments or workshops.

Learning Objectives:

1. To learn about atom and their characteristics
2. To learn about nucleus and their properties
3. To learn the fundamentals of lasers and holography
4. To learn the basics of electricity and magnetism

MODULE-1   Atomic and Nuclear Physics   Teaching Hours: 15 Hours

Atomic Physics: Structure of atom. Rutherford's model of atom; Bohr model, energy levels, hydrogen spectrum. Idea of discrete energy levels and electron spin: Franck-Hertz and Stern-Gerlach experiments, Significance of four quantum numbers, Pauli's exclusion principle, Orbital magnetic dipole moment, Orbital, spin and total angular momenta, and Vector model of atom.

Nuclear Physics and Radioactivity: Composition and size of nucleus, atomic masses, isotopes, isobars, isotones. Alpha, beta and gamma particles/rays and their properties; radioactive decay law. Mass-energy relation, mass defect; binding energy per nucleon and its variation with mass number; nuclear fission and fusion.

MODULE-2   Lasers   Teaching Hours: 15 Hours

Introduction to Lasers: Characteristics of laser light, Spontaneous emission, Stimulated emission, Stimulated absorption, Einstein coefficients, Characteristics of laser radiation, Population inversion and condition for light amplification, Essential components of the laser, Optical resonator, CW and pulsed laser, peak power and pulse energy.

Application of lasers: Holography: Formation of a hologram, Reconstruction of the hologram, Requirements, Application In forensic investigation.

MODULE-2   Electricity and Magnetism   Teaching Hours: 15 Hours

Electric field and potential: Electric field lines. Electric flux. Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry. Conservative nature of

Electrostatic Field. Electrostatic Potential. Laplace's and Poisson equations. Electrostatic energy of a charged sphere.

Magnetic Field: Biot-Savart Law and its simple applications: straight wire and circular loop. Ampere's Circuital Law and its application solenoid and wire. Properties of magnetic field: curl and divergence. Magnetic Force on (a) point charge (b) current carrying Torque on a current loop in a uniform Magnetic Field.

Electromagnetic Induction: Faraday's Law. Lenz's Law. Self-Inductance and Mutual Inductance. Energy stored in a Magnetic Field. Introduction to Maxwell's Equations. Charge Conservation and Displacement current.

Reference books:

1. Physics of atoms and molecules, B. H. Bransden and C. J. Joachain, 2003, Pearson.
2. Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
3. Laser Fundamentals, William T. Silfvast, 2008, Cambridge University Press.
4. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw.
5. Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education.
6. Introduction to Electrodynamics, D.J. Griffiths, 3rd Edition, 1998, Benjamin Cummings.

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UGFS S2-P5: General Chemistry-II

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme								
					Theory						Practical		
					Internal Exams				University Exams		University Exams (LPW)		Total
Th	**Tu**	**Pr**	**C**	**TCH**	TA-1 & TA-2		MSE						
					Marks	**Hrs**	**Marks**	**Hrs**	**Marks**	**Hrs**	**Marks**	**Hrs**	
3	0	0	3	3	25	00:45	50	01:30	100	03:00	-	-	200

* Note: TA-2 will be in form of assignments or workshops.

Learning objectives:

1. To learn about about various analytical techniques.
2. To learn about calibration and standards.
3. To learn about basic electrochemistry.
4. To learn about basic nuclear and radiation chemistry.

MODULE-1	Analytical Chemistry	Teaching Hours: 15 Hours

Concepts of Controls & Standards: Calibration, Positive and Negative control, False positive and false negative results, Reference Standards, Certified Reference Materials, Internal Standards and Internal Standardisation Method, Standard Addition Calibration Method.

Statiscal Evaluation: Determinant and indeterminant errors, Normal error curve, Accuracy and Precision, Relative and standard deviation, Methods for minimizing errors, Criteria for rejection of observation, Significant figures and computation rules, Error propagation.

Precipitation: Desirable properties of gravimetric precipitates, Formation of gravimetric precipitates, Conditions for quantitative precipitations, Contamination in precipitates, Method for removal of impurities in precipitates, Steps involved in quantitative precipitation, Organic precipitants (oxine, dithizone, α-nitroso-(naphthol, cupferon, dimethyl glyoxime) in chemical analysis.

Analytical Reagents: Theoretical and practical aspects of the use of EDTA, cerate, iodate, bromate, chloramine-T, Karl Fischer and periodate reagents in chemical analysis.

Radio-Analytical Methods: Elementary theory, Isotope dilution and Neutron activation methods and applications.

MODULE-2	Electrochemistry	Teaching Hours: 15 Hours

Arrhenius theory of electrolytic dissociation, Hydrolysis of salts, hydrolysis constant, buffer solutions, indicators and theory of acid-base indicators. Migration of ions: transference number and its determination by Hittorf methods. Conductance of electrolyte solutions, molar conductance of electrolyte and its splitting into ionic molar conductance, Kohlrausch law of

independent migration of ions, ionic mobility. Application of conductance measurements: determination of degree of dissociation and dissociation constant of weak electrolytes/acids, solubility of sparingly soluble salts, and Conductometric titrations.

MODULE-3	Nuclear and Radiation Chemistry	Teaching Hours: 15 Hours

Nucleus and its classification, nuclear forces, nuclear binding energy, stability of nucleus. Radioactivity: Radioactive elements, general characteristics of radioactive decay, decay kinetics (decay constant, half-life, mean life period), units of radioactivity. Nuclear fission: the process, fragments, mass distribution, and fission energy. Nuclear reactor: the natural uranium reactor, classification of reactors, breeder reactor. Nuclear fusion and stellar energy.

Radiation chemistry: Elementary ideas of radiation chemistry, radiolysis of water and aqueous solutions, unit of radiation chemical yield (G-value), radiation dosimetry (Fricke's dosimeter), units of radiation energy (Rad, Gray, Rontgen, RBE, Rcm, Sievert)

Reference Books:

1. Modern Methods of Chemical Analysis', R.L. Pecscock, L.D. Shields, T. Cairns, and I.C. Mc William, 2nd Edition (197 6), John Willey, New York.
2. 'Basic Concepts of Analytical Chemistry', S.M.Khopkar, 2nd edition (1998), New Age International Publications, New Delhi.
3. ' Analytical Chemistry', G.D. Christian, John Willey & sons, New York (2001).
4. Instrumental Methods of Analysis', H.H. Willard, L.L. Merritt, and J.A.Dean, 6th edition(l986), CBS Publishers & Distributors, Shahdara, Delhi.
5. Principles of Instrumental Analysis, D.A. Skoog, F.J.Holler and T.A. Nieman, , 5th edition (l998), Horcourt Brace & Company, Florida.
6. Physical Chemistry, P. Atkins and J. De Paul, 8th Edition (2006), International Student Edition, Oxford University Press.
7. Physical Chemistry, P. C. Rakshit, 5th Edition (1988), 4th Reprint (1997), Sarat Book House, Calcutta.
8. Principles of Physical Chemistry, B. R. Puri, L. R. Sharma, and M. S. Pathania, 37th Edition (1998), Shoban Lal Nagin Chand & Co., Jalandhar.
9. Physical Chemistry, K. J. Laidler and J. M. Meiser, 3rd Edition, Houghton Mifflin Comp., New York, International Edition (1999).
10. Essentials of Nuclear Chemistry H. J. Arnikar, 4th Edition (1995), New Age International (p) Ltd., Wiley Eastern Ltd., New Delhi.

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(Ministry of Home Affairs, Government of India)

UGFS S2-P6: General Biology-II

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory					Practical		
					Internal Exams				University Exams	University Exams (LPW)		Total
Th	Tu	Pr	C	TCH	TA-1 & TA-2		MSE					
					Marks	Hrs	Marks	Hrs	Marks	Hrs	Marks	Hrs
3	0	0	3	3	25	00:45	50	01:30	100	03:00	-	-	200

* Note: TA-2 will be in form of assignments or workshops.

Learning Objectives:

1. Knowledge of Human anatomy and physiology
2. Understanding of concept of evolution and ecology
3. Knowledge of Plant anatomy and physiology

MODULE-1	Animal-Anatomy and Physiology	Teaching Hours: 15 Hours

Animal cell and Animal tissues- Type, structure, location and function, Basics of Human physiology (Parts and their functions)-Digestive system, Respiratory system, Circulatory system, Excretory system, Skeletal system, Muscular system, Nervous system and Endocrine system, Entomology- General characteristics of Arthropoda, Characteristics features, classification of insects, Life cycle of insect (Flies, Beetles).

MODULE-2	Evolution and Ecology	Teaching Hours: 15 Hours

Evolution:

Theories of Origin of life, Biological evolution and evidences for biological evolution, Theories of evolution; Mechanism of evolution - variation (mutation and recombination) and natural selection with examples, types of natural selection, Gene flow and genetic drift, Hardy - Weinberg's principle, Adaptive radiation

Ecology:

Ecological hierarchy, Habitat and niche, Components of environment, Effect of abiotic factors of environment, Ecological adaptations, Population and population attributes; population interactions, Ecosystem- Components; productivity and decomposition; energy flow; Ecological pyramids; Nutrient cycles; Ecological succession, Ecological services

MODULE-3	Plant-Anatomy and Physiology	Teaching Hours: 15 Hours

Plant cell, Morphology of different parts of flowering plants- root, stem, leaf, flower, fruit and seed, Structure of pollen grain and its role in species identification, Diatoms- Characteristic and structure, Plant anatomy-Location and functions of different tissues and tissue systems in flowering plants, Basics of plant physiology-Transport in Plants, Growth and Development.

References and Suggested Readings:

1. Jennifer L. Regan, Andrew F. Russo, Cinnamon L. VanPutte (2021) Seeley's Essentials of Anatomy and Physiology, 11th Edition. McGraw Hill
2. Elaine N. Marieb, Suzanne Keller (2017) Essentials of Human Anatomy & Physiology Global Edition, 12th Edition ,Pearson Education
3. Richard Crang, Sheila L. Sobaski (2018) Plant Anatomy: A Concept-Based Approach to the Structure of Seed Plants, 1st Edition, Springer
4. S N Pandey, B K Sinha (2005)Plant Physiology, 4th Edition, S Chand
5. William G. Hopkins , Norman P A Huner (2013) Introduction to Plant Physiology 4th Edition, Wiley India
6. T M Smith, R L Smith (2015) Elements of Ecology Global Edition, 9th Edition , Pearson Education India
7. Douglas J. Futuyma (2020), Mark Kirkpatrick Evolution, 4th Edition, Oxford University Press

UGFS S2-SE-2: English

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme								
					Theory						Practical		
					Internal Exams				University Exams		University Exams (LPW)		Total
					TA-1 & TA-2		MSE						
Th	Tu	Pr	C	TCH	Marks	Hrs	Marks	Hrs	Marks	Hrs	Marks	Hrs	
2	0	0	2	2	25	00:45	50	01:30	100	03:00	-	-	200

* Note: TA-2 will be in form of assignments or workshops.

Learning Objectives:

1. To develop understanding about basic grammar.
2. To learn how to write different letters, paragraph, essay, etc.

MODULE-I   Basic Grammar   Teaching Hours: 15 Hours

Articles, Verbs: Auxiliaries, Finite and Non Finites, Time and Tens, Subject: Verb Agreement (concord), Active and Passive Voice, Narration, Single word / verb substitution, Common Error, Comparison, Antonym, homonym, Sentence, Building (Vocabulary).

MODULE-2   Formal and Official Writing   Teaching Hours: 15 Hours

Précis, Essay, Paragraph Writing and Comprehension, Official Correspondence, Memorandum; Circular Letter.

References and Suggested Readings:

1. English Grammar- N.D. Turton, ABC of Common Grammatical Error for learners and Teachers.
2. English Grammar- Dr. K.K. Ramchandran et al; business Communication.
3. Technical English- Sharon j Gerson and Steven M Gerson
4. Angela Burt, Quick Solutions to common Error in English.
5. W. Foulsham, The Complete letter writer.
6. John East wood- Oxford guide to English Grammar.

2. To use a digital multimeter for measuring dc voltage, dc current, resistance and capacitance.
3. B-H curve-Determination of the hysteresis energy loss.
4. To determine the resistance per cm of a given wire by plotting a graph of potential difference versus current, and hence determining the resistivity.
5. Measurement of field magnetic field strength and its variation in a solenoid.

MODULE-5	General Chemistry-II

1. Preparation of molar solutions and molal solutions of NaOH & HCl.
2. Quantitative estimation of protein in any food sample by UV-Visible spectroscopy
3. Complexometric titration of Zinc using EDTA.
4. Determination of oxidation & reduction potential of Potassium ferrocyanide by Electrochemical workstation.
5. To perform test for alcohols using positive and negative controls.

MODULE-6	General Biology-II

1. Preparation of temporary slides of animal tissue
2. Separation of plant pigments through paper chromatography
3. Test for presence of urea, sugar, albumin and bile salt in urine.
4. Study the plant population density and frequency by quadrat method.
5. Study of different soil samples for texture, moisture content, pH and water holding capacity.

SEMESTER-III

UGFS S3-P1 Forensic Psychology

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory					Practical		
					Internal Exams				University Exams	University Exams (LPW)		Total
Th	Tu	Pr	C	TCH	TA-1 & TA-2		MSE					
					Marks	Hrs	Marks	Hrs	Marks	Hrs	Marks	Hrs	
3	0	0	3	3	25	00:45	50	01:30	100	03:00	-	-	200

Learning Objectives:

1. Understand the practical role played by contemporary forensic psychologists in society
2. Demonstrate a knowledge of forensic psychology as a discipline and research methods used within forensic psychology
3. Demonstrate awareness of the fundamental application of psychology, as a science, to understand key forensic issues

MODULE-1	Basics of Psychology	Teaching Hours: 15 Hours

Psychology Introduction Scope and importance, Principles of development, Attention and perception, Process of learning, Memory and forgetting, Motivation, Attitudes, Values of emotions, Behavioural problems, Conflict and use of defence mechanisms, Psychology of criminal behaviour.

MODULE-2	Techniques of Forensic Psychology	Teaching Hours: 15 Hours

Forensic Psychology: Truth and Deception, Psychology of lying, Various methods of lie detection, Principles of Polygraph, Legal aspects, Narco analysis, Brain Fingerprinting, BEOS: History, Importance as an investigative tool, methods as use of drugs, Hypnosis etc., Limitations and legal aspects.

MODULE-3	Forensic psychology of crime	Teaching Hours: 15 Hours

Forensic Psychology and the Law, Ethical Issues in Forensic Psychology, Civil and criminal case assessment, Assessing mental competency, Mental disorders and Forensic Psychology, Eye witness testimony, Criminal profiling- need and types, Forensic Scientific evidence, Crime and Psychopathology, Genetics and Crime, Serial murders, Modus Operandi.

References and Suggested Readings:

1. Bruce A. Arrigo, Stacey L. Shipley: Introduction to Forensic Psychology, Second Edition.
2. Jadunath Sinha: Elementary Psychology.
3. Bruce, A. A: Introduction to Forensic Psychology, Academic Press, 2000.

4. Shapiro, D. L.: Forensic Psychology Assessment – An Investigative Approach, Allen & Bacon, 1991.
5. Kleiner, M.: Handbook of Polygraph Testing, Academic Press, 2002.
6. Turrey, B.: Criminal profiling – An Introduction to Behavioral Evidence Analysis, Academic Press, 1999.

UGFS S3-P2: Forensic Chemistry - I

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory						Practical	
					Internal Exams				University Exams		University Exams (LPW)		Total
Th	Tu	Pr	C	TCH	TA-1 & TA-2		MSE						
					Marks	Hrs	Marks	Hrs	Marks	Hrs	Marks	Hrs	
3	0	0	3	3	25	00:45	50	01:30	100	03:00	-	-	200

Learning Objectives:

1. To help students learn basics of forensic chemistry.
2. To help students learn about quality management.
3. To study and understand Narcotics and psychotropic substances.
4. To learn about explosives, arson and petroleum products.

MODULE-1	Quality Management	Teaching Hours: 15 Hours

Forensic chemistry:
- Introduction to forensic chemistry, Types of cases/exhibits received for analysis, Overview of forensic chemical analysis

Quality management:
- Introduction to Quality, Quality Assurance, Quality control, TQM
- Definition of Accreditation, History and development of ISO
- Importance of accreditation in Forensic science laboratories, Process of accreditation, Quality system, International Laboratory Accreditation Co-operation (ILAC), Asia Pacific Laboratory Accreditation Co-operation (APLAC). American Society of Crime Laboratory Directors (ASCLD)
- Traceability and Validation of new methods, measurement of uncertainty, Equipment maintenance and calibration
- Proficiency testing, internal audit/External audit, MRM Training and conferences

MODULE-2	Narcotic Drugs & Explosives	Teaching Hours: 15 Hours

Narcotic Drugs &Psychotropic Substances:
- Introduction to NDPS drugs, Controlled Substances, Classification of controlled substances, Precursor chemicals, Narcotic raids and clandestine drug laboratories investigation, Mandatory provisions of NDPS Act, 1985.
- Drug addiction (Physical & Psychological), Drug dependence and Drug Tolerance.
- Designer Drugs, Analysis of Drug of abuse by colour test and TLC.
- Case studies.

Explosives:
- Introduction, Classification and chemistry of explosives; Post blast investigation.
- Systematic examination of explosive and explosion residues (organic and inorganic) by colour test and TLC.
- Case studies.

MODULE-3 Fire & Petroleum products	Teaching Hours: 15 Hours

Introduction to Fires &Arson Investigation:
- Introduction to Thermodynamics and Chemistry of Fire, Investigation of Fire and Arson, Forensic Analysis of Fire Debris by Instrumental methods, Case studies.

Forensic Analysis of Petroleum Products:
- Introduction to Petroleum Products and Analysis of Petrol, Kerosene and Diesel as per BIS Specifications. Case Studies

Reference Books:
1. J ASiegel, P.J Saukko (2000) Encyclopaedia of Forensic Sciences Vol. I, II and III, Acad. Press.
2. NABL -, Guide for Internal audit and Management Review for Laboratories.
3. NABL-210, Assessor Guide Issue No.3, 1.5.2002.
4. DFSS: Manuals of Forensic Sciences.
5. Maudham Bassett et al.; Voget's Textbook of Quantitative Chemical Analysis, 6th Ed. Longman Essex.
6. Brean S. Furniss Etal; A.I. Vogel Textbook of Practical Organic Chemistry, Addison Wesley Longman, Edinburg.
7. D A Skoog, D.M. West, F.J. Holler; Analytical Chemistry – An Introduction, 7th Ed. Saunders College Pub, Philadelphia, USA.
8. Boudreau JE, Etal; Arson & Arson Investigation, Survey & Assessment National Institutes of Law Enforcement, U.S. Deptt. Of Justice, U.S. Govt Printing Press.
9. Dettean J D; Kirk's Fire Investigation, 5th Ed. Prentice Hall, Eaglewood Cliffs, N. J.
10. Yinon Jitrin; Modern Methods & Application in Analysis of Explosives, John Wiley & Sons, England.
11. Working Procedure Manual – Chemistry, Explosives and Narcotics, BPR&D Pub.
12. C.A. Watson; Official and Standardized Methods of Analysis, Royal Society of Chemistry, UK.
13. Feigl; Spot Test in Inorganic Analysis, Elsevier Pub. New Delhi.
14. Feigl; Spot Test in Organic Analysis, Elsevier Pub. New Delhi.
15. Silverman; Organic Chemistry of Drug Design & Drug Action, Elsevier Pub. New Delhi.
16. Abraham Burger; Medicinal Chemistry & Drug Discovery, 6 Vol Set, 6th Ed John Wiley & Sons, NY.
17. NDPS Act, 1985.

UGFS S3-P3 Forensic Physics - I

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory				Practical			
					Internal Exams			University Exams	University Exams (LPW)			Total
Th	Tu	Pr	C	TCH	TA-1 & TA-2		MSE		Marks	Hrs	Marks	Hrs
					Marks	Hrs	Marks	Hrs				
3	0	0	3	3	25	00:45	50	01:30	100	03:00	-	-	200

Learning objectives:
1. Students will be able to explain the properties of the materials, glass and soil nature
2. Students will be able to examine different types of papers and paint.
3. Students will gain understanding of road collisions and reconstruction of the incidents.

MODULE-1	Glass	Teaching Hours: 15 Hours

Introduction to glass, Types of glass and their compositions, Forensic examination of glass fractures under different conditions, determination of direction of impact: hackle marks, backward fragmentation, Physical measurements of glass, color and fluorescence, physical matching, density comparison, physical measurements, refractive index by refractometer, elemental analysis, and interpretation of glass evidence, Case Studies.

MODULE-2	Paints	Teaching Hours: 15 Hours

Introduction, Composition, Manufacture of Paint, types of paint, Forensic Examination of Paints and Coatings: Collection and Preservation of paint samples, macroscopic and microscopic techniques for the characterization of Paint Fragments, Physical , Chemical & Instrumental analysis of paint, , interpretation of Paint Evidence, Case Studies.

MODULE-3	Soil	Teaching Hours: 15 Hours

Soil and its composition, Classification of soil, Collection and preservation of soil as a evidence, analysis of soil samples: Physical, chemical and instrumental, interpretation of soil evidence, Soil as a geomarker, Case Studies.

References and Suggested Readings:

1. Forensic Science Evidence: Can the Law Keep Up With Science (Criminal Justice: Recent Scholarship by Donald E. Shelton.
2. M. Byrd, *Crime Scene Evidence: A Guide to the Recovery and Collection of Physical Evidence*, CRC Press, Boca Raton (2001).
3. 2. T.J. Gardener and T.M. Anderson, *Criminal Evidence*, 4th Ed., Wadsworth, Belmont (2001).

4. 3. S.H. James and J.J. Nordby, *Forensic Science: An Introduction to Scientific and Investigative Techniques*, 2nd Edition, CRC Press, Boca Raton (2005).

5. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's, *Techniques of Crime Scene Investigation*, CRC Press, Boca Raton (2013).

UGFS S3-P4: Basics of Computer & Biometrics

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory						Practical	
					Internal Exams				University Exams		University Exams (LPW)		Total
Th	Tu	Pr	C	TCH	TA-1 & TA-2		MSE						
					Marks	Hrs	Marks	Hrs	Marks	Hrs	Marks	Hrs	
3	0	0	3	3	25	00:45	50	01:30	100	03:00	-	-	200

Learning Objectives:

At the end of this course, student will gain understanding about;

1. Number systems
2. Computer fundamentals
3. Basics of Computer Networking and Internet

MODULE-1   Number Systems and Computer Fundamentals   Teaching Hours: 15 Hours

Introduction to Binary, Octal, Decimal and Hexadecimal Number Systems; Conversion from Binary to Decimal, Decimal to Binary, Binary to Hexadecimal, Hexadecimal to Binary; Representation of signed and unsigned Binary Numbers; Arithmetic, Logical, Relational and Shift Operations on Binary Numbers; ASCII and UTF.

Definition of Computer, History, Key Terms, Hardware and Software, Primary and Secondary Storage Devices; Basics of Operating System, Introduction to Filesystems, Windows and Linux OS architectures; Introduction to Computer Related Crimes.

MODULE-2 Basics of Computer Networking and Internet   Teaching Hours: 15 Hours

Definition of Computer Network, Components of Network, Topology and Types of network, Introduction to OSI layer and TCP / IP protocol suite, Communication Devices, IP and MAC Addresses, Understanding Internet, Introduction to websites and webpages; understanding Firewall, IDS and IPS; Introduction to Network and Internet Related Crimes.

MODULE-3   Introduction to Biometrics   Teaching Hours: 15 Hours

Introduction - Biometric fundamentals – Biometric technologies – Biometrics vs traditional techniques – Characteristics of a good biometric system – Benefits of biometrics – Key biometric processes: verification, identification and biometric matching – Performance measures in biometric systems. Physiological and behavioural biometrics.

References and Suggested Readings:

1. Operating Systems | Internals and Design Principles, Ninth Edition by William Stallings

2. Modern Operating Systems 4eby Tanenbaum

3. Structured Computer Organization 6/e PaperbackbyTanenbaum

4. Computer Networks: A Top - Down Approach by FOROUZAN

5. TCP/IP Protocol Suite E/4 by Behrouz A. Forouzan

UGFS S3 CE-1	Core Elective - I	L	T	P	Cr	2	0	0	2

UGFS S3 SE -3	Skill Based Elective - III	L	T	P	Cr	2	0	0	2

Yoga and its benefits

UGFS S3-Pr1: Practical-III

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory					Practical		
					Internal Exams				University Exams	University Exams (LPW)		Total
Th	Tu	Pr	C	TCH	TA-1 & TA-2		MSE					
					Marks	Hrs	Marks	Hrs	Marks	Hrs	Marks	Hrs	
0	0	8	4	8							100	6:00	100

Learning Objectives:

At the end of course, students will be gaining the hands on training in the following courses;

MODULE-I	Forensic Psychology

1. To cite a crime case where legal procedures pertaining to psychic behavior had to be invoked.
2. To prepare a report on relationship between mental disorders and forensic psychology.
3. To review a crime case involving serial murders. Comment on the psychological traits of the accused.
4. To cite a crime case involving a juvenile and argue for and against lowering the age for categorizing an individual as juvenile.
5. To cite a criminal case in which narco analysis was used as a means to detect deception.

MODULE-2	Forensic Chemistry-I

1. Identification of NDPS drugs by colour test and TLC.
2. Detection of low explosives by chemical/colour test and TLC.
3. Examinations of petroleum products as per BIS specifications.
4. Identification of alcoholic beverages as per BIS specifications.
5. Analysis of phenolphthalein in bribe trap cases.

MODULE-3	Forensic Physics-I

1. Density gradient analysis of soil samples.
2. Determination of density of glass by specific gravity bottle method
3. Restoration of erased identification marks.
4. Determination of refractive index of glass and liquid.
5. Comparison of broken glass bangles.
6. Physical matching of broken pieces of different objects.
7. Determination of tensile strength of rope/dupatta.
8. Physical examination of paint samples by microscopic method

MODULE-4	Basics of Computer

1. Learning how to install and configure Linux OS
2. Understanding basic Windows OS administration (setting IP address, other network settings, adding/removing software/hardware, device driver settings, configuring printer, etc.).
3. Configuring Widows Firewall and Defender
4. Working with Windows Backup and Restore options

SEMESTER-IV

National Forensic Sciences University
Knowledge | Wisdom | Fulfilment
An Institution of National Importance
(Ministry of Home Affairs, Government of India)

UGFS S4-P1: Forensic Medicine

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory					Practical		
					Internal Exams				University Exams	University Exams (LPW)		Total
Th	Tu	Pr	C	TCH	TA-1 & TA-2		MSE					
					Marks	Hrs	Marks	Hrs	Marks	Hrs	Marks	Hrs	
3	0	0	3	3	25	00:45	50	01:30	100	03:00	-	-	200

Learning Objectives:

At the end of this course, student will gain understanding about;

1. The duties of the first responding officer who receives a call on homicide or suicide case.
2. The steps involved in processing the death scene.
3. The importance of ascertaining whether the crime was staged to appear as suicide or accident.
4. The importance of bloodstain patterns in reconstructing the crime scene.
5. The importance of autopsy.
6. The importance of forensic odontology

MODULE-1	Death Investigations	Teaching Hours: 15 Hours

Fundamental aspects and scope and objectives of forensic medicine. Need of forensic medicine. Approaching the crime scene of death. Inquest, recording dying declaration. Identifying witnesses and, if possible, suspect. Interviewing onlookers and segregating possible witnesses.

Suspect in custody – initial interrogation and searching for evidence. Miranda warning card. Assessing the crime scene. Request for forensic team. Importance of command post and logbook. Management of crowd and media. Importance of taking notes. Items to be a part of noting. Documenting the death scene. Processing evidence. Evaluation of injuries. Importance of canvass form. Indexing the death investigation. Handling buried body cases– search for buried bodies, methods of exhumation. Suicide cases–evaluating the type of injuries, gauging the psychological state of victim, suicide notes.

MODULE-2	Thanatology	Teaching Hours: 15 Hours

Definition of death- types and causes of death. – Mode of death- - post-mortem changes-Estimation of time since death. Molecular and systemic death- Objectives of medico legal autopsy- Medico-legal aspects of death - asphyxia- various types- mechanical asphyxia- hanging strangulation, Death by drowning- medico legal aspects.

MODULE-3	Traumatology	Teaching Hours: 15 Hours

Injuries and violence against women and children. Mechanical Injuries. –Types and classification of injuries. Ante mortem and post-mortem injuries. Aging of injuries. Self-inflicted injuries. -

Thermal deaths – electrocution-sexual offences- investigations of victim and accused. Child abuses –human trafficking investigative protocols.

References and Suggested Readings:

1. K. Smyth, The Cause of Death, Van Nostrand and Company, New York (1982).
2. M. Bernstein, Forensic odontology in, Introduction to Forensic Sciences, 2nd Ed., W. G. Eckert (Ed.), CRC Press, Boca Raton (1997).
3. J. Dix, Handbook for Death Scene Investigations, CRC Press, Boca Raton (1999).
4. H. B. Baldwin and C. P. Mayin, Encyclopaedia in Forensic Science, Volume 1, J. A. Siegel, P.J. Saukkoand G.C. Knupfer (Eds.), Academic Press, London (2000).
5. V. J. Geberth, Practical Homicide Investigation, CRC Press, Boca Raton (2006).
6. T. Beveland R. M. Gardner, Bloodstain Pattern Analysis, 3rdEdition, CRC Press, Boca Raton (2008).

UGFS S4-P2: **Fundamentals of Forensic Toxicology**

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory					Practical		
Th	Tu	Pr	C	TCH	Internal Exams				University Exams		University Exams (LPW)	Total
					TA-1 & TA-2		MSE		Marks	Hrs	Marks	Hrs	
					Marks	Hrs	Marks	Hrs					
3	0	0	3	3	25	00:45	50	01:30	100	03:00	-	-	200

Learning Objectives:

1. To help students learn basic principles of toxicology.
2. To help students learn about xenobiotic and toxic effects.
3. To study and understand concepts of mechanism of toxicity.
4. To learn the concepts of toxicological examination.

Module-1	Basics of Forensic Toxicology	Teaching Hours: 15 Hours

History, Scope and Significance, Crime scene involving poisons, medico legal aspects of poisoning, Laws related to poisons, nodal agencies and stake holders in forensic toxicology, nature of forensic toxicological examinations, Roles and Responsibilities of forensic toxicologists, drug paraphernalia, poisoning management, Format of autopsy report and laboratory report, expert witness testimony.

Module-2 Collection and Preservation	Teaching Hours: 15 Hours

Biological and non-biological samples, classes of matrices, National and International guidelines of toxicological sample collection, post-mortem examination, types of viscera, viscera collection and preservation, types of preservatives, types of containers, self-life of samples, Safety measures of toxicological samples handling, Personal Protective Equipment (PPEs).

Module-3 Extraction and Examination	Teaching Hours: 15 Hours

Extraction of poisons from biological and non-biological samples, Methods of Extraction, Liquid-Liquid extraction, extraction methods for acidic, basic and neutral poisons, extraction of volatile and non-volatile poisons, extraction of plant poisons, common methods of poison detection, chemical tests, Instrumental methods for toxicological examination, Toxicological analysis of decomposed material and body remains, challenges in forensic toxicological examination.

Reference Books:

1. Modi JS: Medical Jurisprudence and Toxicology
2. Taylor: Medical Jurisprudence
3. Parikh CK: Medical Jurisprudence and Toxicology
4. Keith Simpsen & Bernard Knight: Forensic Medicine
5. Poison, CJ, DJ Gee, B. Knight: Forensic Medicine
6. Reddy: Forensic Medicine
7. Laboratory Procedure Manual- Forensic Toxicology, DFS, MHA, New Delhi
8. Pharmacology and Therapeutics-Bhandarkar & Satoskar
9. Medical Pharmacology- Tripathy
10. Essentials of Toxicology- Ellenhorn

UGFS S4-P3 Forensic Ballistics

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme						
					Theory					Practical	
					Internal Exams				University Exams	University Exams (LPW)	Total
Th	Tu	Pr	C	TCH	TA-1 & TA-2		MSE				
					Marks	Hrs	Marks	Hrs	Marks	Hrs	Marks	Hrs	
3	0	0	3	3	25	00:45	50	01:30	100	03:00	-	-	200

Learning Objectives:

After studying this paper the students will know –

1. The classification of firearms and their firing mechanisms.
2. The methods of identifying firearms.
3. The characteristics of ammunition.
4. The importance of firearm evidence.
5. The nature of firearm injuries.
6. The methods for characterization of gunshot residue

MODULE-1	Firearms and Ammunition	Teaching Hours: 15 Hours

Firearms characteristics & classification of firearms, History and background of firearms, Functional assembly & Operating principle of firearms, Characteristics & Working mechanism of Standard: Rifled firearms, Small arms, Shot guns & Non-standard: Improvised, Country made, Imitative firearms, identification of origin. Ammunition & its constructional parts, Classifications of Ammunition on basis of constructional features, Functional assembly of different types of ammunition & their types, Safety aspects for handling firearms and ammunition, cartridge-firing mechanism.

MODULE-2	Basics of Ballistics	Teaching Hours: 15 Hours

Types of ballistics & their aspects, Internal, External, and Terminal Ballistics, General elementary & other principal problems: Heat problems, Pressure, Recoil, Vibration & Jump, Barrel Fouling, Trajectory formation & its computation, Vacuum Trajectories & its measurement, Influence of earth trajectory, Effect of air resistance on trajectories, Parameters involved in exterior ballistics. Effect of projectile on target based on: nature of target, bullet shape, striking velocity, striking angle and nature of target, intermediate targets, and range.

MODULE-3	Analysis of Firearm and Gunshot Residues (GSR)	Teaching Hours: 15 Hours

Identification of firearms, ammunition and their components: Principles, Processing of Firearm Exhibits involved, Class characteristics & Individual characteristics (Identifiable marks)

produced during firing process on cartridge cases & projectiles and their linkage with firearms. Analysis of GSR –Composition of GSR, Location & Collection, Mechanism of formation, Chemical & Instrumental techniques involved in analysis, Shooter Identification technique. Case studies related to firearms cases.

References and Suggested Readings:

1. J. Howard Mathews; Charles C. Thomas, Firearms Identification, Vols 1, 2, & 3; Springfield, Illinois.
2. Hatcher, Jury And Weller, Firearms Investigation, Identification And Evidence; Stackpole Books, Harrisburg, P. A.
3. Vincent Di Maio, Gunshot Wounds; CRC Press, Washington, Dc.
4. Brain J. Heard., Hand Book Of Firearms And Ballistics; John Willey, England.
5. TA, Warlow., Firearms, The Law And Forensic Ballistics; Taylor And Francis, Landon.
6. Karl G. Sellier et al., Wound Ballistics And The Scientific Background; Elsevier, London.
7. M. Johari, Identification Of Firearms, Ammunition And Firearms Injuries; BPR&D, New Delhi.

UGFS S4-P4 Forensic Biology and Wildlife Forensics

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory					Practical		
					Internal Exams				University Exams	University Exams (LPW)		Total
Th	Tu	Pr	C	TCH	TA-1 & TA-2		MSE					
					Marks	Hrs	Marks	Hrs	Marks	Hrs	Marks	Hrs	
3	0	0	3	3	25	00:45	50	01:30	100	03:00	-	-	200

Learning Objectives:

After studying this course, the students will be able to explain-

1. The significance of biological evidence.
2. The forensic importance of hair evidence.

MODULE-1	Introductory Forensic	Teaching Hours: 15 Hours

Brief History of Forensic Biology: Developments and Scope in the field of Forensic Biology, Branches of Forensic Biology Different types of biological Evidences and their significance in Forensic Science Collection, Preservation, Packing, Forwarding and Documentation of Biological Evidences.

Types and identification of microbial organisms of forensic significance, case studies.

Introduction to wood and its anatomy, Identification of endangered wood & its significances, case studies.

Forensic Palynology: Introduction and history of palynology, structure of pollen, identification and comparison of pollen, forensic significance, case studies.

Significance of hair evidence. Transfer, persistence and recovery of hair evidence. Structure of human hair. Comparison of hair samples. Morphology and biochemistry of human hair. Comparison of human and animal hair, case studies.

Introduction and classification of fibers, identification and comparisons of fibers and different microscopic, spectroscopic and chromatographic techniques, case studies.

MODULE-2	Forensic Limnology & Forensic Entomology	Teaching Hours: 15 Hours

Forensic Limnology-diatoms:

Introduction to Forensic Limnology, Role of algae & fungi in Forensic Science, Introduction to Diatoms, Identification of diatoms from biological matrices from soil & water, Diatoms testing, Legal aspects of Diatoms, Case Studies.

Forensic Entomology:

Introduction and History of Forensic Entomology, Anatomy and Taxonomy of Forensically relevant Insects (Diptera), Insect Succession (in buried bodies, burnt bodies, decomposed bodies above the soil and in water) & Factors that affect Insect Succession, Estimating Post-mortem Interval/ Time since infestation from invertebrate development rates, Forensically important Aquatic Insects, Insects as weapons and Threats to National Security, Collection of entomological evidence during death investigations, Forensic Entomology and the Law, Case studies.

MODULE-3	Wildlife Forensics	Teaching Hours: 15 Hours

Definition and advances in wildlife forensics, Threats to the natural resources and wild species inhabiting globally, Importance of Wildlife Conservation, Classification of Species as per IUCN Red Data Book, Introduction to CITES and CBD, Wildlife (Protection) Act, 1972 of India and other related acts, Different Methods of Poaching, Conventional methods of species identification, Morphological identification and examination of wildlife parts and products, Application of DNA technologies used in Wildlife Forensics.

References and Suggested Readings:

1. MariaTeresa,Tersigni-Tarrant, Natalie R. Shirley; "Forensic Anthropology: An Introduction", CRC Press, Taylor & Francis Group, 2012.
2. AngiChristensen, N.Passalacqua,& E. Bartelink; "Forensic Anthropology: Current Methods and Practices", Academic Press, Elsevier, 2014.
3. Anil Mahajan & Surinder Nath; "Application areas of Anthropology", Reliance Publishing House, 1992.
4. Megan Brickley&Roxanna Ferllini; "Forensic Anthropology: Case Studies from Europe", Charles C. Thomas Publisher, Springfield, Illinois, USA, 2007.
5. Whitaker, D.K. and MacDonald, D.U. (1989), Forensic Dentistry, Wolfe Medical Publications Ltd.

UGFS S4 CE-2	Core Elective - II	L	T	P	Cr	2	0	0	2

UGFS S4 SE -3	Skill based Elective - IV	L	T	P	Cr	2	0	0	2

Language

National Forensic
Sciences University
Knowledge | Wisdom | Fulfilment
An Institution of National Importance
(Ministry of Home Affairs, Government of India)

UGFS S4-Pr1: Practical-IV

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory				Practical			
					Internal Exams				University Exams		University Exams (LPW)		Total
Th	Tu	Pr	C	TCH	TA-1 & TA-2		MSE		Marks	Hrs	Marks	Hrs	
					Marks	Hrs	Marks	Hrs					
0	0	8	4	8							100	6:00	100

Learning Objectives:

At the end of course, students will be gaining the hands on training in the following courses;

MODULE-1	Forensic Medicine

1. To design a questionnaire for the first responder to the death scene.
2. To design a protocol to deal with the media at the crime scene.
3. To design a checklist for the forensic scientists at the death scene.
4. To design a canvass form giving description of an unidentified victim.
5. To analyze and preserve bite marks.
6.

MODULE-2	Forensic Toxicology

1. Extraction of heavy metals using wet digestion and dry digestion.
2. Extraction of volatile and non-volatile poisons
3. Analysis of heavy metals using colour tests (reinsch test).
4. Colour test and TLC of various plant poisons and pesticides
5. Analysis of drug using UV-Vis spectroscopy.

MODULE-3	Forensic Ballistics

1. To describe, with the aid of diagrams, the firing mechanisms of different types of firearms
2. To correlate the velocity of bullet with the impact it produces on the target
3. To correlate the striking angle of the bullet with the impact on the target.
4. To estimate the range of fired bullets and to carry out the comparison of fired bullets as well as cartridge cases.
5. To identify gunshot residue.
6. To correlate the nature of injuries with distance from which the bullet was fired.
7. To differentiate, with the aid of diagram, contact wounds, close range wounds and distant wounds.

MODULE-4	Forensic Biology and Wildlife Forensics

1. Microscopic examination of hairs – identification of species origin.
2. Examination of natural fibre like cotton, jute, coir and silk by microscope.
3. Examination of diatoms from different water bodies.
4. Examination of pollen grains of forensic relevant plants.
5. Examination of wood by microscopy method
6. To study life cycle of housefly and interpret time since death

SEMESTER-V

UGFS S5-P1: Forensic Anthropology

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory					Practical		
					Internal Exams				University Exams	University Exams (LPW)		Total
Th	Tu	Pr	C	TCH	TA-1 & TA-2		MSE		Marks	Hrs	Marks	Hrs	
					Marks	Hrs	Marks	Hrs					
3	0	0	3	3	25	00:45	50	01:30	100	03:00	-	-	200

Learning objectives:

At the end of course, students will be able to explain;

1. How wildlife forensics aid in conserving natural resources.
2. How forensic entomology assists in death investigations.
3.

MODULE-1 Basics of anthropology and application in forensics   Teaching Hours: 15 Hours

Forensic Anthropology – History - Scope and development - Role of forensic anthropologist – Collection and preservation of evidences - Human osteology - Determination of age, sex, stature- Determination of personal identity by superimposition technique - Video image analysis - Facial reconstruction – Legal provisions and tools involved in it - Pathology of bones and its importance in identification.

MODULE-2   Basics of odontology and application in forensics   Teaching Hours: 15 Hours

Forensic Odontology: Introduction - Structure and types of teeth - Dentition and dental formula – Dental diseases - Determination of age, sex and race from teeth - Role of teeth in mass disaster – Forensic significance in identification.

MODULE-3   Disaster Victim Identification (DVI)   Teaching Hours: 15 Hours

Identification of burnt bones, skeletal remains in accidents, crimes and mass disaster, Examination and identification of dead bodies in mass disasters, mutilated bodies, fragmentary skeletal remains and bones, Determination of age, sex, race and species origin from bones and assessment of stature.

Reference Books:

1. Forensic Biology. Richard Li, Sue Norman, Jane Schober. Edition Published :2015. ISBN 1439889724, 9781439889725. Published by CRC Press.
2. "Environmental Biology (Principles of Ecology)" by Verma P S and Agarwal V K

3. Wildlife Forensics: Methods and Applications. Editor(s):Jane E. Huffman, John R. Wallace. First Edition published :2012. Print ISBN:9780470662588 |Online ISBN:9781119953142 |DOI:10.1002/9781119953142. Published by John Wiley & Sons, Ltd.

4. Wildlife Forensic Investigation: Principles and Practice. John E. Cooper and Margaret E. Cooper. First Edition published : 2013. ISBN-10 :   :   13-ISBN ;1439813744 -978 Published .1439813744by CRC Press.

5. Webiste : https://moef.gov.in/en/

6. Webiste : http://nbaindia.org/

7. Webiste : https://www.iucn.org/

UGFS S5-P2: Digital Forensics and Cyber Law

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory					Practical		
					Internal Exams				University Exams	University Exams (LPW)		Total
Th	Tu	Pr	C	TCH	TA-1 & TA-2		MSE		Marks	Hrs	Marks	Hrs	
					Marks	Hrs	Marks	Hrs					
3	0	0	3	3	25	00:45	50	01:30	100	03:00	-	-	200

Learning Objectives: After studying this paper, the students would be able to:

1. Understand the different types of crimes in the cyberspace.
2. Get familiar with the principles of Digital Forensics.
3. Learn the basics of Incident Response and principles pertaining to digital evidence.
4. Get an overview of the different sections of IT Act and laws related to the admissibility of digital evidences.

MODULE-I   Forms of Cyber-Crime and Introduction to Digital Forensics   Teaching Hours: 15 Hours

Cyber-crime – Overview, Internal and External Attacks, Online and Offline Attacks.

Cyber-crime against Individual and Organization – Email spoofing, Phishing: types and techniques, spamming, unauthorized access to computer, Denial-of-Service (DoS) attack and its types, DDoS attack, Computer sabotage, Malwares and its types, E-mail bombing, Salami Attack, Software Piracy, Industrial Espionage; Cyber-crime against women and children, Crimes on social media, Online and Banking frauds, Intellectual Property Frauds. Different stages of cyber-attack.

Digital Forensics – Introduction, Objective, Methodology, Rules and Services of Digital Forensics, various branches of digital forensics - Live Forensics, Disk Forensics, Network Forensics, Mobile Device Forensics etc.

MODULE-2   Incident Response and Digital Evidence   Teaching Hours: 15 Hours

Incident Response and First Responder at crime scene – role, toolkit, stages of response, Do's and Don'ts. Types and source of Digital Evidences, Principles for collection of digital evidence, Best Evidence Rule, Forensic Readiness: Planning and Pre-search requirement, Qualities and Ethics of a good forensic investigator, Code of Ethics, benefits and challenges in digital forensics, Search, Seizure Collection and Preservation of Volatile and Non-volatile evidence; Introduction to Imaging, Hashing, Deleted data recovery.

MODULE-3   Introduction to IT Act and Cyber Laws   Teaching Hours: 15 Hours

IT Act 2000 - Objectives, Applicability, Non-applicability, Definitions, Amendments and Limitations; Digital Signature and its legal recognition, Electronic records and their legal recognition, Electronic Evidence, Electronic governance, Controller and Certifying Authorities; Information Technology (Amendment) Act 2008 – Objective, Applicability and Jurisdiction; Various cyber-crimes under Sections 43 (a) to (j), 43A, 65, 66, 66A to 66F, 67, 67A, 67B, 70, 70A, 70B, 80 etc. along with respective penalties, punishment and fines. Penal Provisions for Phishing, Spam, Virus, Worms, Malware, Hacking, Trespass and Stalking; Relevant Sections of Indian Evidence Act.

References and Suggested Readings:

1. Nina Godbole and Sunit Belapore, "Cyber Security: Understanding Cyber-crimes, Computer Forensics and Legal Perspectives", Wiley Publications, 2011.
2. Bill Nelson, Amelia Phillips and Christopher Steuart, "Guide to Computer Forensics and Investigations, 5th Edition", Cengage, 2010 BBS.
3. William Stallings. "Cryptography and Network Security: Principles and Practices, 5th Edition", Prentice Hall Publication Inc., 2007.
4. Majid Yar, "Cybercrime and Society", Sage Publications, 2006.
5. Michael E. Whiteman and Herbert J. Mattord, "Principles of Information Security", Vikas Publishing House, New Delhi, 2003.
6. EC-Council, "Computer Hacking Forensic Investigator v.9".
7. Harish Chander; "Cyber Laws and IT Protection", PHI Learning Pvt. Ltd, 2012.
8. Karnika Seth; "Computers, Internet and New Technology Laws", Lexis Nexis Buttersworth Wadhwa, 2012.

UGFS S5-P3: Forensic Chemistry - II
Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme								
					Theory						Practical		
Th	Tu	Pr	C	TCH	Internal Exams				University Exams		University Exams (LPW)		Total
					TA-1 & TA-2		MSE						
					Marks	Hrs	Marks	Hrs	Marks	Hrs	Marks	Hrs	
3	0	0	3	3	25	00:45	50	01:30	100	03:00	-	-	200

Learning objectives:

After studying this course, the students will be able to explain –

1. The importance of Forensic Chemistry
2. Forensic chemical evidences
3. Significance of chemical evidences in forensic science
4. Petroleum analysis
5. Fire investigation and significance
6. Explosives evidences and investigation.

MODULE-1	Teaching Hours: 15 Hours

Alcoholic Beverages: Forensic Analysis of alcoholic beverages, country made liquor, illicit liquor and medicinal preparations containing alcohol as constituents. Case studies.

Bribe Trap: Examination of Chemicals (Phenolphthalein) used in Bribe trap cases. Case studies.

Inks: Forensic Examination of inks by various techniques, Dating and aging of inks

Polymers: Forensic examination of plastics and Adhesives.

MODULE-2 Food Chemistry	Teaching Hours: 15 Hours

Study of common food adulterants, Analysis of Lipids and fats: Physical examination of lipids, Chemical examination of lipids (Acid value, Saponification value, Ester value, Acetyl value, Iodine value), Test for hydrogenated oils and fats, Detection and Determination of rancidity, Analysis of butter and butter fats, Analysis of adulterated and non-adulterated oils.

Analysis of dairy products: Milk and its products for adulteration.

MODULE-3 Narcotic drugs & and psychotropic substances	Teaching Hours: 15 Hours

Crime scene search for narcotics, drugs and psychotropic substances – Searching a suspect, a dwelling, a vehicle- Clandestine drug laboratories Investigation-Collection and preservation of drug evidence- Testing of narcotics, drugs and psychotropic substances- Isolation techniques for purifying narcotics, drugs and psychotropic substances –Presumptive and screening tests for narcotics, drugs and psychotropic substances-Microcrystalline testing of drugs of abuse.

Suggested Readings:

1. Moffat, A.C.: Osselton, D. M. Widdop, B.: Clarke's Analysis of Drugs and Poisons in Pharmaceuticals, body fluids and postmortem material, 3rd ed., Pharmaceutical Press2004.

2. Bogusz, M. J., Hand Book of Analytical Separations, Vol. 2: Forensic Science, 1st ed., Elsevier Science, 2000.

3. Siegel, J.A., Saukko, P. J., Knupfer, G.,: Encyclopedia of Forensic Sciences (Vol3), Academic Press, 2000.

4. Eckert; An Introduction to Forensic Science, CRC Press

5. James, S. H. and Nordby, J. J.: Forensic Science: An Introduction to Scientific and Investigative Techniques, 2003.

6. Saferstein, R: Criminalistics - An Introduction to Forensic Science, Prentice Hall, 1995.

7. Sarkar, S: Fuels and Combustion, Orient Longman, 1990

8. Verma, R. M: Analytical Chemistry – Theory and Practice, CBS Pub., 1994

9. Svehla, G. Ed.: Vogel's Qualitative Inorganic Analysis, Longman, 1998.

10. Bassett: Vogel's Text Book of Quantitative Inorganic Analysis, Longman, 1978

11. Vogel, A. I: Text Book of Practical Organic Chemistry including Qualitative Organic Analysis, ELBS, 1971.

12. Skoog, D. A., West, D. M. and Holler, F. J: Analytical Chemistry: An Introduction, Saunders College, 1994.

13. Siegel, J. A, Saukko, P. J. and Knupfer, G. C: Encyclopedia of Forensic Sciences, Academic Press, 2000.

14. Townsends, A. (Ed): Encyclopedia of Analytical Science, Academic Press, 2005.

15. Beveridge, A: Forensic Investigation of Explosives, Taylor & Francis, 2000.

16. Yallop, H. J: Explosion Investigation, Forensic Science Society & Scottish Academic Press, 1980.

17. Narayanan, T. V: Modern Techniques of Bomb Detection and Disposal, R. A. Security System, 1995.

18. Yinon, J. and Zitrin, S: The Analysis of Explosives, Oxford: Pergamon, 1981

19. An Introduction to Physics and chemistry of Petroleum

20. Kinghorn: Introduction to Petrochemicals Sukumar Maiti

21. D.W.Waples : Geochemistry in Petroleum Exploration

22. A.L.Waddams : Petroleum Geochemistry and Geology Chemicals from Petroleum

23. Day& Underwood :Analytical Chemistry

24. H. J. Arnikar Essentials of Nuclear Chemistry, 4th Edition Wiley Eastern (1987).

25. 38. H. J. M. Bowen. Buttler and Tanner Chemical Applications of Radioisotopes, (1969).

26. G Friedlander, T. W. Kennedy, E. S. Macias and J. M. Miller, Introduction of Nuclear and Radiochemistry, 3rd Edition, John Wiley (1981).

27. P.D.Vowels and D.W: Experiments in Environmental chemistry.

UGFS S5-P4: Instrumental Techniques-I

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory					Practical		
Th	Tu	Pr	C	TCH	Internal Exams				University Exams	University Exams (LPW)		Total
					TA-1 & TA-2		MSE		Marks	Hrs	Marks	Hrs	
					Marks	Hrs	Marks	Hrs					
3	0	0	3	3	25	00:45	50	01:30	100	03:00	-	-	200

Learning objectives:

1. To know about various microscopes, their parts and working
2. To know about basic analytical techniques
3. To know about pH and buffer systems
4. To learn about various electrophoretic techniques
5. To learn about separation and extraction techniques

MODULE-1	Microscopy	Teaching Hours: 15 Hours

Mirrors & Lenses, Basic principles of microscopy, Simple and Compound microscope, Study of different types of microscopes: Light Microscope & Electron Microscope: Comparison microscope, Phase contrast microscope, Stereoscopic microscope, Polarizing microscope, Fluorescence microscopy, IR microscopy, Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM).

MODULE-2	Teaching Hours: 15 Hours

Biological / Biochemical Analytical Techniques: Introduction to pH, Buffer systems and pH meter, Physiological solution, Theories of Precipitation, Coagulation, Sedimentation & Centrifugation, Different centrifugation techniques: Density Gradient Centrifugation, Differential Centrifugation & Preparative Centrifugation.

Electrophoretic techniques: Zone electrophoresis (ZE), Paper electrophoresis (PE), Classical gel electrophoresis (CGE), Starch gel electrophoresis (SGE), Poly acrylamide gel electrophoresis (PAGE), SDS-PAGE, Isoelectric focusing (IEF) & Two dimensional SDS-PAGE.

MODULE-3	Teaching Hours: 15 Hours

Electromagnetic Spectrum: Electromagnetic radiations, Absorption & Emission Spectra, General properties of electromagnetic radiations: Wave and Quantum mechanical properties, Atomic & molecular spectra, Florescence & Phosphorescence, Jablonski Diagram.

Theoretical Concepts of Separation and Extraction techniques: Adsorption, Absorption & Partition, Partition co-efficient, Solvent extraction and Multiple extraction, Supercritical Fluid Extraction, Accelerated Solvent Extraction, Solid Phase Extraction & Solid Phase Micro

Extraction, Plate theory and concept of theoretical plates with respect to peak width and peak intensity, Rate theory and van Deemter equation, Concept of Retention factor and Retention time.

Reference Books:

1. D.A.Skoog, F.J.Holler and T.A.Neman, Harcoust Principles of Instrumental Analysis college publishers, Singapore
2. G.D.Christian and J.E.O'Reilly, Instrumental Analysis, Allyn and Bacon, Inc., Boston.
3. F.W.Fifield and D.Kealey, Principles and practice of Analytical Chemistry, International Textbook Company, London. SCHOOL OF FORENSIC SCIENCES M. Sc. Forensic Sciences
4. R.P.Bauman, Absorption Spectroscopy, John Wiely, New York.
5. M.Donhrow, Instrumental Methods in Analytical Chemistry; Their Principles and practice Vol.2, optical method, Pitaman, New York.
6. G.G.Guilbanlt, Practical Fluorenscence: Theory, Methods and Practice, Marcel Dekker, New York. 7. S.Udenfriend, Fluorescence Assay in Biology and Medicine, Academic Press, New York.
8. W.J.Price, Spectrochemical Analysis by Atomic Absorption, Hyden, London.
9. R.S.Alger, Electron Paramagnetic Resonance: Techniques and Applications, Interscience, New York.
10. Analytical Chemistry by open Learning, John Wiley & Sons, New York.
11. J.C.Giddings, Dynamics of Chromatography, Marcel Dekker, New York.
12. R.C.Grob, Modern Techniques of Gas Chromatography, Marcel Dekker, New York.
13. J.A.Dean, Chemical Separation Methods, Ban Nostrand Reinhold Co., New York.
14. R.E.Smith, Ion Chromatography Applications, C.R.C. Press, Inc., Boca Raton.
15. R.E.Smith, Supercritical Fluid Technology, C.R.C. Press, Inc., Boca Raton.
16. G.Zweig and J.R.Whitaker, Paper Chromatography and Electrophoresis, Academic Press, New York.
17. Safferstein: Forensic Science Handbook Vol. I, II, III.
18. Lee Honry: An Introduction to Forensic Science
19. Egon Stahl: Thin Layer Chromatography

UGFS S5 CE-3	Core Elective - III	L	T	P	Cr	2	0	0	2

SCHOOL OF FORENSIC SCIENCES

B.Sc.–M.Sc. Forensic Sciences

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(Ministry of Home Affairs, Government of India)

UGFS S5-Pr1: Practical-V

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory				Practical			
					Internal Exams				University Exams		University Exams (LPW)		Total
Th	**Tu**	**Pr**	**C**	**TCH**	TA-1 & TA-2		MSE						
					Marks	Hrs	Marks	Hrs	Marks	Hrs	Marks	Hrs	
0	0	8	4	8							100	6:00	100

Learning Objectives:

At the end of course, students will be gaining the hands on training in the following courses;

MODULE-I	Forensic Anthropology

7. Determination of age from skull and teeth
8. To determine the sex from skull.
9. To determine sex from pelvis.
10. To study identification and description of bones and their measurements.
11. To investigate the differences between animal and human bones.
12.

MODULE-2	Digital Forensics & Cyber Law

1. Acquisition and Preservation of Volatile data from standalone computer.
2. Hash Calculation the files using different algorithms.
3. Recovery of Deleted Files and Folders
4. Imaging of data storage media using different file formats
5. Recovery Password from the protected word, pdf and rar files.

MODULE-3	Forensic Chemistry-II

1. To carry out qualitative test of ethyl alcohol.
2. To perform confirmatory test for ethyl alcohol and methyl alcohol
3. To identify drugs of abuse by spot tests.
4. To perform TLC of drugs of abuse
5. To carry out qualitative test for bribe trap by UV and TLC
6. To perform microcrystalline tests for drugs of abuse.
7. To study the case and prepare a report on clandestine drug investigation.
8. To study the case and prepare a report on narcotic drugs investigation.

MODULE-4	Instrumental Techniques-I

1.   To study the Parts of Compound Microscope

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2.   Preparation of buffer
3.   pH metric titration of strong acid vs. strong base and weak acid vs. strong base.
4.   Extraction of plant-based drugs by Soxhlet.
5.   To understand & perform calibration of the instrument

SEMESTER-VI

UGFS S6-P1: Forensic Physics - II

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory					Practical		
					Internal Exams				University Exams	University Exams (LPW)		Total
Th	Tu	Pr	C	TCH	TA-1 & TA-2		MSE					
					Marks	Hrs	Marks	Hrs	Marks	Hrs	Marks	Hrs	
3	0	0	3	3	25	00:45	50	01:30	100	03:00	-	-	200

Learning Objectives:

After studying this course, the students will be able to explain –

1. Tool marks, Tyre marks, Foot print, Lip and Ear print, and their nature in forensic science
2. Fiber evidences
3. Restoration of erased marks

MODULE-1 Tool Mark & Fiber Evidence	Teaching Hours: 15 Hours

Introduction to tool marks, Types of tool marks, Class characteristics and individual characteristics of tool marks, Collection and Preservation of tool marks, Forensic examination of tool marks, Case Studies.

Fibre evidence – artificial and man-made fibres. Collection of fibre evidence. Identification and comparison of fibres. Cloth evidence – importance, collection, analysis of adhering material. Matching of pieces.

MODULE-2 Restoration of erased marks & Bite marks	Teaching Hours: 15 Hours

Erased marks:

Principle of restoration of erased marks, Techniques involved for alteration of individual markings, Restoration of erased and obliterated marks on various surfaces, Photography and Forensic assessment of methods for restoration of obliterated marks, case studies.

Bite marks:

Objectives and forensic importance of bite-mark examination, the typical bite marks morphology, types of bite marks, Evidence collection from victims and suspects, Photography, lifting, preservation of bite marks, casting of bite marks, Identification and comparison of bite marks, Case Studies.

MODULE-3 Tyre Prints and Impressions	Teaching Hours: 15 Hours

Tyre Impressions:

Introduction to tire impressions, Collection and Preservation of the tire impression evidence, Forensic Significance of skid marks, Forensic Examination for identification and comparison, Case Studies.

Footprints & Shoe impression examination:

Introduction to footprints & Shoe impression, locating impressions at the scene of crime, Evidence collection: Collection, Lifting/Casting and Preservation of foot/footwear impressions, importance of Gait pattern, Forensic Identification and Methods of comparison, Case Studies.

Lip print:

Introduction to Cheiloscopy and history of lip prints, Classification of lip prints, Collection, Development, Identification and Comparison of lip prints.

Ear Prints:

Introduction to the history of ear prints, Morphology of the ear, Procedure of taking standards from the suspects, Identification and comparison of ear prints.

References and Suggested Readings:

1. Forensic Science Evidence: Can the Law Keep Up With Science (Criminal Justice: Recent Scholarship by Donald E. Shelton
2. M. Byrd, *Crime Scene Evidence: A Guide to the Recovery and Collection of Physical Evidence*, CRC Press, Boca Raton (2001).
3. 2. T.J. Gardener and T.M. Anderson, *Criminal Evidence*, 4th Ed., Wadsworth, Belmont (2001).
4. 3. S.H. James and J.J. Nordby, *Forensic Science: An Introduction to Scientific and Investigative Techniques*, 2nd Edition, CRC Press, Boca Raton (2005).
5. 4. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's, *Techniques of Crime Scene Investigation*, CRC Press, Boca Raton (2013).

UGFS S6-P2: Information Security Audit and Compliance

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory					Practical		
					Internal Exams				University Exams	University Exams (LPW)		Total
Th	Tu	Pr	C	TCH	TA-1 & TA-2		MSE		Marks	Hrs	Marks	Hrs	
					Marks	Hrs	Marks	Hrs					
3	0	0	3	3	25	00:45	50	01:30	100	03:00	-	-	200

Learning Objectives: After studying this paper, the students would be able to:

1. Understand the various concepts of information security, risks, threats and vulnerabilities.
2. Understand the various policy standards, baselines, and classification of information assets.
3. Get familiar with the concepts of risk management and other security technologies like firewalls, VPNs, Honeypots, IPS and IDS.
4. Comprehend the techniques for implementing information security and its subsequent management.

MODULE-1	Introduction to Information Security	Teaching Hours: 15 Hours

Basics of Information Security – CIA Triad, Threats and vulnerabilities, Policy standards, Procedures, Guidelines and Baselines, Information Asset Classification: Classification of Information, Information Assets - Owner, Custodian, User Access Control, Authentication and Authorization; System Development Lifecycle and SSDLC -Investigation, Analysis, Logical and Physical Design, Implementation and security; CCNS Security Model; Attacks: Malicious code, Backdoors, Password crack.

MODULE-2	Risk Management and Security Technologies	Teaching Hours: 15 Hours

Overview of Risk, Risk Identification- asset identification and recovery, Information Asset valuation, Vulnerability and Threat identification; Risk Assessment- likelihood, risk determination, Identification of controls, documentation; Risk Control Strategies- defend, transfer, mitigate, accept and terminate; Cost Benefit Analysis (CBA), Quantitative v/s Qualitative Risk Control Practices.

Access Controls- identification, authorization, authentication and accountability; Firewalls- processing modes, types, generations, configuration and content filters; Remote Access and VPNs; Intrusion Detection and Prevention System (IDPS)- types, Detection methods, Response behaviour, approaches, strengths and limitations, deployment and effectiveness measurement; Honeypots and Honeynets, Scanning and Analysis Tools- ports scanners, firewall analysis tools, operating system detection tools, vulnerability scanners and packet sniffers; Biometric Access Controls.

MODULE-3   Security Planning, Implementation and Maintenance   Teaching Hours: 15 Hours

Information Security Planning and Governance, IS Policies- EISP, ISSP, SysSP, policy management; NIST Security Models, IETF Security Architecture, Baselining and Best Business Practices, Security Education, Training and Awareness Program; Business Impact Analysis, Incident Response Planning, Disaster Recovery Planning, Crisis Management.

Information Security Project Management, Conversion Strategies and Bull's Eye Model, Consideration for Organizational Change, Information Systems Security Certification and Accreditation- certification vs accreditation, NIST SP 800-37, National Information Assurance Certification and Accreditation Process (NIACAP), ISO 27001/27002 system certification and accreditation; Security Management Maintenance Models- NIST SP 800-100, Security Maintenance Model, Monitoring Internal and External Environment, Vulnerability Assessment and Remediation; Digital Forensics- The team, methodology.

References and Suggested Readings:

1. Michael E. Whiteman and Herbert J. Mattord, "Principles of Information Security", Vikas Publishing House, New Delhi, 2003.
2. William Stallings. "Cryptography and Network Security: Principles and Practices, 5th Edition", Prentice Hall Publication Inc., 2007.
3. Majid Yar, "Cybercrime and Society", Sage Publications, 2006.
4. EC-Council, "Computer Hacking Forensic Investigator v.9".
5. Atul Kahate, "Cryptography and Network Security", 3rd Edition, McGraw Hill Education (India) Pvt. Ltd., New Delhi, 2009.

UGFS S6-P3: Basics of Immunology and Forensic Serology

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory					Practical		
					Internal Exams				University Exams	University Exams (LPW)		Total
Th	Tu	Pr	C	TCH	TA-1 & TA-2		MSE					
					Marks	Hrs	Marks	Hrs	Marks	Hrs	Marks	Hrs	
3	0	0	3	3	25	00:45	50	01:30	100	03:00	-	-	200

Learning objectives:

At the end of this course, students will be able to explain;

1. The significance of serological evidence.
2. The importance of biological fluids-blood, urine, semen, saliva, sweat and milk-in crime investigations.
3. The usefulness of genetic markers in forensic investigations.
4. The forensic importance of bloodstain patterns.

MODULE-1   Immunology   Teaching Hours: 15 Hours

Introduction and history of Immunology, Innate and Acquired immunity

Antigen – Epitope, essential factors for antigenicity, haptens and adjuvant.

Antibody: structure and function, antigenic determinants on immunoglobulins, isotypic, allotypic and ideotypic variants, antigen and antibody interactions, and their importance.

Major histocompatibility complex and their importance in Forensics, Antigen Processing and presentation. Generation of humoral and cell mediated immune responses, B-cell receptor, T-cell receptor, Cytokines and their role in immune regulation.

MODULE-2   Basics of Serology   Teaching Hours: 15 Hours

Blood and its composition, Haemoglobin and its variants, History and genetics of ABO and Rh blood grouping system and its significance in forensic investigation, Other forensically relevant blood group like MN, I, P, Kell, Duffy, Kidd, Lewis, Lutheran and Bombay blood group, Secretors and non- secretors, HLA antigens and its importance.

MODULE-3   Forensic Identification of Biological Fluids   Teaching Hours: 15 Hours

Study of blood stain patterns, Composition, presumptive and confirmatory tests for blood, semen, saliva, urine, and other biological fluids, origin of species, Blood grouping of dried blood stains, semen, saliva stains (Absorption, Elution, Absorption Inhibition method, and mixed

agglutination), Recent developments in detection of various body fluids by spectroscopic techniques (FTIR and Raman). Polymorphic enzymes and their forensic significance.

Reference Books:

1.The examination and Typing of Blood Stains in the crime laboratory – B J Culliford, U. S. Dept. of Justice, Washington D. C.

2. Blood Group Serology – Boorman KE, Dodd BE and LOncoln PJ, Chuchill Livingstone Inc. New York.

3. Laboratory Procedure Manual - Forensic Serology (2005), Directorate of Forensic Science, MHA, New Delhi.

4. Laboratory Procedure Manual – DNA Profiling (2005), Directorate of Forensic Science, MHA, New Delhi.

5. Molecular Biology of the Cell, 6th Edition (2014) – Bruce Alberts, et al., Garland Science, ISBN: 978-0815341055.

6. Forensic DNA Typing, Second Edition: Biology, Technology, and Genetics of STR Markers 2nd Edition (2005) - John M. Butler, Academic Press, ISBN:0121479528.

7. Forensic Science: An Introduction to Scientific and Investigative Techniques – StuartH. James, Jon J. Nordby, CRC Press, ISBN:0849327474.

8. An Introduction to Forensic Genetics 2ndEdition (2010) - William Goodwin, Adrian Linacre and SibteHadi, Wiley-Blackwell, ISBN: 978-0470710197.

UGFS S6-P4: Instrumental Techniques - II

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme						
					Theory				Practical		
					Internal Exams			University Exams	University Exams (LPW)		Total
Th	Tu	Pr	C	TCH	TA-1 & TA-2		MSE				
					Marks	Hrs	Marks	Hrs	Marks	Hrs	Marks	Hrs	
3	0	0	3	3	25	00:45	50	01:30	100	03:00	-	-	200

Learning objectives:

1. To learn about various spectroscopic techniques
2. To learn about various chromatographic and hyphenated techniques
3. To learn about various elemental techniques.

MODULE-1	Spectroscopic Techniques	Teaching Hours: 15 Hours

UV-Visible spectroscopy: Theory, Instrumentation and Applications; Infrared Spectroscopy: Molecular vibration, Theory of IR absorption, IR Sources and Instrumentation, FT-IR Applications; Raman Spectroscopy: Theory of Raman spectroscopy, Instrumentation and Applications. Differences & Similarities between Raman & IR spectroscopy. FT-NIR spectroscopy: Theory, Instrumentation & Applications, Neutron Magnetic Resonance: Theory, Instrumentation & Application, Mass Spectrometry: Theory, Instrumentation and Applications.

MODULE-2	Chromatographic Techniques	Teaching Hours: 15 Hours

Introduction to Chromatography: Partition, Adsorption, Ion exchange, Affinity Chromatography, Size Exclusion Chromatography, their principle and types of chromatography. Forensic applications of Chromatography.

Gas Chromatography: Principle, instrumentation and applications. Gas-liquid and gas-solid chromatography, GC – MS, GC – MS – MS (Tandem).

Gas Chromatography – Head Space: Principle, instrumentation and applications.

High Performance Liquid Chromatography: Principle, instrumentation and applications, LC – MS, LC – MS – MS (Tandem).

MODULE-3	Elemental Techniques	Teaching Hours: 15 Hours

Atomic Absorption Spectroscopy: Theory, Instrumentation and Applications.

Atomic Emission Spectroscopy: Theory, Instrumentation and Applications.

ICP-OES: Theory, Instrumentation and Applications.

ICP-MS: Theory, Instrumentation and Applications.

X-Ray Spectroscopy: Theory, Types, Instrumentation and Applications.

EDXRF: Theory, Instrumentation and Applications.

Reference Books:
1. D.A.Skoog, F.J.Holler and T.A.Neman, Harcoust Principles of Instrumental Analysis college publishers, Singapore
2. G.D.Christian and J.E.O'Reilly, Instrumental Analysis, Allyn and Bacon, Inc., Boston.
3. F.W.Fifield and D.Kealey, Principles and practice of Analytical Chemistry, International Textbook Company, London. SCHOOL OF FORENSIC SCIENCES M. Sc. Forensic Sciences
4. R.P.Bauman, Absorption Spectroscopy, John Wiely, New York.
5. M.Donhrow, Instrumental Methods in Analytical Chemistry; Their Principles and practice Vol.2, optical method, Pitaman, New York.
6. G.G.Guilbanlt, Practical Fluorenscence: Theory, Methods and Practice, Marcel Dekker, New York. 7. S.Udenfriend, Fluorescence Assay in Biology and Medicine, Academic Press, New York.
8. W.J.Price, Spectrochemical Analysis by Atomic Absorption, Hyden, London.
9. R.S.Alger, Electron Paramagnetic Resonance: Techniques and Applications, Interscience, New York.
10. Analytical Chemistry by open Learning, John Wiley & Sons, New York.
11. J.C.Giddings, Dynamics of Chromatography, Marcel Dekker, New York.
12. R.C.Grob, Modern Techniques of Gas Chromatography, Marcel Dekker, New York.
13. J.A.Dean, Chemical Separation Methods, Ban Nostrand Reinhold Co., New York.
14. R.E.Smith, Ion Chromatography Applications, C.R.C. Press, Inc., Boca Raton.
15. R.E.Smith, Supercritical Fluid Technology, C.R.C. Press, Inc., Boca Raton.
16. G.Zweig and J.R.Whitaker, Paper Chromatography and Electrophoresis, Academic Press, New York.
17. Safferstein: Forensic Science Handbook Vol. I, II, III.
18. Lee Honry: An Introduction to Forensic Science
19. Egon Stahl: Thin Layer Chromatography.

UGFS S6 CE-4	Core Elective - IV	L	T	P	Cr	2	0	0	2

UGFS S6-Prl: Practical-VI

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory					Practical		
Th	**Tu**	**Pr**	**C**	**TCH**	Internal Exams				University Exams	University Exams (LPW)		**Total**
					TA-1 & TA-2		**MSE**		**Marks**	**Hrs**	**Marks**	**Hrs**
					Marks	**Hrs**	**Marks**	**Hrs**				
0	0	8	4	8							100	6:00	100

Learning Objectives:

At the end of course, students will be gaining the hands on training in the following courses;

MODULE-I	Forensic Physics-II

Practical:

1. To identify and compare tool marks.
2. To compare cut or torn cloth samples by physical matching.
3. Casting of foot and tyre impressions
4. Identification and comparison of ear prints and lip prints
5. Casting of bite marks
6. Development of latent foot marks

MODULE-2	Information Security Audit and Compliance

1. Secure configuration of ports and services of windows system
2. Encrypting and Decrypting the partition using Bit Locker
3. Creating sandbox and honeypots for analysis of malwares
4. Vulnerability scanning using different tools
5. Creating different rules and Configuring firewall

MODULE-3	Basics of Immunology and Forensic Serology

1. Physical, biochemical and spectrophotometric examination of blood stains.
2. Examination of seminal stains by crystal tests, biochemical and microscopical analysis.
3. Examination of saliva and its stains.
4. Biochemical and microscopic examination of urine.
5. Determination of origin of species from biological fluids.
6. Blood group typing of biological fluid stains by absorption elution, absorption inhibition and mixed agglutination techniques.
7. Isolation of DNA from blood and its quantification.
8. Collection and extraction of DNA using FTA card.

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MODULE-4	Instrumental Techniques-II

1. UV-Visible spectroscopic determination of chemical dyes of forensic importance
2. To understand and perform quantitation by calibration graph method, internal standard method and standard edition method with the help of any one pharmaceutical drugs.
3. Validation of a method (drugs, pesticide) by anyone instrumental technique

SEMESTER-VII

Specialization-1

"Forensic Physics
&
Ballistics"

UGFS S7-SP 1-P1: Lasers and Spectroscopy

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory					Practical		
					Internal Exams				University Exams	University Exams (LPW)		Total
Th	Tu	Pr	C	TCH	TA-1 & TA-2		MSE					
					Marks	Hrs	Marks	Hrs	Marks	Hrs	Marks	Hrs	
3	0	0	3	3	25	00:45	50	01:30	100	03:00	-	-	200

Learning Objectives:

At the end of this course, students will be able to explain;

1. Light sources and basic components of optical spectrometer
2. Light detectors and Gratings
3. Vacuum pumps and gauges
4. Optical fibers
5. Spectroscopic techniques and their application

MODULE-1   Basic components of optical spectroscopy   Teaching Hours: 15 Hours

Light sources and spectrometer: CW & pulsed light sources (Lasers), Sodium lamp, a brief review of Lasers, Q-switching and Mode locking to generate short and ultra-short laser pulses, Laser output profile. Prisms and gratings, Czerny-Turner Spectrometer/ Monochromator, Resolution and dispersion of Prism and grating spectrometer, Charge Coupled Devices (CCD), Photodiodes and Photomultiplier tubes.

MODULE-2   Vacuum Science and Optical Fibre   Teaching Hours: 15 Hours

Vacuum Science and Technology: Types of Vacuum and different flow regimes, Conductance, pumping speed and Throughput, Creation of vacuum: Vacuum pumps, Rotary vane pump and Turbo-molecular pump, measuring the vacuum: Pirani and Penning gauges, Vacuum chamber and their components, Requirement of vacuum for an experiment (e.g. CRT, Fragmentation studies of a molecule etc.).

Optical Fibers: Advantages of optical fiber communication over normal medium, Step index and graded-index fibers, Numerical aperture, single mode and multimode fiber. Relative refractive index, losses in optical fiber communication.

MODULE-3   Spectroscopic Techniques   Teaching Hours: 15 Hours

Absorption and emission spectroscopy, Raman Spectroscopy and its application. Principle of Fourier Transform Infrared (FTIR) spectroscopy, Fluorescence spectroscopy, Laser Induced Breakdown Spectroscopy, Application of laser spectroscopy.

Reference books:

1. Laser Fundamentals, William T. Silfvast, 2008, Cambridge University Press.
2. Laser Spectroscopy 1: Basic Principles, Wolfgang Demtröder, 2014, 5th edition, Springer.
3. Laser Spectroscopy 2: Experimental Techniques, Wolfgang Demtröder, 2016, 5th edition, Springer.
4. Vacuum Physics and Techniques, T. A. Delchar, Chapman and Hall.
5. Introduction to Fibre Optics, A. K. Ghatak & K. Thyagarajan, 1998, Cambridge University Press.

UGFS S7-SP 1-P2: Advancement in Forensic Ballistics and Armour Material

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory					Practical		
					Internal Exams				University Exams	University Exams (LPW)		Total
Th	Tu	Pr	C	TCH	TA-1 & TA-2		MSE					
					Marks	Hrs	Marks	Hrs	Marks	Hrs	Marks	Hrs	
3	1	0	4	4	25	00:45	50	01:30	100	03:00	-	-	200

Learning objectives:

At the end of this course, students will be able to explain;

1. The classification of firearms and their firing mechanisms.
2. The methods of identifying firearms.
3. The characteristics of ammunition.
4. The importance of firearm evidence.
5. The nature of firearm injuries.
6. The methods for characterization of gunshot residue.

MODULE-1   Ballistics & its forensic aspects   Teaching Hours: 15 Hours

Introduction to forensic ballistics, Arms Act, Classification of firearms, firing mechanism, measurement of strength of barrel, trigger pull, assembling and dismantling of firearms, Ammunition and its types, safety aspects for handling of firearm and ammunition.

Concepts of Internal Ballistics, various factors affecting the internal ballistics, Theory of recoil and its measurement

MODULE-2   Core concepts of External & Terminal Ballistics   Teaching Hours: 15 Hours

Principles of external ballistics, Trajectory Formation & its computation, effect of air resistance on trajectory, Angle of Fall, Influence of Earth on Trajectory, base drag, yaw, shape of projectile and stability, ballistics coefficient and limiting velocity, Ballistics tables, measurements of trajectory parameters, Escape velocity & Ricochet.

Effect of projectile on hitting the target, Ricochet and its effects, stopping power of the bullet, Introduction to wound ballistics & its forensic significance, nature of wounds and injuries, Determination of nature, range and time of firing, GSR analysis

MODULE-3   Instrumental techniques used for ballistic evidence analysis   Teaching Hours: 15 Hours

Bore scope, Comparison Microscope, Stereo microscope, travelling microscope, Scanning Electron microscope, EDXRF, BDAS, IBIS, Management and reconstruction of cases involving firearm; Report writing and court findings

Principles and practice of identification of origin of ammunition and their components, purpose and procedure for test firing.

Reference Books:

1. J. Howard Mathews; Charles C. Thomas, Firearms Identification, Vols 1,2,& 3; Springfield, Illinois;
2. Hatcher, Jury And Weller, Firearms Investigation, Identification And Evidence; Stackpole Books, Harrisburg, P A
3. Vincent Di Maio, Gunshot Wounds; Crc Press, Washington, Dc;
4. Brain J. Heard;, Hand Book Of Firearms And Ballistics; John Willey, England;
5. TA, Warlow; Firearms, The Law And Forensic Ballistics; Taylor And Francis, Landon;
6. Karl G. Sellier et al ; Wound Ballistics And The Scientific Background; Elsevier, London
7. M. Johari, Identification Of Firearms, Ammunition And Firearms Injuries; BPR&D, New Delhi;
8. L V. Hogg; The Cartridges Guide - A Small Arms Ammunition Identification Manual; The Stackpole Co., Harrisburg, P A
9. Gary J. Ordog, Management Of Gunshot Wounds, Elsevier, New York
10. Working Procedures Manual: Ballistics, BPR&D Pub.
11. S.K.Sharma, cyber laws and crime.
12. Fry & Nystron,security monitoring, O. reilly
13. Tipton Krause, Information security management, Aner Bach
14. Schneiner, hacking the code, Syngrers.

UGFS S7-SP 1-P3: Audio and Video Analysis

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory					Practical		
					Internal Exams				University Exams	University Exams (LPW)		Total
Th	Tu	Pr	C	TCH	TA-1 & TA-2		MSE					
					Marks	Hrs	Marks	Hrs	Marks	Hrs	Marks	Hrs	
3	1	0	4	4	25	00:45	50	01:30	100	03:00	-	-	200

Learning objectives:
At the end of this course, students will be able to explain;

1. Voice identification, handling of audio recording evidences and speaker profiling
2. The authenticity of audio recordings
3. Video/image analysis and CCTV analysis
4. Biometric Analysis for Identification of Individual

MODULE-1   Introduction to voice identification/speaker recognition. Teaching Hours: 15 Hours

Introduction to voice identification/speaker recognition and its forensic importance, History of voice analysis, Voice production and its uniqueness, collection of standards for comparison, handling of audio recording evidences & its physical examination, Components of speaker recognition- feature extraction, pattern matching and comparison, normalization techniques, speaker profiling, enhancement of speech signal/audio recordings, establishing the authenticity and integrity of audio recordings.

MODULE-2   Approaches to speaker recognition   Teaching Hours: 15 Hours

Approaches to speaker recognition, phonetic Transcription, linguistic & phonetic analysis, acoustic parameters for examining speech samples, Fourier analysis, frequency & time domain representation of speech signal, analogue to digital conversion

Alcohol speech relationships, Techniques used in forensic audio/voice examination and analysis

Report writing, Limitations, Precautions, Related Case Studies and its admissibility in court proceedings

MODULE-3   Video/Image analysis   Teaching Hours: 15 Hours

Concepts of Video/Image analysis, establishing the authenticity of video/image files, Processing of video/image evidences, Enhancement techniques, Specific frame analysis, technical

parameters of video/image, Biometric Analysis for Identification of Individual, Scope & its forensic application in the field of security, CCTV analysis

Related Case Studies and its admissibility in court proceedings.

Reference books:

1. Forensic Speaker Identification by Phil Rose & James R Robertson
2. Forensic Voice Identification by Harry Hollien
3. The Acoustic Analysis of Speech by Ray D Kent & Charles Read
4. Speech Language & Hearing Disorders by Franklin H Silverman
5. Voice Recognition by Richard L Klevans & Robert D Rodman
6. Multimedia Forensics and Security: Foundations, Innovations, and Applications by Mohamed Mostafa Fouad et al
7. Multimedia Forensics and Security by Chang-Tsun Li
8. Intelligent Video Surveillance Systems by Jean-Yves Dufour
9. Digital Image Processing by Rafael Gonzalez & Richard Woods
10. Digital Image forensics by Roy, A. et al

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(Ministry of Home Affairs, Government of India)

UGFS S7-SP 1-P4: **Research Methodology**

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme								
					Theory							Practical	
					Internal Exams				University Exams		University Exams (LPW)		Total
Th	Tu	Pr	C	TCH	TA-1 & TA-2		MSE		Marks	Hrs	Marks	Hrs	
					Marks	Hrs	Marks	Hrs					
3	1	0	4	4	25	00:45	50	01:30	100	03:00	-	-	200

Learning objectives:

At the end of this course, students will be able to explain;

1. Literature review
2. The development of a research plan
3. Data collection, interpretation and errors
4. Important components for writing the research paper and thesis
5. Basics of Ethical issues, Intellectual property rights, Copy right

MODULE-1   Basics of research   Teaching Hours: 15 Hours

Objectives and types of research: Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, and Conceptual vs. Empirical. Research Formulation, Literature review and Development of hypothesis. Research design and methods, developing a research plan - Exploration, Description, Diagnosis, and Experimentation. Determining experimental and sample designs.

MODULE-2   Data analysis methods   Teaching Hours: 15 Hours

Data Collection and analysis: Methods of data collection – Sampling Methods and Data Processing. Data Analysis: Types of data, Basic concept of frequency distribution, measure of central values – Mean, median and mode, measure of dispersion, range, mean deviation and standard deviation, probability, theory and classical definition of probability, Bayes theorem of probability, conditional probability and coincidence probability, Chi-square test, ANOVA, SPSS. Types of Errors and Interpretation of Findings

MODULE-3   Scientific reports and thesis writing   Teaching Hours: 15 Hours

Reporting and thesis writing: Structure and components of scientific reports and thesis, Significance and Different steps in the preparation, Illustrations, Bibliography. Presentations: Oral and Poster, Importance of effective communication in scientific research.

Basics of Ethical issues, Intellectual property rights, Copy right, Reproduction of published material: Plagiarism in scientific research and communications.

Reference books:

1. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International.

2. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, EssEss Publications. 2 volumes.

3. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.

4. Wadehra, B.L. 2000. Law relating to patents, trade marks, copyright designs and geographical indications. Universal Law Publishing.

5. Anthony, M., Graziano, A.M. and Raulin, M.L., 2009. Research Methods: A Process of Inquiry, Allyn and Bacon.

6. Carlos, C.M., 2000. Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options. Zed Books, New York.

7. Leedy, P.D. and Ormrod, J.E., 2004 Practical Research: Planning and Design, Prentice Hall. 12. Satarkar, S.V., 2000. Intellectual property rights and Copy right. EssEss Publications.

UGFS S7 CE-5	Core Elective - V	L	T	P	Cr	2	0	0	2

UGFS S7-SP1-Pr1: Practical-VII

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory						Practical	
					Internal Exams				University Exams		University Exams (LPW)		Total
Th	**Tu**	**Pr**	**C**	**TCH**	TA-1 & TA-2		MSE						
					Marks	**Hrs**	**Marks**	**Hrs**	**Marks**	**Hrs**	**Marks**	**Hrs**	
0	0	8	4	8							100	6:00	100

Learning Objectives:

At the end of course, students will be gaining the hands on training in the following courses;

MODULE-I	Lasers and Spectroscopy

List of Practical:

1. Measurement of wavelength of laser using diffraction grating.
2. Measurement of the Prism angle, Angle of minimum deviation and Refractive index of a prism using spectrometer.
3. To determine the Resolving Power of a Prism.
4. Determination of Numerical Aperture of given optical fibre and find its acceptance cone.
5. Determine the wavelength of Sodium light using diffraction grating.

MODULE-2	Advancement in Forensic Ballistics and Armour Material

1. Characteristics of Firearms-Caliber, Choke, Trigger pull, and Proof marks.
2. Examination and comparison of fired bullet with reference to caliber, rifling characteristics, and identification of firearm
3. Examination and comparison of fired cartridge case with reference to caliber, firing pin, breech face, chamber indentations, extraction, and ejector marks by comparison microscope
4. Determination of shot numbers from size and weight of shots
5. Identification of propellants
6. Chemical tests for powder residue and barrel wash
7. Instrumental examination of GSR

MODULE-3	Audio and Video Analysis

1. Recording, editing, processing, and conversion of audio files using Goldwave v 5.63 software.
2. Speech acquisition and analysis of speech samples using CSL-4500 and Multispeech software.
3. Detection of tampering in audio files, audio restoration and speech enhancement using CEDAR Cambridge™.
4. Working procedure of SIS.
5. Working procedure of Voice net software.
6. Video analysis and detection of tampered video files using Video focus.

MODULE-4	Research Methodology

1. Calculation of mean, median and mode
2. Calculation of standard deviation
3. Calculation of variance
4. Perform chi square test on a given set of data
5. Perform T-test and student's T-test on a given set of values

Specialization-2

"Fingerprints and Questioned Documents"

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UGFS S7-SP 2-P1: Advanced Fingerprint Technologies

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme								
					Theory						Practical		
Th	Tu	Pr	C	TCH	Internal Exams				University Exams		University Exams (LPW)		Total
					TA-1 & TA-2		MSE		Marks	Hrs	Marks	Hrs	
					Marks	Hrs	Marks	Hrs					
3	1	0	4	4	25	00:45	50	01:30	100	03:00	-	-	200

Learning objectives:

At the end of this course, students will be able to explain;

1. Basics of fingerprint development techniques
2. Significance of ridgeology and poroscopy

MODULE-1   Advanced Fingerprint Development Techniques   Teaching Hours: 15 Hours

Development of fingerprint from porous surfaces
- Development of fingerprint from non-porous surfaces
- Development of fingerprint from nanoparticles
- Molecular finger print residues found on various substrates

MODULE-2 Introduction & Importance of ridgeology and poroscopy   Teaching Hours: 15 Hours

For individual identification. Application of the pores dimensions and ridge dimensions in the identification- scope of establishing the identification – characteristics and traits. Application of edgeoscopy- personal identification using fingerprints.

MODULE-3   Teaching Hours: 15 Hours

Automated fingerprint Identification and imaging systems

Reference Books:

1. David R. Ashbaugh; Quantitative and Qualitative Friction Ridge Analysis, CRC Press (1999)
2. E. Roland Menzel; Fingerprint Detection with Lasers, 2nd Ed., Marcel Dekker, Inc. USA (1999)
3. James F. Cowger; Friction Ridge skin, CRC Press London, (1993)
4. Mehta, M.K; Identification of Thumb Impression & Cross Examination of Finger Prints, N.M. Tripathi Pub. Bombay (1980)
5. Moenssens; Finger Prints Techniques, Chitton Book Co. Philadelphia, NY (1975)

6. Chatterjee S.K.; Speculation in Finger Print Identification, Jantralekha Printing Works, Kolkata (1981)

7. Cowger, James F; Friction ridge skin- Comparison and Identification of fingerprints, CRC Press, NY (1993)

8. Cook Nancy; Classifying Finger Prints, Innovative learning pub. Mento Park (1995)

9. Cossidy M.J; Footwear Identification, Royal Canadian Mounted Police, Ontario, Canada (1980)

10. J A Seigel, P.J Saukoo and G C Knupfer; Encyclopedia of Forensic Sciences Vol. I, II and III, Acad. Press (2000)

11. Smith B.C, Holland MM, Sweel DL & Dizinno. A; DNA & Forensic Odontology- Manual of Forensic Odontology, Colorado Springs, USA (1995)

12. Hillison, S; Dental Anthropology, Cambridge Univ. Press, UK (1996)

13. Kasprzak J; Possibilities of Cheiloscopy in Forensic Science (1980)

14. Iannarelli, A V; Ear Identification, Forensic Identification series, Paramount (1989).

15. Henry C. Lee & R. E. Ganesslen; Advances in Finger Print Technology, CRC Press, London (1991). 16. Saxena, B.L.; Law and techniques relating to identification of handwriting, disputed documents, finger prints, foots and detection of forgeries, Central Law Agency, Allahabad (1990)

17. Hardless, H.R; Disputed documents examination and fingerprints Identification (with Illustrations, Sketches, Diagrams, Photos etc), Law Book Co. Allahabad (1995)

18. Menzel, E Roland; Fingerprint detection with lasers, Marcel Dekker, NY (1999)

19. Jain L C; Intelligent Biometric Techniques in Fingerprint and face recognition, CRC Press Ohio (1999)

20. Bridges B C; Criminal Inverstigation, Practical fingerprinting, Thumb Impressions, Hand writing expert testimony opinion Evidence, University Book Agency, Allahabd (2000)

21. Maltoni, Davide; Handbook of fingerprint recognition, Springer Verlag, NY (2003)

22. Ratha Nalini; Automatic Fingerprint recognition system, Springer Pub., NY (2004)

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An Institution of National Importance
(Ministry of Home Affairs, Government of India)

UGFS S7-SP 2-P2: Advances in Forensic Document Examination

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory					Practical		
					Internal Exams				University Exams	University Exams (LPW)		Total
Th	Tu	Pr	C	TCH	TA-1 & TA-2		MSE					
					Marks	Hrs	Marks	Hrs	Marks	Hrs	Marks	Hrs	
3	1	0	4	4	25	00:45	50	01:30	100	03:00	-	-	200

Learning objectives:

At the end of this course, students will be able to explain;

1. The basics of forensic document examination
2. Examination of alterations in documents
3. Forensic examination of different types of documents

MODULE-1 Basics of Document and handwriting examination. Teaching Hours: 15 Hours

Roles of Forensic Document Examiner, Scope of document examination, basic tools needed for forensic documents examination and their significance, Types of documents for examination, Care and Handling of Document Exhibits, Individuality in handwriting, natural variations, tremors in handwriting, handwriting comparison, Basics of Forensic linguistics and stylistics, its importance in writer identification.

MODULE-2 Examination of special class of writings and impressions. Teaching Hours: 15 Hours

Disguised writing and anonymous letters, Examination of alterations in documents, Examination, preservation and decipherment of secret writing, Indented writings and charred writings, seal and other mechanical impressions, Forgeries & amp; its types, related case studies, Determination of age of document and writings, reporting of the cases and related case studies.

MODULE-3 Forensic Examination of different types of Document   Teaching Hours: 15 Hours

Examination of Photostat (Xerox) copies, carbon copies, fax message, type writings, printed matter, Examination of e-documents & amp; digital signature, counterfeit currency notes, passports, visa, credit cards, debit cards, legal deeds, postal stamps, etc, Related Case Studies.

Types of computer printers and their working: dot-matrix, daisywheel, line printers, ink-jet, thermal jet and laser printers, Examination of Computer printouts.

References:

1. Koppenhaver, K. (2010). Forensic Document Examination: Principles and Practice (1 st Ed.).

2. 2. Osborn, A. (1929). Questioned documents. 2d. ed (1st ed.). Albany, N.Y.: Boyd printing Company.

3. Hilton, O. (1993). Scientific examination of questioned documents (1st ed.). Boca Raton:CRC Press.

4. Harrison, W. (1958). Suspect documents.

5. Kelly, J., & Lindblom, B. (2006). Scientific examination of questioned documents. Boca Raton, FL: CRC/Taylor & Francis.

6. Ellen, D. (2006). Scientific examination of documents. Boca Raton, FL: Taylor & Francis.

7. Huber, R., & Headrick, A. (1999). Handwriting identification (1st ed.). Boca Raton: CRC Press.

SCHOOL OF FORENSIC SCIENCES

B.Sc.–M.Sc. Forensic Sciences

National Forensic
Sciences University
Knowledge | Wisdom | Fulfilment
An Institution of National Importance
(Ministry of Home Affairs, Government of India)

UGFS S7-SP 2-P3: Forensic Accounting and Auditing
Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory					Practical		
					Internal Exams				University Exams	University Exams (LPW)		Total
Th	Tu	Pr	C	TCH	TA-1 & TA-2		MSE					
					Marks	Hrs	Marks	Hrs	Marks	Hrs	Marks	Hrs	
3	1	0	4	4	25	00:45	50	01:30	100	03:00	-	-	200

Learning objectives:

At the end of this course, students will be able to explain;

1. Forensic Accounting and frauds
2. Money Laundering and Fraud deterrence
3. Investigation of frauds and Legal Framework for Forensic Accounting

MODULE-1   Forensic Accounting and frauds   Teaching Hours: 15 Hours

Principles and concepts of Forensic Accounting, Forensic auditing, Fraud triangle, types of frauds, methods for fraud detection, types of Financial Statement Frauds, Responsibility of Management and Auditors, reporting financial frauds, theory of fraud perpetrator, Litigation support bankruptcy, product liability, business valuations

Occupational frauds and abuses, Asset misappropriation, cheque tampering, false refunds, credit/debit card fraud.

MODULE-2   Money Laundering and Fraud deterrence   Teaching Hours: 15 Hours

Basic concepts of money laundering, history, methods & related laws, fraud deterrence, international money laundering council, banking operations- national/international, commercial & economic damages and their factors, Investigative protocols for fraud detection, Corruption and Bribery, fraudulent schemes, Currency transaction

Tracing Illicit Transactions, examination, analysis and interpretation of electronic data relating to fraud, cyber crime loss evaluations, investigation of e-data, capturing digital media-hard drives, emails, deleted overwritten files, data recovery and extraction.

**MODULE-3   Investigation of frauds and Legal Framework for Forensic Accounting
Teaching Hours: 15 Hours**

Fictitious revenues generation, Concealed liabilities and expenditures, Red flags, Whistle blowers and responses to fraud, Evidence collection and data analysis and interpretation, reporting methods, Prevention and detection of conflicts of interest, Law in relation to cyber-crimes, Ethics for Forensic Accountants, Code of Ethics, Code of Professional Standards, Laws Related to Fraud, Individual Rights during Examination, Criminal Prosecutions for Fraud, The Civil Justice System, expert testimony, Intellectual property rights

Reference books:

1. Money Laundering: A guide for criminal Investigation by John Madinger, Sydney A. Zalopany CRC Press New York (1999)
2. Financial Investigation and Forensic Accounting by George Manning CRC Press, New York USA (1999)
3. Corporate Fraud Hand Book by Joseph T Wells, John Wiley Sons Canada (2004)
4. Principles of Fraud Examination by Joseph T. Wells, John Wiley Sons Canada (2005)

UGFS S7-SP 2-P4: Research Methodology

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory						Practical	Total
Th	Tu	Pr	C	TCH	Internal Exams				University Exams		University Exams (LPW)	
					TA-1 & TA-2		MSE		Marks	Hrs	Marks	Hrs	
					Marks	Hrs	Marks	Hrs					
3	1	0	4	4	25	00:45	50	01:30	100	03:00	-	-	200

Learning objectives:
At the end of this course, students will be able to explain;

1. Literature review
2. The development of a research plan
3. Data collection, interpretation and errors
4. Important components for writing the research paper and thesis
5. Basics of Ethical issues, Intellectual property rights, Copy right

MODULE-1   Basics of research   **Teaching Hours: 15 Hours**

Objectives and types of research: Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, and Conceptual vs. Empirical. Research Formulation, Literature review and Development of hypothesis. Research design and methods, developing a research plan - Exploration, Description, Diagnosis, and Experimentation. Determining experimental and sample designs.

MODULE-2   Data analysis methods   **Teaching Hours: 15 Hours**

Data Collection and analysis: Methods of data collection – Sampling Methods and Data Processing. Data Analysis: Types of data, Basic concept of frequency distribution, measure of central values – Mean, median and mode, measure of dispersion, range, mean deviation and standard deviation, probability, theory and classical definition of probability, Bayes theorem of probability, conditional probability and coincidence probability, Chi-square test, ANOVA, SPSS. Types of Errors and Interpretation of Findings

MODULE-3 Scientific reports and thesis writing   **Teaching Hours: 15 Hours**

Reporting and thesis writing: Structure and components of scientific reports and thesis, Significance and Different steps in the preparation, Illustrations, Bibliography. Presentations: Oral and Poster, Importance of effective communication in scientific research.

Basics of Ethical issues, Intellectual property rights, Copy right, Reproduction of published material: Plagiarism in scientific research and communications.

 Reference books:

1. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International.
2. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, EssEss Publications. 2 volumes.
3. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.
4. Wadehra, B.L. 2000. Law relating to patents, trade marks, copyright designs and geographical indications. Universal Law Publishing.
5. Anthony, M., Graziano, A.M. and Raulin, M.L., 2009. Research Methods: A Process of Inquiry, Allyn and Bacon.
6. Carlos, C.M., 2000. Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options. Zed Books, New York.
7. Leedy, P.D. and Ormrod, J.E., 2004 Practical Research: Planning and Design, Prentice Hall. 12. Satarkar, S.V., 2000. Intellectual property rights and Copy right. EssEss Publications.

UGFS S7 CE-5	Core Elective - V	L	T	P	Cr	2	0	0	2

UGFS S7-SP2-Pr1: Practical-VII

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory					Practical		
					Internal Exams				University Exams	University Exams (LPW)		Total
Th	Tu	Pr	C	TCH	TA-1 & TA-2		MSE		Marks	Hrs	Marks	Hrs	
					Marks	Hrs	Marks	Hrs	Marks	Hrs	Marks	Hrs	
0	0	8	4	8							100	6:00	100

Learning Objectives:

At the end of course, students will be gaining the hands on training in the following courses;

MODULE-I	Modern Trends in Fingerprint Science

1. Analysis of fingerprints with microscopic techniques for the ridge dimensions with the complete identification profiling
2. Comparison of males' and females' fingerprints with the specific reference to the ridge dimensions
3. Development of latent finger prints using Ninhydrin.
4. Development of latent finger prints using iodine fuming
5. Development of latent finger prints using Nanoparticles
6. Understanding AFIS method of fingerprints analysis
7. Palatoprints
8. Cheiloscopy
9. Importance of molecular fingerprints with special refernce to fingerprint residues using instrumental methods

MODULE-2	Advances in Forensic Document Examination

1. Examination and Identification of handwriting on the basis of class and individual characteristics.
2. Examination and identification of forged signatures.
3. Identification of disguised in handwriting
4. Examination and identification of natural variations in handwritings
5. Examination of additions, alterations, and obliterations in the documents.
6. Examination of security features of currency notes, passports, visa
7. Examination of rubber seal impressions
8. Determination of sequence of strokes

MODULE-3	Forensic Accounting and Auditing

1. Examination of ink by TLC
2. Examination of ink by GCMS
3. Examination of ink by LCMS
4. Examination of ageing of paper
5. Examination of currency notes
6. Examination of Passport
7. Examination of Stamp
8. Examination of Rubber Stamp Impressions
9. Related case studies

MODULE-4	Research Methodology

1. Calculation of mean, median and mode
2. Calculation of standard deviation
3. Calculation of variance
4. Perform chi square test on a given set of data
5. Perform T-test and student's T-test on a given set of values

Specialization-3

"Forensic Chemistry and Toxicology"

UGFS S7-SP 3-P1: Forensic Pharmacy and Pharmacology of Controlled Drugs

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory						Practical	
					Internal Exams				University Exams		University Exams (LPW)		Total
Th	Tu	Pr	C	TCH	TA-1 & TA-2		MSE						
					Marks	Hrs	Marks	Hrs	Marks	Hrs	Marks	Hrs	
3	1	0	4	4	25	00:45	50	01:30	100	03:00	-	-	200

* Note: TA-2 will be in form of assignments or workshops

Learning objectives:

1. To help students learn basics of pharmacology.
2. To help students learn concepts forensic pharmacology.
3. To study and understand action of various drugs.

MODULE-1 Basic Principles of Forensic Pharmacy   **Teaching Hours: 15 Hours**

Introduction to Pharmacology and Forensic Pharmacy, Branches of Pharmacology, Scope of Forensic Pharmacy, Pharmacopoeias IP, USP, EP, pharmacognosy, pharmacovigilance, Nature and Source of drug, forms of drugs, classification of drugs, Prodrug and soft drug concept, Drug synthesis,Route of administration of Drugs, Factor affecting the effects of Drug, Ferguson's principle, Adverse drug reactions and drug induced side effects.

MODULE -2   Concepts of Pharmacology   **Teaching Hours: 15 Hours**

Pharmacokinetics, Bioavailability, Bioequivalence and Bioaccumulation, Efficacy and potency, Dose response relationship, Pharmacodynamics, Phase–I and Phase–II mechanism, Drug Therapeutic Index, Drug Receptor concept, types of receptors and mechanism of action, Pharmacokinetic drug interactions, various biological barriers, Agonism, Antagonism, Addition, Synergism, Potentiation, drug addiction and drug dependence, drug tolerance, drug hypersensitivity.

MODULE-3 Pharmacology of Different classes of controlled drugs   Teaching Hours: 15 Hours

Pharmacology of neurotransmitters like GABA, Glutamate, Glycine, Serotonin, Dopamine, General Anaesthetics, Neuroleptics, Sedatives, Hypnotics, Alcohol, antihypertensive drugs,

Antidepressant, Anti-stimulants, anti-maniacs & hallucinogens, Anti-infective drugs Antipyretics, NSAIDs, and antipsychotics, Case Studies

Detection of prohibited drugs (anabolic steroids, peptide hormones, growth factors and mimetics, betagonist, metabolic modulators, diuretics and masking agents and beta blockers by different techniques)

Reference Books:

1. Klaassen, C. D.: Casarett and Doull's Toxicology: The Basic Science of Poisons, 5th ed, McGraw-Hill, 1995.
2. Moffat, A.C.: Osselton, D. M. Widdop, B.: Clarke's Analysis of Drugs and Poisons in Pharmaceuticals, body fluids and post-mortem material, 3rd ed., PharmaceuticalPress2004.
3. Bogusz, M. J.: Hand Book of Analytical Separations, Vol. 2: Forensic Science, 1st ed., Elsevier Science ,2000.
4. Siegel, J.A., Saukko, P. J., Knupfer, G.: Encyclopaedia of Forensic Sciences (Vol3), Academic Press, 2000.
5. Rang, P.H., Dale, M.M., Ritter, M.J.: Pharmacology, 4th ed., Harcourt/Churchill Livingstone, 2000.
6. Paranjape, H.M., Bothara, G.K., Jain, M.M.: Fundamentals of Pharmacology, 1st ed., Nirali Prakashan, 1990.
7. Budhiraja, R.D.: Elementary Pharmacology and Toxicology, Popular Prakashan, 2nd ed.,1999.
8. Wiseman, H and Henry J.: Management Of Poisoning, A Handbook for Health care workers, 1st ed., A.I.T.B.S, 2002
9. Hardman, J. G. and Limbird, L. E.: Goodman and Gilman's The Pharmacological basis of Therapeutics, 9th ed., McGraw-Hill, 1996
10. Stolmen, A.; Progress in Chemical Toxicology: Academic Press, New York (1963)
11. Modi, Jaisingh, P.; Textbook of Medical Jurisprudence& Toxicology, M.M. Tripathi Publication (2001)
12. Pillay, V. V.; Handbook of Forensic Medicine and Toxicology, Paras Pub., 2001
13. Curry, A. S: Poison Detection in Human Organ

SCHOOL OF FORENSIC SCIENCES

B.Sc.-M.Sc. Forensic Sciences

National Forensic
Sciences University
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(Ministry of Home Affairs, Government of India)

UGFS S7-SP 3-P2: Advanced Forensic Toxicology

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory					Practical		
Th	Tu	Pr	C	TCH	Internal Exams				University Exams	University Exams (LPW)		Total
					TA-1 & TA-2		MSE					
					Marks	Hrs	Marks	Hrs	Marks	Hrs	Marks	Hrs	
3	1	0	4	4	25	00:45	50	01:30	100	03:00	-	-	200

* Note: TA-2 will be in form of assignments or workshops

Learning objectives:

1. To help students learn basic principles of toxicology.
2. To help students learn about xenobiotics and toxic effects.
3. To study and understand concepts of mechanism of toxicity.

Module-1 Concepts of Toxicology	Teaching Hours: 15 Hours

Branches of toxicology, Toxicants and Types of Toxicants, Dose and related terms used in toxicology, Sources of poisoning, duration and frequency of exposure, modals of toxicity testing, Laws and Regulations in toxicological testing, Regulatory bodies national and International, Risk and Hazard characterization, Global Harmonization System (GHS), Good Laboratory Practice (GLP).

Module-2 Principles of Toxicology	Teaching Hours: 15 Hours

Dose-effects and dose-response relationship, types of toxicity, Factors affecting toxicity – species and strain, age, sex, nutritional status, hormones, environmental factors, circadian rhythms, Enzyme Induction and Inhibition, molecular mechanism of toxicity, role of electrophiles and nucleophiles in toxicity, translocation of toxicants, toxico-kinetics and toxico-dynamics processes, detoxification of xenobiotics, biotransformation of xenobiotics, bioaccumulation of xenobiotics, anti-dotal therapy.

Module-3 Toxic effects of Xenobiotics	Teaching Hours: 15 Hours

Toxic effects of drugs, mechanism of drug toxicity, Toxic effects of pesticides, mechanism of pesticide toxicity, toxicity, Toxic effects of heavy metals, mechanism of heavy metal toxicity, Toxic effects of Alcohol and solvents, mechanism of poisonous liquor, Toxic effects of plant poisons, Toxic effects of insects and animal poison, toxicity symptoms and treatment of xenobiotics.

Reference books:

1. Curry: Analytical Methods in Human Toxicology, Part II, 1986.
2. Gupta, P.K. Fundamentals of Toxicology: Essential Concepts and Applications. India, Elsevier Science, 2016.
3. Casarett & Doll Toxicology: The Basic Science of poisons.
4. Clark, E.G.C.: Isolation and identification of Drugs, 1966
5. Curry, A.S.: Poison Detection in Human Organs, 1976
6. Curry, A.S.: Advances in Forensic Chemical Toxicology, 1972
7. Holfmann, F.G.: Handbook of Drug and Alcohol Abuse.
8. Turner: Drugs & Poisons.
9. Samford: Poisons Their Isolation Identification
10. Stoleman: Progress in Chemical Toxicology.
11. Sunshine, I: Guidelines for Analytical Toxicology Programme, Vol-I, CRC press, 1950.
12. Sunshine, I: Handbook of Analytical Toxicology, press, 1969.
13. Mule, S. J. et al.: Immunoassays for Drugs subjects to ab, CRC Press, 1974
14. Connors, K.: A text book of Pharmaceuticals analysis, Interscince, New York, 1975

UGFS S7-SP 3-P3: Modern and Applied Analytical Forensic Chemistry
Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory						Practical	Total
Th	Tu	Pr	C	TCH	Internal Exams				University Exams		University Exams (LPW)	Total
					TA-1 & TA-2		MSE		Marks	Hrs	Marks	Hrs	
					Marks	Hrs	Marks	Hrs					
3	1	0	4	4	25	00:45	50	01:30	100	03:00	-	-	200

* Note: TA-2 will be in form of assignments or workshops

Learning objectives:

1. To help students learn advanced aspects of forensic drug chemistry.
2. To help students learn the concepts of petro-forensics and international guidelines about fire forensics.
3. To study and understand various chromatographic and spectroscopic techniques.

MODULE-1 Advanced Forensic Drug Chemistry	**Teaching Hours: 15 Hours**

Drug Trafficking, Forensic examination of drugs/Narcotics - Cannabis, Phenethylamines (Amphetamine, Methamphetamine), Hydroxyl derivative (Ephedrine), Ketone Derivative (Cathinone), Methoxy Derivative (Mescaline), Tertiary Amines (Cocaine and Opiates), Tryptamines (Psilocin and Psilocybin), Anabolic Steroids, Miscellaneous Controlled Substances (Barbiturates, Benzodiazepines, GHB, Ketamine and LSD).

Presumptive/Screening and Confirmatory Methods: Colour/spot test, microscopic examination, Microcrystalline tests, Thin-Layer Chromatography, Sample Preparation before TLC Specimen, Extraction Evaluation of TLC for Drug Screening, Immunoassay Methods, Other instrumental techniques involved in analysis. Format of NDPS Report Writing& Court Room Testimony. Case studies.

MODULE-2	**Teaching Hours: 15 Hours**

Petro Forensics:
Distillation and fractionation of petroleum. Commercial uses of different petroleum fractions.
Physical Properties of Petroleum Products Analytical Techniques: Quantitative and Qualitative Steps in Analysis of Petroleum, Analysis of traces of petroleum products in forensic exhibits. Case studies.

Fire Chemistry:
Scientific Investigation of Fire, NFPA 921 and NFPA 1033, Separation and analytical techniques of ignitable liquid residues, Interpretation of Data Obtained from Fire Debris, Quality Assurance in Fire debris Analysis, Report Writing and Court Testimony. Case studies.

MODULE-3	Teaching Hours: 15 Hours

Explosives Chemistry:

Introduction and assessment of explosives, Oxygen balance, Explosive Power Index, Heat and Temperature of Explosion, Pressure of explosion, Mechanism of Ignition and hot spot formation. Thermal decomposition, physical and chemical aspects of combustion, Deflagration and Detonation, Analysis of low and high explosives by different instrumental techniques, Quality control, Proficiency Testing, Interpretation and Significance of Results. Case studies.

Chemical Warfare Agents:

Classification, physical and biochemical properties, toxic effects detection by Biosensors and various instrumental techniques.

Reference Books:

1. Clarke's Analysis of Drugs and Poisons, (Formerly Isolation & Identification of Drugs) 3rd Ed. 2 Vol. Set.
2. Clark, E.G.C.: Isolation and identification of Drugs, VI and Vol. II, 1966, 1975-1986.
3. Modi, Text Book of Medical Jurisprudence Forensic Medicines and Toxicology (1999) CBS Pub. New Delhi.
4. Saferstien (1982) Forensic Science, Handbook, Vol. I, II & III, Prentice Hall Inc. USA.
5. DFS -Working Procedure Manual- Narcotics.
6. E. Stahl (1969) Thin Layer Chromatography: A Laboratory Handbook.
7. Saferstein (1976) Criminalistics.
8. Klaassen, C. D.: Casarett and Doull's Toxicology: The Basic Science of Poisons, 5th ed, McGraw-Hill, 1995.
9. Moffat, A.C.: Osselton, D. M. Widdop, B.: Clarke's Analysis of Drugs and Poisons in Pharmaceuticals, body fluids and post-mortem material, 3rd ed., Pharmaceutical Press2004.
10. Bogusz, M. J., Hand Book of Analytical Separations, Vol. 2: Forensic Science, 1st ed., Elsevier Science, 2000.
11. Siegel, J.A., Saukko, P. J., Knupfer, G.: Encyclopaedia of Forensic Sciences (Vol. 3), Academic Press, 2000.
12. Rang, P.H., Dale, M.M., Ritter, M.J.: Pharmacology, 4th ed., Harcourt/Churchill Livingstone, 2000.
13. Paranjape, H.M., Bothara, G.K., Jain, M.M.: Fundamentals of Pharmacology, 1st ed., Nirali Prakashan, 1990.
14. Budhiraja, R.D.: Elementary Pharmacology and Toxicology, Popular Prakashan, 2nd ed.,1999.
15. Wiseman, H and Henry J.: Management Of Poisoning, A Handbook for Healthcare workers,1st ed., A.I.T.B.S, 2002.
16. Hardman, J. G. and Limbird, L. E.: Goodman and Gilman's The Pharmacological basis of Therapeutics, 9th edn., McGraw-Hill, 1996.
17. Laboratory procedure Manual, Forensic Toxicology: DFS, 2005.
18. Sunshine, I; Methods for Analytical Toxicology, CRC Press USA (1975).
19. Cravey, R.H; Baselt, R.C.: Introduction to Forensic Toxicology, Biochemical Publications, Davis, C.A. (1981).
20. Stolmen, A.; Progress in Chemical Toxicology: Academic Press, New York (1963).
21. Modi, Jaisingh, P.; Textbook of Medical Jurisprudence& Toxicology, M.M. Tripathi Publication (2001).
22. Eckert; An Introduction to Forensic Science, CRC Press.

23. Pillay, V. V.; Handbook of Forensic Medicine and Toxicology, Paras Pub., 2001.
24. Curry, A. S: Poison Detection in Human Organ.
25. James, S. H. and Nordby, J. J.: Forensic Science: An Introduction to Scientific and Investigative Techniques, 2003.
26. Saferstein, R: Criminalistics - An Introduction to Forensic Science, Prentice Hall, 1995.
27. Sarkar, S: Fuels and Combustion, Orient Longman, 1990.
28. Verma, R. M: Analytical Chemistry – Theory and Practice, CBS Pub., 1994.
29. Svehla, G. Ed.: Vogel's Qualitative Inorganic Analysis, Longman, 1998.
30. Bassett: Vogel's Text Book of Quantitative Inorganic Analysis, Longman, 1978.
31. Vogel, A. I: Text Book of Practical Organic Chemistry including Qualitative Organic Analysis, ELBS, 1971.
32. Skoog, D. A., West, D. M. and Holler, F. J: Analytical Chemistry: An Introduction, Saunders College, 1994.
33. Siegel, J. A, Saukko, P. J. and Knupfer, G. C: Encyclopaedia of Forensic Sciences, Academic Press, 2000.
34. Townsends, A. (Ed): Encyclopaedia of Analytical Science, Academic Press, 2005.
35. Beveridge, A: Forensic Investigation of Explosives, Taylor & Francis, 2000.
36. Yallop, H. J: Explosion Investigation, Forensic Science Society & Scottish Academic Press,1980.
37. Narayanan, T. V: Modern Techniques of Bomb Detection and Disposal, R. A. Security System, 1995.
38. Yinon, J. and Zitrin, S: The Analysis of Explosives, Oxford: Pergamon, 1981.
39. An Introduction to Physics and chemistry of Petroleum.
40. Kinghorn: Introduction to Petrochemicals Sukumar Maiti.
41. D.W. Waples: Geochemistry in Petroleum Exploration.
42. A.L. Waddams: Petroleum Geochemistry and Geology Chemicals from Petroleum.
43. Day & Underwood: Analytical Chemistry.

UGFS S7-SP 3-P4: Research Methodology

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory					Practical		
Th	Tu	Pr	C	TCH	Internal Exams				University Exams	University Exams (LPW)		Total
					TA-1 & TA-2		MSE		Marks	Hrs	Marks	Hrs	
					Marks	Hrs	Marks	Hrs					
3	1	0	4	4	25	00:45	50	01:30	100	03:00	-	-	200

* Note: TA-2 will be in form of assignments or workshops

Learning objectives: At the end of this course, students will be able to explain;

1. Literature review
2. The development of a research plan
3. Data collection, interpretation and errors
4. Important components for writing the research paper and thesis
5. Basics of Ethical issues, Intellectual property rights, Copy right

MODULE-1 Basics of research	Teaching Hours: 15 Hours

Objectives and types of research: Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, and Conceptual vs. Empirical. Research Formulation, Literature review and Development of hypothesis.

Research design and methods, developing a research plan - Exploration, Description, Diagnosis, and Experimentation. Determining experimental and sample designs

MODULE-2 Data analysis methods	Teaching Hours: 15 Hours

Data Collection and analysis: Methods of data collection – Sampling Methods and Data Processing. Data Analysis: Types of data, Basic concept of frequency distribution, measure of central values – Mean, median and mode, measure of dispersion, range, mean deviation and standard deviation, probability, theory and classical definition of probability, Bayes theorem of probability, conditional probability and coincidence probability, Chi-square test, ANOVA, SPSS. Types of Errors and Interpretation of Findings

MODULE-3 Scientific reports and thesis writing	Teaching Hours: 15 Hours

Reporting and thesis writing: Structure and components of scientific reports and thesis, Significance and Different steps in the preparation, Illustrations, Bibliography. Presentations: Oral and Poster, Importance of effective communication in scientific research.

Basics of Ethical issues, Intellectual property rights, Copy right, Reproduction of published material: Plagiarism in scientific research and communications.

Reference books:

1. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International.
2. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, EssEss Publications. 2 volumes.
3. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.
4. Wadehra, B.L. 2000. Law relating to patents, trade marks, copyright designs and geographical indications. Universal Law Publishing.
5. Anthony, M., Graziano, A.M. and Raulin, M.L., 2009. Research Methods: A Process of Inquiry, Allyn and Bacon.
6. Carlos, C.M., 2000. Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options. Zed Books, New York.
7. Leedy, P.D. and Ormrod, J.E., 2004 Practical Research: Planning and Design, Prentice Hall. 12. Satarkar, S.V., 2000. Intellectual property rights and Copy right. EssEss Publications.

'UGFS S7 CE-5	Core Elective - V	L	T	P	Cr	2	0	0	2

SCHOOL OF FORENSIC SCIENCES

B.Sc.–M.Sc. Forensic Sciences

National Forensic
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(Ministry of Home Affairs, Government of India)

UGFS S7-SP3-Pr1: Practical-VII

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory					Practical		
Th	Tu	Pr	C	TCH	Internal Exams				University Exams	University Exams (LPW)		Total
					TA-1 & TA-2		MSE					
					Marks	Hrs	Marks	Hrs	Marks	Hrs	Marks	Hrs	
0	0	8	4	8							100	6:00	100

Learning Objectives:

At the end of course, students will be gaining the hands on training in the following courses;

MODULE-I	Forensic Pharmacy and Pharmacology of Controlled Drugs

1. Qualitative and Quantitative analysis of paracetamol
2. Concepts and Parts identification of GC, GC-MS & HPLC.
3. LLE & DLLME based extraction of drugs.
4. Detection of drug classes by imaging system like Raman.
5. Detection of Sugars in Anti-diabetic drugs by IC.
6. Organic composition profiling of drug class by CHNS/O.
7. Detection of anabolic agents in supplements by GCMS.

MODULE-2	Advanced Forensic Toxicology

1. Preparation of standard and working solutions.
2. Plotting of calibration curve and quantification using UV-Vis Spectroscopy
3. Analysis of organochlorine, Organophosphorus, Carbamates and Pyrethroids by colour tests, TLC, GC-MS methods.
4. Identification of common plant poisons Oleander, Dhatura, Calotropis and Ricin.
5. Analysis of alcohol and derivatives by head-space gas chromatography (HS-GC).
6. Extraction and Analysis of heavy metals by microwave extraction and ICP-MS.

Analysis of non-volatile drugs by HPLC

MODULE-3	Modern and Applied Analytical Forensic Chemistry

1. Microcrystalline tests for Narcotic drugs.
2. Separation of Psychotropic substance by TLC.

3. Separation of Cannabis/Opium by TLC, UV, FTIR
4. Analysis of high explosives by TLC, UV, FTIR
5. Qualitative Analysis of fire residues by GC-HS and GC-MS.
6. Analysis of dye in petrol and kerosene by UV spectrophotometry and TLC.
7. Analysis of NDPS drugs and explosives by instrumental techniques.

MODULE-4	Research Methodology

1. Calculation of mean, median and mode
2. Calculation of standard deviation
3. Calculation of variance
4. Perform chi square test on a given set of data
5. Perform T-test and student's T-test on a given set of values

Specialization-4

"Forensic Biology and Biotechnology"

UGFS S7-SP 4-P1: Fundamentals of Biological Chemistry

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory					Practical		
					Internal Exams				University Exams	University Exams (LPW)		Total
Th	Tu	Pr	C	TCH	TA-1 & TA-2		MSE					
					Marks	Hrs	Marks	Hrs	Marks	Hrs	Marks	Hrs	
3	1	0	4	4	25	00:45	50	01:30	100	03:00	-	-	200

* Note: TA-2 will be in form of assignments or workshops

Learning objectives:

At the end of course, students will be able to demonstrate understanding about;

1. Fundamentals of biomolecules
2. Chemistry of Carbohydrates, Proteins and Lipids
3. Basics of Enzymes and Enzyme kinetics

MODULE-1   Biomolecules   Teaching Hours: 15 Hours

Chemical foundations of Biology: pH, acids, bases pK, buffers, Atomic bonds and Molecular interactions: Weak bonds (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction), Covalent bonds,

Bioenergetics: Basic principles, Laws of thermodynamics, Equilibria and concept of free energy, Standard free energy, free energy change.

MODULE-2   Chemistry of Carbohydrates, Lipids and Proteins   Teaching Hours: 15 Hours

Chemistry of Carbohydrates: Definition, biological importance and classification. Monosaccharides Isomerism, anomerism. Sugar derivatives, Disaccharides, Polysaccharides. Structures of starch, glycogen and glycosaminoglycan.

Chemistry of Lipids: Definition, Biological importance and classification. Fats and fatty acids. Introduction to compound lipids. Hydrophobic and hydrophilic groups. Cholesterol. Bile salts. Micelle. Bimolecular leaflet, Lipoproteins – formation, function and turnover.

Chemistry of Proteins: Biological importance, classification of amino acids, amino acid racemization, and titration curve of amino acids, Proteins and peptides – Composition of proteins – Primary, Secondary and Tertiary structure of protein. Simple, conjugated, globular and fibrous proteins, denaturation and denaturation.

MODULE-3   Enzymology   Teaching Hours: 15 Hours

- Enzymes: Properties, Nomenclature, Classification,
- Enzyme kinetics, Mechanism of enzyme action,
- Enzyme inhibition
- Regulation of enzyme action.

Reference Books:

1. Lehninger Principles of Biochemistry 6th Edition (2012) – Nelson and Cox, W.H. Freeman, ISBN: 978-1429234146
2. L. Stryer, Biochemistry, 5th Edition, (2002) Freeman &Co. New York
3. Wang, Xing, Kuruc, Matthew. 2019. Functional Proteomics, Springer.
4. E.D. Hoffmann, V. Stroobant. 2007. Mass Spectrometry: Principles and Applications, John Wiley & Sons Ltd. The Atrium, Southern Gate, Chichester, West Sussex PO198SQ, England.
5. D. Kambhampati. 2004. Protein Microarray Technology, WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, Germany.

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UGFS S7-SP 4-P2: Molecular Biology and rDNA technology

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory					Practical		
Th	Tu	Pr	C	TCH	Internal Exams				University Exams	University Exams (LPW)		Total
					TA-1 & TA-2		MSE					
					Marks	Hrs	Marks	Hrs	Marks	Hrs	Marks	Hrs	
3	1	0	4	4	25	00:45	50	01:30	100	03:00	-	-	200

* Note: TA-2 will be in form of assignments or workshops

Learning objectives:

At the end of this course, students will be able to explain;

1. Basics of Molecular Biology
2. Genetic Engineering and rDNA technology
3. Fundamentals of rDNA technology

MODULE-1 Basics of Molecular Biology and advanced techniques Teaching Hours: 15 Hours

- Organization of genome in prokaryotes and eukaryotes
- Chemical structure of DNA and RNA
- DNA replication: Enzymes and accessory proteins, Mechanism of DNA replication in prokaryotes and eukaryotes.
- Procedure for collection and preservation of biological sample for DNA analysis.
- Techniques of DNA isolation and its quantitation.
- Polymerase Chain Reaction and its variants in PCR and primer designing
- DNA separation and detection techniques
- Methods of DNA sequencing
- Florescence in situ hybridization (FISH) for genome analysis and Chromosome micro-dissection

MODULE-2 Central Dogma of Genetic Engineering and rDNA technology   Teaching Hours: 15 Hours

- Transcription: RNA polymerases, features of prokaryotic and eukaryotic promoters,
- Assembly of transcription initiation complex in prokaryotes and eukaryotes and its regulation;
- Synthesis and processing of prokaryotic and eukaryotic transcripts. Transport of RNA within eukaryotic cell.

- Translation: Structure and role of t-RNA in protein synthesis, ribosome structure, basic features of genetic code and its deciphering, translation (initiation, elongation and termination in detail in prokaryotes as well as eukaryotes).

MODULE-3	Fundamentals of rDNA technology	Teaching Hours: 15 Hours

- General introduction and concept of recombinant DNA technology.
- DNA modifying enzymes
- Cloning strategies: Genomic libraries, cDNA libraries, single gene cloning.
- Vectors: Types of vectors and choice of vectors- Plasmids, cosmids, lamda phage vectors, shuttle vectors, BACs and YACs
- Choice of hosts, Methods for transferring recombinant DNA to host cells (Transformation and Transfection)
- Expression systems in Eukaryotic cells, Yeast, Bacteria, Insect cell lines, Gene screening
- Biosafety guidelines and containment strategies.

Reference Books:

1. Forensic DNA Typing, Second Edition: Biology, Technology, and Genetics of STR Markers 2nd Edition (2005) - John M. Butler, Academic Press, ISBN:0121479528
2. Advanced Topics in Forensic DNA Typing: Methodology (2011), John M. Butler, Academic Press, ISBN: 978-0123745132
3. Advanced Topics in Forensic DNA Typing: Interpretation, (2014) - John Butler, Academic Press, ISBN:19780124052130
4. Forensic DNA Analysis Technological Development and Innovative Applications, 1st ed. (2021) - Elena Pilli and Andrea Berti, Apple Academic Press, Inc., ISBN 9781771889056
5. Forensic DNA Profiling - A Practical Guide to Assigning Likelihood Ratios, 1st ed. (2020) - Jo-Anne Bright and Michael D. Coble, CRC Press, ISBN: 9780367029029
6. Forensic Practitioner's Guide to The Interpretation of Complex DNA Profiles, 1st ed. (2020) - Peter Gill et. al., Academic Press, ISBN: 978-0-12-820562-4
7. Interpreting Complex Forensic DNA Evidence, 1st ed. (2020) - Jane Moira Taupin, CRC Press, ISBN:978-1-138-49567-8
8. An Introduction to Forensic Genetics, 2ndEdition (2010) - William Goodwin, Adrian Linacre and SibteHadi, Wiley-Blackwell, ISBN: 978-0470710197
9. Forensic Genetics in the Governance of Crime, 1st ed. (2019) - Helena Machado and Rafaela Granja, Palgrave Macmillan, ISBN 978-981-15-2429-5
10. High-Throughput Next Generation Sequencing – Methods and applications, 1st ed. (2011), Young Min Kwon and Steven C. Ricke, Humana Press, ISBN: 9781617790881
11. Next Generation DNA Led Technologies, 1st ed. (2016), SharadaAvadhanam et. al., Springer, ISBN: 978-981-287-669-0
12. Next Generation Sequencing – Methods and Protocols, 1st ed. (2018) - Steven R. Head et. al., Humana Press, ISBN: 978-1-4939-7514-3
13. A Primer of Conservation Genetics. 2004. Richard Frankham, Jonathan D. Ballou, David A. Briscoe. Cambridge University Press. http://www.cambridge.org/9780521831109

14. An Introduction to Population Genetics Theory and Applications. Rasmus Nielsen, Montgomery Slatkin. Publisher: Sinauer Associates, Year of Publication-2013.

15. Population Genomics :Concepts, Approaches and Applications. Edited by Om P. Rajora. Publisher : Springer International Publishing. DOI: 10.1007/978-3-030-04589-0. Year of Publication : 2019.

16. Conservation and the genetics of populations / Fred W. Allendorf, Gordon Luikart, Sally N. Aitken; with illustrations by AgostinhoAntunes. – 2nd ed. ISBN 978-0-470-67146-7. Year of Publication : 2013. Publisher: John Wiley & Sons, Ltd

17. Population genetics by Matthew B. Hamilton. 2009. ISBN 978-1-4051-3277-0. Publisher: John Wiley & Sons, Ltd

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UGFS S7-SP 4-P3: Forensics Genomics and DNA Profiling

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory					Practical		
					Internal Exams				University Exams	University Exams (LPW)		Total
Th	Tu	Pr	C	TCH	TA-1 & TA-2		MSE					
					Marks	Hrs	Marks	Hrs	Marks	Hrs	Marks	Hrs	
3	1	0	4	4	25	00:45	50	01:30	100	03:00	-	-	200

* Note: TA-2 will be in form of assignments or workshops

Learning objectives:

At the end of this course, students will be able to explain;

1. STR profiling
2. Application of lineage markers in DNA Forensics
3. Fundamentals of bioinformatics and its application in Forensics

MODULE-1   Advanced topics in STR Profiling   Teaching Hours: 15 Hours

- Modern techniques for DNA extraction and quantification
- STR Profiling, Types of errors, Result interpretation and Report Writing
- DNA Mixtures – Current status of tools and guidelines
- Paternity/maternity indices, Sibship indices

MODULE-2   Application of lineage markers in DNA Forensics   Teaching Hours: 15 Hours

- Mitochondrial DNA analysis for human and related databases
- Advanced Y-STR and X-STR analysis and its significance in establishing paternal relationships.
- Identity, Phenotypic and ancestry informative markers
- Genealogy and its applications in forensic genetics
- Quality assurance and quality control in DNA forensics
- Molecular autopsy and tissue identification by DNA and RNA
- Concepts in Next Generation Sequencing (NGS) and Genome analysis

MODULE-3   Fundamentals of bioinformatics and its application in Forensics Teaching Hours: 15 Hours

- Biological Data: The form of biological information
- Primer designing for forensically important markers
- Various databases for lineage and mtDNA markers

- 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. Similarity and homology, Scoring matrices, Dynamic programming algorithms, Needleman-Wunsch and Smith-waterman, FASTA, BLAST and other variants of BLAST
- Multiple Sequence Alignment and Whole genome analysis, existing software tools for MSA
- Database management tools in DNA Forensics: CODIS and DNAxs
- Other Databases and Online-Tools: NCBI, STRBase, STRidER, PhyloTreemt, SNPforID Browser, popSTR browser, ALFRED, scientific literature

References:

- Forensic DNA Typing, Second Edition: Biology, Technology, and Genetics of STR Markers 2nd Edition (2005) - John M. Butler, Academic Press, ISBN:0121479528
- Advanced Topics in Forensic DNA Typing: Methodology (2011), John M. Butler, Academic Press, ISBN: 978-0123745132
- Advanced Topics in Forensic DNA Typing: Interpretation, (2014) - John Butler, Academic Press, ISBN:19780124052130
- Forensic DNA Analysis Technological Development and Innovative Applications, 1st ed. (2021) - Elena Pilli and Andrea Berti, Apple Academic Press, Inc., ISBN 9781771889056
- Forensic DNA Profiling - A Practical Guide to Assigning Likelihood Ratios, 1st ed. (2020) - Jo-Anne Bright and Michael D. Coble, CRC Press, ISBN: 9780367029029
- Forensic Practitioner's Guide to The Interpretation of Complex DNA Profiles, 1st ed. (2020) - Peter Gill et. al., Academic Press, ISBN: 978-0-12-820562-4
- Interpreting Complex Forensic DNA Evidence, 1st ed. (2020) - Jane Moira Taupin, CRC Press, ISBN:978-1-138-49567-8
- An Introduction to Forensic Genetics, 2ndEdition (2010) - William Goodwin, Adrian Linacre and SibteHadi, Wiley-Blackwell, ISBN: 978-0470710197
- Forensic Genetics in the Governance of Crime, 1st ed. (2019) - Helena Machado and Rafaela Granja, Palgrave Macmillan, ISBN 978-981-15-2429-5
- High-Throughput Next Generation Sequencing – Methods and applications, 1st ed. (2011), Young Min Kwon and Steven C. Ricke, Humana Press, ISBN: 9781617790881
- Next Generation DNA Led Technologies, 1st ed. (2016), Sharada Avadhanam et. al., Springer, ISBN: 978-981-287-669-0
- Next Generation Sequencing – Methods and Protocols, 1st ed. (2018) - Steven R. Head et. al., Humana Press, ISBN: 978-1-4939-7514-3
- A Primer of Conservation Genetics. 2004. Richard Frankham, Jonathan D. Ballou, David A. Briscoe. Cambridge University Press. http://www.cambridge.org/9780521831109
- An Introduction to Population Genetics Theory and Applications. Rasmus Nielsen, Montgomery Slatkin. Publisher: Sinauer Associates, Year of Publication-2013.

- Population Genomics :Concepts, Approaches and Applications. Edited by Om P. Rajora. Publisher : Springer International Publishing. DOI: 10.1007/978-3-030-04589-0. Year of Publication : 2019.
- Conservation and the genetics of populations / Fred W. Allendorf, Gordon Luikart, Sally N. Aitken; with illustrations by Agostinho Antunes. – 2nd ed. ISBN 978-0-470-67146-7. Year of Publication : 2013. Publisher: John Wiley & Sons, Ltd
- Population genetics by Matthew B. Hamilton. 2009. ISBN 978-1-4051-3277-0. Publisher: John Wiley & Sons, Ltd

UGFS S7-SP 4-P4: Research Methodology

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory					Practical		
					Internal Exams				University Exams	University Exams (LPW)		Total
Th	Tu	Pr	C	TCH	TA-1 & TA-2		MSE					
					Marks	Hrs	Marks	Hrs	Marks	Hrs	Marks	Hrs	
3	1	0	4	4	25	00:45	50	01:30	100	03:00	-	-	200

* Note: TA-2 will be in form of assignments or workshops

Learning objectives: At the end of this course, students will be able to explain;

1. Literature review
2. The development of a research plan
3. Data collection, interpretation and errors
4. Important components for writing the research paper and thesis
5. Basics of Ethical issues, Intellectual property rights, Copy right

MODULE-1   Basics of research   Teaching Hours: 15 Hours

Objectives and types of research: Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, and Conceptual vs. Empirical. Research Formulation, Literature review and Development of hypothesis.

Research design and methods, developing a research plan - Exploration, Description, Diagnosis, and Experimentation. Determining experimental and sample designs.

MODULE-2 Data analysis methods   Teaching Hours: 15 Hours

Data Collection and analysis: Methods of data collection – Sampling Methods and Data Processing. Data Analysis: Types of data, Basic concept of frequency distribution, measure of central values – Mean, median and mode, measure of dispersion, range, mean deviation and standard deviation, probability, theory and classical definition of probability, Bayes theorem of probability, conditional probability and coincidence probability, Chi-square test, ANOVA, SPSS. Types of Errors and Interpretation of Findings.

MODULE-3 Scientific reports and thesis writing   Teaching Hours: 15 Hours

Reporting and thesis writing: Structure and components of scientific reports and thesis, Significance and Different steps in the preparation, Illustrations, Bibliography. Presentations: Oral and Poster, Importance of effective communication in scientific research.

Basics of Ethical issues, Intellectual property rights, Copy right, Reproduction of published material: Plagiarism in scientific research and communications.

Reference books:

1. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International.
2. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, EssEss Publications. 2 volumes.
3. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.
4. Wadehra, B.L. 2000. Law relating to patents, trade marks, copyright designs and geographical indications. Universal Law Publishing.
5. Anthony, M., Graziano, A.M. and Raulin, M.L., 2009. Research Methods: A Process of Inquiry, Allyn and Bacon.
6. Carlos, C.M., 2000. Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options. Zed Books, New York.
7. Leedy, P.D. and Ormrod, J.E., 2004 Practical Research: Planning and Design, Prentice Hall. 12. Satarkar, S.V., 2000. Intellectual property rights and Copy right. EssEss Publications.

UGFS S7 CE-5	Core Elective - V	L	T	P	Cr	2	0	0	2

UGFS S7-SP4-Pr1: Practical-VII

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							Total
					Theory					Practical		
					Internal Exams				University Exams	University Exams (LPW)		
Th	**Tu**	**Pr**	**C**	**TCH**	TA-1 & TA-2		MSE		**Marks**	**Hrs**	**Marks**	**Hrs**	
					Marks	**Hrs**	**Marks**	**Hrs**					
0	0	8	4	8							100	6:00	100

Learning Objectives:

At the end of course, students will be gaining the hands on training in the following courses;

MODULE-I	Fundamentals of Biological Chemistry

1. Estimation of Protein, Sugar, Lipid and Cholestrol
2. Protein Extraction and Separation by SDS PAGE
3. Denaturation and renaturation of Protein
4. Measuring time dependent activity of an enzyme
5. Estimation of Km and Vmax for an enzyme.

MODULE-2	Molecular Biology and rDNA technology

- DNA extraction from biological samples

- Polymerase Chain Reaction

- Sanger Sequencing

MODULE-3	Forensics Genomics and DNA Profiling

- STR Profiling and report writing using simulated evidences

- Analysis of lineage markers (Y-STR and mtDNA) from simulated samples

- Primer designing and sequence alignment for forensic markers

- Data retrieval and analysis from various databases: NCBI, PubMed Central, STRidER

- Construction of phylogenetic tree and phylogeographic analysis using various tools

- Extraction of proteins from different body fluids

- Native PAGE, and Iso electric focusing

- Intrinsic fluorescence of body fluids

- Application of Swiss PDB viewer, Rasmol, NCBI database and FASTA sequence

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MODULE-4	Research Methodology

1. Calculation of mean, median and mode
2. Calculation of standard deviation
3. Calculation of variance
4. Perform chi square test on a given set of data
5. Perform T-test and student's T-test on a given set of values

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Specialization-5

"Cyber Forensic"

UGFS S7-SP 5-P1: Advanced Digital Forensics

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory					Practical		
					Internal Exams				University Exams	University Exams (LPW)		Total
Th	Tu	Pr	C	TCH	TA-1 & TA-2		MSE					
					Marks	Hrs	Marks	Hrs	Marks	Hrs	Marks	Hrs	
3	1	0	4	4	25	00:45	50	01:30	100	03:00	-	-	200

* Note: TA-2 will be in form of assignments or workshops

Learning Objectives: After studying this paper the students will be able to –

1. Understand the various stages of digital forensics investigation
2. Get familiar with the various artifacts and their sources, found in Windows Operating System.
3. Get a basic understanding of the various artifacts and evidences found in Linux and MAC forensics.
4. Identify the working of various tools and techniques used for digital forensics examination.
5. Get familiar with the various issues and challenges faced by digital forensic investigators.

MODULE-1   Cyber-crime Investigation and Digital Forensics   Teaching Hours: 15 Hours

Introduction to cyber-crime investigation, Conducting an Investigation, preparing for search and seizure, securing crime scene, seizing digital evidence at SOC; Daubert Standards; ISO/IEC 27037: 2012; Forensics Investigation Process- Pre-search consideration, Collection of Evidences from crime scene, Acquisition, & Preservation, Examination and Analysis, Documentation and Reporting, Maintaining the Chain of Custody; Collection of Volatile and Persistent Data.

Hashing Algorithms; Cloning of Digital Exhibits, Different Imaging Formats– Raw Format, Proprietary Formats, Advanced Forensic Formats; Imaging vs Cloning/Copying; Data Acquisition from live systems, Shutdown Systems, Remote systems, RAID Servers and Encrypted systems; Validating Data Acquisitions techniques (Linux and Windows); Digital Forensics Standard Operating Procedures. Software and Hardware Tools used in Forensic Analysis – Open Source and Proprietary tools; Challenges and issues in Cyber-crime investigation and Digital forensics.

MODULE-2   Forensic Analysis of Windows System Artifacts   Teaching Hours: 15 Hours

File Systems, Registry, Event logs, Shortcut files, Executables; Windows registry, startup tasks, Jumplists, Volume Shadow Backup, Shellbags; Forensic Analysis of the Registry – Use of registry viewers, Amcache.hve, Shimcache.hve, Regedit; Extracting USB related artifacts and examination of protected storages. Email investigations; Data recovery – Tools and techniques; Malware and

Ransomware Analysis; Recycle Bin Forensics (INFO, $I, $R files); Anti-forensic techniques and their detection: Data Wiping, Partition Deletion, Bit-Shifting, Alternate Data Streams (ADS), Hidden files, Data in the Slack Space and Unallocated Space, Steganography and Steganalysis, File Extension Mismatch, Disk Encryption etc.

MODULE-3   **Forensic Analysis of Linux and MAC System Artifacts**   **Teaching Hours: 15 Hours**

Linux File-system and Artifacts – Introduction and Architecture of Linux OS, Booting Process, Basics of Linux file-system, Use of built-in command line tools for forensic investigation – dd, dcfldd, fdisk, mkfs, mount, unmount, md5sum, sha1sum, dmseg, grep, find, pstree, ls, kill, history, xxd; Hash Computation and Verification; Checking File Extension Mismatch, Keyword Searching, Fragmentation of Forensic Images; Ownership and Permissions, Hidden files, User Accounts and Logs; Mounting of hard disk having forensic image; Timeline analysis.

MAC File-system and Artifacts – Introduction to MAC OS and File-system, Booting Process in MAC, System Services, Hidden directories, System Logs and user artifacts; Forensic Acquisition and Analysis of Plists; Function of File Vault, Keychain.

Suggested Reading and Books:

1. Bill Nelson, Amelia Phillips and Christopher Steuart, "Guide to Computer Forensics and Investigations, 5th Edition", Cengage, 2010 BBS.
2. Dr. Darren Hayes, "A Practical Guide to Computer Forensics Investigation", Pearson Publishers, 2014.
3. EC-Council, "Computer Hacking Forensic Investigator v.9".
4. Eoghan Casey; "Handbook of Digital forensics and Investigation", Elsevier Academic Press, 2009.
5. Nina Godbole and Sunit Belapore; "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley Publications, 2011.
6. Harlan Carvey; "Windows Forensic Analysis Toolkit", Syngress, 2012.
7. Anthony Reyes, Jack Wiles; "The Best Damn Cybercrime and Digital Forensic Book", Syngress, USA, 2007.
8. Dr. Philip Polstra, "Linux Forensics with Python and shell scripting", Pentester Academy, 2015.
9. Jessie Varsalone and Rob Maxwell, "MAC OS X Forensic Field Guide: Digital Forensics Field Guides", Syngress, 2015.

UGFS S7-SP 5-P2: Mobile and Network Forensics

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory						Practical	
Th	Tu	Pr	C	TCH	Internal Exams				University Exams		University Exams (LPW)	Total
					TA-1 & TA-2		MSE					
					Marks	Hrs	Marks	Hrs	Marks	Hrs	Marks	Hrs	
3	1	0	4	4	25	00:45	50	01:30	100	03:00	-	-	200

*Note: TA-2 will be in form of assignments or workshops

Learning Objectives: After studying this paper the students will be able to –

1. Get familiar with the different mobile and network-based technologies.
2. Identify the various artifacts of evidentiary value found in mobile phone devices.
3. Appreciate the different data acquisition techniques used in mobile device forensics.
4. Understand the various evidences to be collected from different networking devices and to analyse the same.
5. Identify the different tools and techniques used for forensic analysis of mobile phones and computer networks.
6. Get to know about the challenges in forensic investigation of mobile phones and computer networks.
7. Get familiar with the basics of cloud computing and Forensics.

MODULE-1 Introduction to Mobile and Network Technologies   Teaching Hours: 15 Hours

Mobile Technologies - Asynchronous Transfer Mode (ATM), Wireless Application Protocol (WAP); Cellular technologies including Advanced Mobile Phone System (AMPS), Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA) and Global System for Mobile Communications (GSM); Functions of Subscriber Identity Module (SIM), International Mobile Equipment Identity (IMEI), Bluetooth and Mobile Payment Gateways; Understanding of the mobile phone operating systems – Android, iOS, Windows; Basics of Rooting \ Jailbreaking.

Basics of Networking - Server, client, routers, Shared Printers and other peripherals, Network Interface Card. Network Devices – hubs, Switches, routers, repeaters; Network Topologies; Introduction to OSI model and TCP/IP model; HTTP, World Wide Web, Web Browsers, Web Servers, Domain Names, URL and DNS; IP addressing – types and classes; Types of Networks – LAN, MAN, WAN and PAN; Routers and Routing Protocols; Basics of Wi-Fi; Basics of Cloud Computing.

MODULE-2   Mobile Device Forensics   Teaching Hours: 15 Hours

Introduction to Mobile Forensic, Types of Evidence present in mobile phones - SIM card, Internal, and evidences in SD card; SIM Card File-system and architecture; Different Stages of Forensic Investigation, Building Mobile Forensic Toolkit, Seizure and Preservation of mobile phones, Data Acquisition, Examination and Analysis, Tool Selection; Data Acquisition Methods –

Manual, Physical, Logical, File System, Advanced Logical, Selective and Qualcomm Acquisition. Extraction of data from damaged phones: JTAG, Chip-off and Micro-Read; Good Forensic Practices; Tracking of mobile phone location. Analysis of mobile data like SMS, call logs, contacts, media files, recordings and important mobile application data (IM Chats like WhatsApp, telegram, iMessage, Email clients, Calendar, Reminder and Note apps); Challenges and Issues in Mobile forensics; CDR and IPDR analysis; Introduction to iOS Device Forensics.

MODULE-3	Network Forensics and Analysis	Teaching Hours: 15 Hours

Common Network Attacks; Post-mortem and Real-time analysis, Live Packet Capturing and Analysis; Searching and collection of evidences from the network; Monitoring of computer network and activities; Log files as Evidence: Legality of using Logs, Ensuring log file accuracy, Log Management System and its functions, Centralized Logging, Challenges and issues in log management and analysis; Event Correlation: Pre-requisites and approaches; Condensing Logs, Security Information and Event Management System (SIEM), tools for SIEM – Splunk, EDR Crowdstrike etc. Log capturing and analysis tools; Collection and Analysis of Router, Firewall and IDS logs; Evidence collection and analysis from CCTV DVRs; Network Packet Analyzer tools; Forensic analysis of online browsing activity and related artifacts; Introduction to Cloud Forensics.

Suggested Reading and Reference Books:

1. Beherouz. A Forouzan; "Data Communication and Networking", 4th Edition, TMH, 2000.
2. Anita Goel; "Computer Fundamentals", Pearson Publications, 2010.
3. Satish Bommisetty, Rohit Tamma and Heather Mahalik, "Practical Mobile Forensics – Dive into mobile Forensics on iOS, Android, Windows and Blackberry Devices with action-packed, practical guide", PACKT Publishing, 2015.
4. Iosif I. Androulidakis, "Mobile Phone Security and Forensics – A Practical Approach", Springer New York Heidelberg, 2012.
5. Sherri Davidoff and Jonathan Ham; "Network Forensics – Tracking Hackers through Cyberspace", Pearson Publications, 2012.
6. Samir Datt; "Learning Network Forensics – Identify and Safeguard your Networks against both Internal and External Threats, hackers and malware attacks", PACKT Publishing, 2016.
7. EC-Council, "Computer Hacking Forensic Investigation, v.9".
8. Jonathan Zdziarski, "iOS Forensic Investigative Methods", 2012.
9. Terrence V. Lillard; "Digital Forensics for Network, Internet and Cloud Computing: A Forensic Evidence Guide for moving Targets and Data", Syngress Publications, 2010.

UGFS S7-SP 5-P3: Vulnerability Assessment and Penetration Testing

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory					Practical		
					Internal Exams				University Exams	University Exams (LPW)		Total
Th	Tu	Pr	C	TCH	TA-1 & TA-2		MSE					
					Marks	Hrs	Marks	Hrs	Marks	Hrs	Marks	Hrs	
3	1	0	4	4	25	00:45	50	01:30	100	03:00	-	-	200

* Note: TA-2 will be in form of assignments or workshops

Learning Objectives: After studying this paper the students will be able to –

1. Understand the need for security assessments and vulnerability management governance.
2. Get familiar with the various tools and techniques used for penetration testing and vulnerability assessment.
3. Identify the modus operandi of different attacks and security assessment pre-requisites.
4. Study the importance of penetration testing and vulnerability assessment in the cyberspace.

MODULE-1   Vulnerability Management Governance and Security Assessment Teaching Hours: 15 Hours

Security Basics, Understanding the need for security assessment, penetration testing lifecycle, OWASP top 10 and testing guide, target scoping and planning, deciding upon the type of vulnerability, Estimating resources and deliverables, Preparing test plans, Information Gathering: Passive and Active Information Gathering.

MODULE-2   Penetration Testing Basics Tools and Techniques   Teaching Hours: 15 Hours

Setting up the virtual lab, Using Kali Linux: Linux File-System, user privileges, file permissions, editing files, data manipulations, managing networking, Netcat; Bash and Python Scripting; Using the Metasploit Framework; Open-source Intelligence Gathering tools and Techniques, Finding Vulnerabilities and Capturing Traffic; Enumeration and Vulnerability Assessment; Gaining Remote Access, Cracking Passwords, Creating Backdoors using Backdoor Factory; Social Engineering; Client-side Exploitation.

MODULE-   Vulnerability Assessment Techniques   Teaching Hours: 15 Hours

Importance of web application security testing, Application Profiling, Common Web Application Security Testing tools, Privilege Escalation, Threat Modelling, Maintaining Access and Clearing

Tracks, Vulnerability Scoring, Bypassing Anti-virus Applications; Vulnerability Reporting and Metrics- Importance of Reporting, type of reports, reporting tools, collaborative vulnerability management with Faraday v2.6 Metrics.

Suggested Reading and Reference Books:

1. Sagar Rahalkar, "Network Vulnerability Assessment: Identify security loopholes in your network's infrastructure", Packt Publishing, Birmingham, 2018.
2. Georgia Weidman, "Penetration Testing: A Hands-on Introduction to Hacking", No Starch Press Inc., USA, 2014.
3. Rafay Baloch, "Ethical Hacking and Penetration Testing Guide", CRC Press, Taylor and Francis, USA, 2015.
4. Patrick Engebreston, "The Basics of Hacking and Penetration Testing", Syngress Press, Elsevier, 2011.

UGFS S7-SP 5-P4: Research Methodology

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory						Practical	
					Internal Exams				University Exams		University Exams (LPW)	Total
Th	Tu	Pr	C	TCH	TA-1 & TA-2		MSE		Marks	Hrs	Marks	Hrs
					Marks	Hrs	Marks	Hrs				
3	1	0	4	4	25	00:45	50	01:30	100	03:00	-	-	200

* Note: TA-2 will be in form of assignments or workshops

Learning objectives: At the end of this course, students will be able to explain;

1. Literature review
2. The development of a research plan
3. Data collection, interpretation and errors
4. Important components for writing the research paper and thesis
5. Basics of Ethical issues, Intellectual property rights, Copy right

MODULE-1   Basics of research   **Teaching Hours: 15 Hours**

Objectives and types of research: Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, and Conceptual vs. Empirical. Research Formulation, Literature review and Development of hypothesis

Research design and methods, developing a research plan - Exploration, Description, Diagnosis, and Experimentation. Determining experimental and sample designs

MODULE-2   Data analysis methods   **Teaching Hours: 15 Hours**

Data Collection and analysis: Methods of data collection – Sampling Methods and Data Processing. Data Analysis: Types of data, Basic concept of frequency distribution, measure of central values – Mean, median and mode, measure of dispersion, range, mean deviation and standard deviation, probability, theory and classical definition of probability, Bayes theorem of probability, conditional probability and coincidence probability, Chi-square test, ANOVA, SPSS. Types of Errors and Interpretation of Findings

MODULE-3 Scientific reports and thesis writing   **Teaching Hours: 15 Hours**

Reporting and thesis writing: Structure and components of scientific reports and thesis, Significance and Different steps in the preparation, Illustrations, Bibliography. Presentations: Oral and Poster, Importance of effective communication in scientific research.

Basics of Ethical issues, Intellectual property rights, Copy right, Reproduction of published material: Plagiarism in scientific research and communications.

Reference books:

1. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International.
2. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, EssEss Publications. 2 volumes.
3. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.
4. Wadehra, B.L. 2000. Law relating to patents, trade marks, copyright designs and geographical indications. Universal Law Publishing.
5. Anthony, M., Graziano, A.M. and Raulin, M.L., 2009. Research Methods: A Process of Inquiry, Allyn and Bacon.
6. Carlos, C.M., 2000. Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options. Zed Books, New York.
7. Leedy, P.D. and Ormrod, J.E., 2004 Practical Research: Planning and Design, Prentice Hall. 12. Satarkar, S.V., 2000. Intellectual property rights and Copy right. EssEss Publications.

UGFS S7 CE-5	Core Elective - V	L	T	P	Cr	2	0	0	2

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UGFS S7-SP5-Pr1: Practical-VII

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory					Practical		
Th	Tu	Pr	C	TCH	Internal Exams				University Exams	University Exams (LPW)		Total
					TA-1 & TA-2		MSE					
					Marks	Hrs	Marks	Hrs	Marks	Hrs	Marks	Hrs	
0	0	8	4	8							100	6:00	100

Learning Objectives:

At the end of course, students will be gaining the hands on training in the following courses;

MODULE-I	Advanced Digital Forensics

1. Windows Registry and Log Data Analysis
2. Hiding and Un-hiding information using steganography
3. Recovery and analysis of slack space data
4. Tracking and analysing of source of email
5. Static and Behavioural analysis of Malware

MODULE-2	Mobile and Network Forensics

1. Data Acquisition and Analysis of Android Phones
2. Analysis of Mobile Applications
3. Traffic Analysis of Network by Live packet capturing
4. Network scanning using different tools
5. Analysing Browser History and Browser Caches of windows system

MODULE-3	Vulnerability Assessment and Penetration Testing

1. Banner Grabbing and Enumeration of web server
2. Port Scanning and Google Dorking
3. Vulnerability Assessment of a website / web application
4. Social Engineering Exploit using Kali Linux
5. Erasing tracks using different tools

MODULE-4	Research Methodology

1. Calculation of mean, median and mode
2. Calculation of standard deviation
3. Calculation of variance
4. Perform chi square test on a given set of data

5. Perform T-test and student's T-test on a given set of values

SEMESTER-VIII

UGFS S8-SP 1/2/3/4/5-Entern	Internship	L	T	P	Cr	0	0	48	24

SEMESTER –IX

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PGFS S9-SP 1/2/3/4/5-P1: Ethics in Science Education and Research

Teaching and Evaluation Scheme

Teaching Scheme					Evaluation Scheme							
					Theory					Practical		
					Internal Exams				University Exams	University Exams (LPW)		Total
Th	Tu	Pr	C	TCH	TA-1 & TA-2		MSE					
					Marks	Hrs	Marks	Hrs	Marks	Hrs	Marks	Hrs	
2	0	0	2	2	25	00:45	50	01:30	100	03:00	-	-	200

* Note: TA-2 will be in form of assignments or workshops

Learning objectives:

At the end of course, students will be able to explain;

1. Ethics in Academic Research
2. Postulates for Maintaining Ethical Standards in Higher Education
3. Ethics with respect to science and research
4. Publication ethics

MODULE-1 Ethics in Higher Education and Academic Research   Teaching Hours: 15 Hours

Ethics in Academic Research, Issues in Research Ethics, Postulates for Maintaining Ethical Standards in Higher Education like; Reliability and Integrity, Objectivity, Genuineness, Respect for Intellectual Property, Novelty in Publication, Confidentiality and Anonymity, Agreement for Consent, Concerns of Ethics in Academic Structure.

MODULE-2   Ethics of Research and Publication   Teaching Hours: 15 Hours

Ethics with respect to science and research, Collaborative Research and Sharing of Credits, Ethical Conventions of Publications, Research Supervisor-Student Relationship, General Responsibilities of Authors, Ethical Conventions of Publications, Peer-Reviewed Scholarly Journals, Predatory journals, Scientific misconducts: falsification, fabrication, and plagiarism, Impact factor of Journals, H-Index.

MODULE-3   Publication Ethics   Teaching Hours: 15 Hours

Publication ethics: definition, introduction and importance, Best practices/standards setting initiatives and guidelines: COPE, WAME, etc. Conflicts of interest, Publication misconduct: definition, concept, problems that lead to unethical behaviour and vice versa, Violation of publication ethics, authorship and contributor ship, Identification of publication misconduct, complaints and appeals.

Suggested Readings:

1. Ethics in Science Education Research and Governance, Edited by K Muralidhar Amit Ghosh AK Singhvi, Indian National Science Academy 2019.
2. Charles E. Harris et al, Engineering Ethics, Cengage, 2009
3. N. N. Das, Ethical Considerations.
4. R. Subramaniam, Professional Ethics Oxford University Press
5. Ranjit Kumar, Research methodology- a step by step guide for beginners, Sage publications, 2011

PGFS S9-SP 1/2/3/4/5-P2	Open Seminar and Comprehensive Viva -I	L	T	P	Cr	0	0	6	3

PGFS S9-SP 1/2/3/4/5-P3	M.Sc. Project (To Be continued in 10th Semester)	L	T	P	Cr	0	0	24	12

SEMESTER –X

PGFS S10-SP 1/2/3/4/5-P1	Open Seminar and Comprehensive Viva -II	L	T	P	Cr	0	0	6	3

PGFS S10-SP 1/2/3/4/5-P2	M.Sc. Project	L	T	P	Cr	0	0	48	24

SYLLABUS FOR CORE ELECTIVES

GROUP-A

CE-1-A	Anti-Dope Forensics	L	T	P	Cr	2	0	0	2

Learning objectives:

At the end of course, students will be able to explain;

1. Anti-Dope Forensics & Drugs of Abuse in Sports
2. Pharmacodynamics and Pharmacokinetics of Dope drugs
3. Dope testing in Humans & Animals

MODULE-1   Introduction to Anti-Dope Forensics & Drugs of Abuse in Sports Teaching Hours: 15 Hours

Doping & Sports Forensics; Problem of Doping in Sports; Types of Sports under anti-doping norms; Introduction to Dope Drugs; New medicines and medical technologies; Stimulants, Anabolic Steroids, Energy Boosters, Contraband Drugs, Growth Hormones, Diuretics, Synthetic Oxygen Carriers, Blood Doping, Insulin, Gene Doping; Therapeutic drug use exemptions.

MODULE-2   Pharmacovigilance and Legal aspects   Teaching Hours: 15 Hours

Pharmacodynamics and Pharmacokinetics of Dope drugs; Protecting the health of the athlete and maintaining clean sport; Healthcare providers at major sporting events; National & International Laws governing doping in sports; Anti- Doping Agencies NADA & WADA; Need of Doping Education & Awareness among athletes.

MODULE-3   Testing & Analysis   Teaching Hours: 15 Hours

Dope testing in Humans & Animals; Guidelines for dope testing; Role of Body Fluids in Analysis of Dope drugs (Blood, Urine, and Saliva & Sweat); International Standards for Dope testing Laboratories and Accreditation, Effective Testing Programs. Case Studies.

Suggested readings:
1. W. Goodwin, A. Linacre, H. Sibte, An Introduction to Forensic Genetics, John Wiley & Sons, England, 2007, pp. 17-25.
2. World Anti-Doping Agency (WADA), The World Anti-Doping Code, Montreal, 2009 (accessed April 2011) http://www.wada-ama.org.
3. At-a-Glance - About Anti-Doping." World Anti-Doping Agency. N.p., 04 July 2014. Web. 18 Apr. 2016.

4. At-a-Glance - The Doping Control Process." World Anti-Doping Agency. N.p., 04 July 2014. Web. 18 Apr. 2016.

5. Reardon, Claudia L., and Creado, Shane. "Drug Abuse in Athletes." Substance Abuse and Rehabilitation (2014): 95-105. Web. 29 Feb. 2016.

6. 2016 Prohibited List." World Anti-Doping Agency. N.p., 29 Sept. 2015. Web. 18 Apr. 2016.

7. Moston, S., & Engelberg, T. (2016). Detecting Doping in Sport (1st ed.). Routledge. https://doi.org/10.4324/9781315718514.

CE-2-A	Incident Response Management	L	T	P	Cr	2	0	0	2

Learning objectives:

At the end of course, students will be able to explain;

1. Key concepts of information security
2. Incident response
3. Steps involved in Incident handling

MODULE-1   Introduction to Incident Response   **Teaching Hours: 15 Hours**

Computer Security Incident, Key Concepts of Information Security, Incident Management, Purpose of Incident Management, Need and Goals of Incident Response, Incident Response Plan, Signs / Indicators of an Incident, Incident Categories, Incident Prioritization, Incident Response, Incident Handling, Estimating Cost of an Incident, Incident Reporting, Incident Response Team, Incident Response Team Members Roles and Responsibilities.

MODULE-2   Management of Incident Response   **Teaching Hours: 15 Hours**

Steps of Incident Response / Handling: 1: Identification, 2: Incident Recording, 3: Initial Response, 4: Communicating the Incident, 5: Containment, 6: Formulating a Response Strategy, 7: Classification, 8: Investigation, 9: Data Collection, 10: Forensic Analysis, 11: Evidence Protection, 12: Notifying External Agencies, 13: Eradication, 14: Systems Recovery, 15: Documentation, 16: Damage and Cost Assessment, 17: Lessons Learned, 18. Review and Update the Response Policies.

MODULE-3 Goals of Incident Response   **Teaching Hours: 15 Hours**

Goals of Incident Response, Incident Response Plan, Incident Identification, Incident Prioritization, Incident Handling, Estimating Cost of an Incident, Incident Reporting, Incident Reporting Organizations, Vulnerability Resources.

References and Suggested Readings:

1. CERT IN Guidelines.

2. ENISA Manuals
3. Computer Incident Response and Forensics Team Management: Conducting a Successful Incident Response, Leighton Johnson, Syngresss
4. Incident Handling and Response: A Holistic Approach for an efficient Security Incident Management by Jithin Alex,
5. The Computer Incident Response Planning Handbook: Executable Plans for Protecting Information at Risk, N.K. McCarthy, Incident Response & Computer Forensics, Jason T. Luttgens, McGraw-Hill

CE-3-A	Multimedia Forensics	L	T	P	Cr	2	0	0	2

Learning objectives:
1. Introduction to multimedia forensics and multimedia files
2. Source identification of multimedia evidences
3. Enhancement and authentication of multimedia exhibits
4. Content analysis of the files

MODULE-1   Introduction to Multimedia Forensics   Teaching Hours: 15 Hours

Need of multimedia forensics, multimedia tools, their applications, forgeries in media files, Handling and preservation of multimedia files, Legal Aspects of digital multimedia evidence, and recovery of audio and video files, copyright infringement, plagiarism and related laws.

MODULE-2   Audio, Video and Image Examination   Teaching Hours: 15 Hours

Authentication of audio, video and image file, enhancement techniques, forensic voice analysis, video/image analysis, Digital Signal Processing, Origin and integrity of multimedia files, digital watermarking, LPC, DFT and FFT, Multimedia file Formats, Tools for Analysis

MODULE-3   CCTV Forensics: Teaching Hours: 15 Hours

Role and functioning of CCTV cameras, Types of CCTVs, CCTV footage analysis, Handling, Preservation and transport of CCTV footages, Video Management system, CCTV surveillance, Intelligent Video analytics and related case studies

Reference books:
1. Forensic Speaker Identification by Phil Rose & James R Robertson
2. Forensic Voice Identification by Harry Hollien
3. The Acoustic Analysis of Speech by Ray D Kent & Charles Read
4. Voice Recognition by Richard L Klevans & Robert D Rodman
5. Multimedia Forensics and Security: Foundations, Innovations, and Applications by Mohamed Mostafa Fouad et al

6. Multimedia Forensics and Security by Chang-Tsun Li
7. Intelligent Video Surveillance Systems by Jean-Yves Dufour
8. Digital Image Processing by Rafael Gonzalez & Richard Woods
9. Digital Image forensics by Roy, A. et al

CE-4-A	Forensic Statistics	L	T	P	Cr	2	0	0	2

Learning objectives:

At the end of course, students will be able to explain;

1. Importance of statistics in Forensic Science
2. Different types of distributions; Normal, Binomial and Poisson
3. Concept of probability theory, Chi square test, Student's t-test etc.

MODULE-1   Introduction to statistics   Teaching Hours: 15 Hours

Importance of statistics in interpreting forensic data in research work and quality control, Data, Population, Distribution, Location, Random experiment, Brief introduction to sampling and data collection, Frequency distribution, Concept of measures of central tendencies, Normal distribution, Arithmetic mean, Median & Mode concept of measures of dispersion, Variance, Normal distribution, Variance, Standard Deviation, Coefficient of variation.

MODULE-2 Introduction to Probability distribution functions   Teaching Hours: 15 Hours

Concept of probability, Definitions of probability, Discrete random variables and probability distributions, Addition, multiplication and Bayer's theorem & applications, Probability in Forensic Evidence, Concept of random variable, Discrete and continuous, Some examples, Concept of probability distribution, Binomial, Poisson, Normal distribution , Definitions, statements of properties of above distribution and examples, Simple linear regression and correlation, Concept of computational methodology, Examples, Concept of tests of hypothesis, Null and alternative hypothesis , Critical region , Types of errors & level of significance

MODULE-3 Statistical tools and techniques   Teaching Hours: 15 Hours

Large samples tests, Test for single mean, Difference of means, Single proportion and difference of proportion examples - Chi square test for goodness of fit and test for independence of attributes, Examples, Hypothesis testing for one or two population means, Student's t-test, t-test for simple mean, Difference of means, Examples. Hypothesis testing for small sample sizes and multinomial experiments, Fisher's exact test, Analysis of variance and multiple comparison tests, F-test for equality of variance, Examples, Concept of analysis of variance, Computational procedure for ANOVA one way and two way classification, Examples.

Suggested Reading:

1. David Lucy: Introduction to Statistics for Forensic Scientists, Wiley, 2004

2. Colin Aitken & Franco Taroni: Statistics and E valuation of Evidence for Forensic Scientists (Statics in

practice)

3. Wing kam Fung & Yue-Quing Hu: Statistical DNA Forensics, Theory Methods & Computation, Wiley,

2008.

4. I. W. Evett & B. S. Wier: Interpreting DNA Evidence – Statistical Genetics for Forensic Scientists, 1998

5. Miller, J. C. and Miller, J. N.: Statistics for Analytical Chemistry, Ellis Horwood, 1988

6. Fisher, R. A.: Statistical Methods for Research Workers, John Wiley, 1954

7. Sokal, R. R. and Rolf, F. J.: Biometry – Principles and Practices of Statistics in Biological Research, Freeman, 1981

8. Bhaskar Rao T.: Methods of Biostatistics, Paras, 2001.

9. Rama Krishnan P., Biostatistics, Saras, 1995.

10. Meier, P. C. and Zund, R. E.: Statistical Methods in Analytical Chemistry, Wiley, 2000.

11. Rao, V. K., Biostatistics – A Manual of Statistical methods for use in Health, Nutrition and Anthropology,

Jaypee Medical Pub., 1996**.**

CE-5-A	Accident Investigations	L	T	P	Cr	2	0	0	2

Learning objectives:
At the end of course, students will be able to explain;

1. Motor vehicle accident

2. The analysis of Pre-crash and Post-crash movement

3. Tachograph data & Tachograph charts

MODULE-1   Motor Vehicle Accidents   Teaching Hours: 15 Hours

Accident scene, Sources of forensic information, Eyewitness accounts, Extent of vehicle damage, Visibility conditions, Photographs of accident site, Estimation of speed, Tire marks, skid marks,

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scuff marks, Maintenance of vehicles, Abandoned vehicles, Importance of air bags, Railway accidents.

MODULE-2	Accident Analysis	Teaching Hours: 15 Hours

Pre-crash movement, Post-crash movement, Collision model, Gauging driver's reaction, Occupants's kinematics, Types of injuries resulting from accident, Biomechanics of injuries, Hit and run investigations, Trace evidence at accident sites.

MODULE-3	Tachographs	Teaching Hours: 15 Hours

Forensic significance of tachograph data, Tachograph charts, Principles of chart analysis, Accuracy of speed record, Tire slip effects, Falsification and diagnostic signals, Route tracing.

References and Suggested Readings:

1. T.S. Ferry, Modern Accident Investigation and Analysis, Wiley, New York (1988).
2. D. Lowe, The Tachograph, 2nd Edition, Kogan Page, London (1989).
3. T.L. Bohan and A.C. Damask, Forensic Accident Investigation: Motor Vehicles, Michie Butterworth, Charlottesville (1995).
4. S.C. Batterman and S.D. Batterman in Encyclopedia of Forensic Sciences, Volume 1, J.A. Siegel, P.J. Saukko and G.C. Knupfer (Eds.), Academic Press, London (2000).

CE-6-A	Immunology and Immunological Techniques	L	T	P	Cr	2	0	0	2

Learning objectives:
At the end of course, students will be able to explain;

1. Immunology
2. Fundamentals of Antigen and Antibody
3. Different techniques to study antigen-antibody interactions

MODULE-1	Overview of Immunology	Teaching Hours: 15 Hours

Phylogeny of immune system, Innate and Acquired immunity, Clonal nature of immune response, Cells and Organs of the immune system: Hematopoiesis and differentiation, B-lymphocytes, T-lymphocytes, Macrophages, Dendritic cells, Natural killer cells, Lymphokine activated killer cells, Eosinophils, Neutrophils and Mast cells, Organization and structure of lymphoid organs.

MODULE-2 Antigen and Antibody	Teaching Hours: 15 Hours

Antigen – Epitope, essential factors for antigenicity, haptenes and adjuvant. Antibody: structure and function, antigenic determinants on immunoglobulins, isotypic, allotypic and ideotypic variants, antigen and antibody interactions, and their importance, Major histocompatibility complex and their importance in Forensics, Antigen Processing and presentation, Cytokines and their role in immune regulation.

MODULE-2 Immunotechniques	Teaching Hours: 15 Hours

Different techniques to study antigen-antibody interactions, immunodiffusion, Immunoelectrophoresis, radioimmunoassay, ELISA, immunohistochemistry, development of dot blot, Flow cytometry, production of monoclonal and polyclonal antibodies, hybridoma technology, Vaccine, Concepts of vaccines, whole-organism vaccines, recombinant vaccines, DNA vaccine, synthetic peptide and multivalent sub unit vaccines., different strategies of vaccine development.

Reference Books

1. 1.J. Owen, J. Punt, S. Stranford, (2012) Kuby Immunology (8th Edition), WH Freeman
2. and Company, USA.
3. 2.J.M. Berg, J.L. Tymoczko, L. Stryer. (2012) Biochemistry (7th Edition), WH Freeman
4. and Company, USA.
5. 3.D. Male, J. Brostoff, D. Roth, I. Roitt, (2012) Immunology (8th Edition), Saunders,
6. Elsevier, USA.
7. 4.K. Murphy (2011) Janeway's Immunobiology (8th Edition), Garland Science, USA.
5. A. Abbas, A. Lichtman, S. Pillai, (2014) Cellular and Molecular Immunology (8th
8. Edition), Saunders, Elsevier, USA

GROUP-B

Core electives:

CE-1-B	Clinical Toxicology	L	T	P	Cr	2	0	0	2

Learning objectives:

At the end of course, students will be able to explain;

1. General principle of clinical toxicology
2. Epidemiological toxicity & drug toxicology
3. Heavy metal & Pesticide induced toxicity

MODULE-1	Overview of Clinical Toxicology	Teaching Hours: 15 Hours

General principle of clinical toxicology, acute, sub-acute, sub-chronic and chronic toxicity, human healthcare, Estimation of LD50 and ED50, Symptoms of clinical toxicity, Assessment of clinical symptoms, complete blood count profile, kidney and liver function test, urine test etc., Erythrocyte sedimentation rate (ESR) determination and its importance in the diagnosis of certain diseases, Duties and responsibilities of registered medical practitioner, forensic investigator and police person, Green toxicology for the protection human and environment health.

MODULE-2	Epidemiological toxicity & drug toxicology	Teaching Hours: 15 Hours

Epidemiological toxicity, poisoning, risk assessment and characterization methods, exposure and hazard assessment, Drug safety and evaluation, drug toxicology, adverse reaction of drug, Carcinogenic and non-carcinogenic effects of environmental toxicants, head and neck cancer, cancer risk assessment, Neurobehavioral dysfunctions in children and adults, occupational hazards, chronic poisoning and adverse consequences.

MODULE-3		Teaching Hours: 15 Hours

Heavy metal induced toxicity: Signs and Symptoms of arsenic, lead, cadmium, mercury toxicity, oxidative stress, Analysis of heavy metal in tissue and body fluids, food items, extraction techniques of these heavy metal and their determination, Determination of trace metals present in cosmetic products and their toxic effects, method of clinical assessment, common antidotes.

Pesticide induced toxicity: Types of pesticides, classification, uses, harmful clinical effect and treatment, Pesticide poisoning in farmers, suicides, depression and neuropsychological effects, assessment of clinical symptoms, general health questionnaire (GHQ), Mechanism of action of pesticide toxicity, first aid in pesticide poisoning, method of clinical assessment, common antidotes.

References and Suggested Readings:

1. Modi JS: Medical Jurisprudence and Toxicology

2. Brent , J. , K. L. Wallace , K. K. Burkhart , et al., eds. Critical Care Toxicology . Philadelphia: Elsevier Mosby , 2005.

3. Parikh CK: Medical Jurisprudence and Toxicology

4. Levine , B. Postmortem forensic toxicology . In Principles of Forensic Toxicology , ed. B. Levine , pp. 3 – 13 . Washington, DC : AACC Press , 2003 .

5. Mancuso , J. D. , M. Ostafi n , and M. Lovell , Postdeployment evaluaton of health risk communication after exposure to a toxic industrial chemical . Mil. Med . 173 : 369 – 374 , 2008 .

6. Laboratory Procedure Manual- Forensic Toxicology, DFS, MHA, New Delhi

7. Pharmacology and Therapeutics-Bhandarkar & Satoskar 8. Essentials of Toxicology- Ellenhorn

CE-2-B	Forensic DNA Analysis	L	T	P	Cr	2	0	0	2

Learning objectives:

At the end of course, students will be able to explain;

1. Basics of DNA
2. Forensic DNA typing
3. Paternity testing

MODULE-1   Basics of DNA   **Teaching Hours: 15 Hours**

Importance of DNA as an evidence in forensic investigation, sequence polymorphisms, individualization of evidence. Structures and functions of nucleic acids, Mitochondrial DNA and its importance. Collection of different biological specimens for DNA analysis.

MODULE- Forensic DNA Typing   **Teaching Hours: 15 Hours**

Principles of extraction and quantification of DNA, Fundamentals of Polymerase chain reaction and its application in forensic DNA analysis, Restriction fragment length polymorphism (RFLP) – genetic markers used in RFLP, typing procedure and interpretation of results, DNA markers, Role of fluorescent dyes, Introduction of Touch DNA in solving crimes.

MODULE-3   Parentage Testing   **Teaching Hours: 15 Hours**

Genetics of paternity in human, Mandelian laws and its relevance in paternity testing, Mathematical basis of parentage identification, Report Writing: Role of DNA typing in identifying unrecognizable bodies.

Allele frequency determination, Hardy-Weinberg law, Probability determination in a population database

References and Suggested Readings:

1. J.M. Butler, Forensic DNA Typing, Elsevier, Burlington (2005).
2. K. Inman and N. Rudin, An Introduction to Forensic DNA Analysis, CRC Press, Boca Raton (1997).
3. H. Coleman and E. Swenson, DNA in the Courtroom: A Trial Watcher's Guide, GeneLex Corporation, Washington (1994).
4. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's, Techniques of Crime Scene Investigation, CRC Press, Boca Raton (2013).

CE-3-B	Forensic Engineering	L	T	P	Cr	2	0	0	2

Learning objectives:

At the end of course, students will be able to explain;

1. Basics of forensic engineering
2. Role and Responsibility of an Engineer at design

MODULE-1   General   **Teaching Hours: 15 Hours**

Scope and need of forensic engineering, basic principles, scientific methods and its application to forensic engineering Definition, Types and root causes of Engineering Failures, Historical context, data collection and information dissemination.

MODULE-2   Case Studies on Engineering Failure   **Teaching Hours: 15 Hours**

Learning from failure: Case studies based on material failure, product failure, structural failure, electrical - mechanical failure, Construction, Chemical, Fires, Blast and Mining related failure.

MODULE-3   Role and Responsibility and Standards   **Teaching Hours: 15 Hours**

Role and Responsibility of an Engineer at design, construction and maintenance stage, Relevant standards for forensic engineering inspections and investigations. Recommendations for Design and Construction Improvements.

References and Suggested Readings:

1. Crime scene management–A scientific approach M.S.Dahiya (2009)
2. Vehicular accident Investigation and reconstruction Kirk (2000)
3. Forensic Engineering Investigation Noon (2009)
4. Forensic Engineering Carper (2000)
5. Forensic Science James Nordby (2005)

CE-4-B	Applied Cryptography	L	T	P	Cr	2	0	0	2

Learning Objectives:

After studying this paper the students will know –

1. The basics concepts of security and cryptography
2. Computer-based symmetric and asymmetric cryptography algorithms
3. Public-Key Infrastructure and Internet Security Protocols.
4. User Authentication Mechanisms and Network Security.

MODULE-1   Concepts of Security and Cryptography Techniques   Teaching Hours: 15 Hours

Need for security, security approaches, basics of cryptography techniques, Substitution and Transposition ciphers, Symmetric and Asymmetric key cryptography, Possible types of attacks, Data Encryption Standard (DES), International Data Encryption Algorithm (IDEA), RC4, Advanced Encryption Standard (AES), Blowfish.

MODULE-2 Asymmetric Key Algorithms, PKI and Internet Security Protocols   Teaching Hours: 15 Hours

Overview of asymmetric key cryptography, RSA Algorithm, Digital Signatures, Attacks on digital signatures, problems with public-key exchange; Introduction to Public-Key Infrastructure, Digital Certificates, Private-key management, Public-key cryptography standards, XML, PKI and security; SSL-TLS, HTTPS v/s SHTTP, Secure Electronic Transaction (SET), SSL v/s SET, Email Security, Wireless Application Protocol (WAP), IEEE 802.11 Security, Security in GSM and 3G.

MODULE-3   User Authentication Mechanisms and Network Security   Teaching Hours: 15 Hours

Introduction, Authentication Basics, Passwords, Authentication Tokens, Certificate-based authentication, Biometric Authentication, Kerberos, Key Distribution Center (KDC), Single Sign On (SSO) approaches, attacks on authentication schemes; Introduction to Network Security, Firewalls- types and techniques, IP Security, Virtual Private Networks (VPNs), Intrusion, IDS and IPS.

Suggested Readings:

1. Atul Kahate, "Cryptography and Network Security", 3rd Edition, McGraw Hill Education (India) Pvt. Ltd., New Delhi, 2009.
2. Nina Godbole and Sunit Belapore, "Cyber Security: Understanding Cyber-crimes, Computer Forensics and Legal Perspectives", Wiley Publications, 2011.
3. William Stallings. "Cryptography and Network Security: Principles and Practices, 5th Edition", Prentice Hall Publication Inc., 2007.

CE-5-B	Data Science & Artificial Intelligence	L	T	P	Cr	2	0	0	2

Learning Objectives:

1. To understand concept of Artificial Intelligence, Machine Learning and Deep Learning
2. To learn various Machine Learning and Deep Learning techniques
3. To create models to understand applications of AI
4. Understand the importance of the body language and gesture

MODULE-1 Introduction to Python   **Teaching Hours: 15 Hours**

Python: Setting up Environment, Basic Python Commands, Creating Python Scripts, Conditions, Loops, List, Dictionary, User Defined Functions, Introduction to Anaconda, Working with NumPy, Pandas and Matplotlib.

Mathematics for Machine Learning: Vectors, Matrices, Linear Equations, Mean, Median, Mod, Standard Deviation and Variance, Probability, Correlation, Regression, Handling and Representing Data.

MODULE-2 Machine Learning (ML)   **Teaching Hours: 15 Hours**

Definition and History of AI, Defining Machine Learning, Applications of ML, Issues and Challenges in ML, Types of ML. Basics of Supervised Learning, Prediction, Classification, Understanding Datasets, Feature Selection, Feature Normalization, Data Cleaning, Training, Testing & Validation Sets, Different Models of Supervised Learning, Hyper parameters, Measuring Performance, Accuracy and Loss Underfitting & Over fitting, Basics of Unsupervised Learning, Different Models of Unsupervised Learning.

MODULE- 3 Neural Network: **Teaching Hours: 15 Hours**

Understanding Biological Brain, Defining Artificial Neural Network (ANN), Applications of ANN & DL. Defining & Building a Perceptron, Feed Forward, Back propagation, Single-layer & Multi-

layer ANNs, building an ANN Model, Activation & Loss Functions, Compiling & Evaluating a Model. Convolutional Neural Networks (CNN): Understanding Convolutions, Pooling, Building & Fitting CNN Models, Evaluating Model Performance. Recurrent Neural Networks (RNN): Basic RNN Architecture, Applications of RNN, Building &

Fitting RNN Models, Evaluating Model Performance. Long Short-Term Memory Networks (LSTM): LSTM Network Architecture, Understanding LSTM, Building LSTMs.

References books:

1. Mathematics for Machine Learning 1st Edition by Marc Peter Deisenroth
2. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems 2nd Edition by Aurélien Géron
3. Python Machine Learning: Machine Learning and Deep Learning with Python, scikit-learn, and TensorFlow 2, 3rd Edition by Sebastian Raschka and Vahid Mirjalili
4. Hands-On Neural Networks with Keras: Design and create neural networks using deep learning and artificial intelligence principles 1st Edition by NiloyPurkait
5. Deep Learning with Keras: Implementing deep learning models and neural networks with the power of Python by Antonio Gulli, Sujit Pal6. Practical Machine Learning for Computer Vision 1st Edition by Valliappa Lakshmanan, Martin Görner and Ryan Gillard
6. Learning OpenCV 4 Computer Vision with Python 3: Get to grips with tools, techniques, and algorithms for computer vision and machine learning, 3rd Edition by Joseph Howseand Joe Minichino
7. Natural Language Processing in Action: Understanding, analyzing, and generating text with Python 1st Editionby Hobson Lane, Hannes Hapke and Cole Howard.
8. Machine Learning for Cybersecurity Cookbook: Over 80 recipes on how to implement machine learning algorithms for building security systems using Python by Emmanuel Tsukerman.

CE-6-B	Forensic Photography	L	T	P	Cr	2	0	0	2

MODULE-1   Basics of Photography   Teaching Hours: 15 Hours

Photography History , Types of Cameras, lenses, filters, films, exposing, , Reprovit unit, Specialized photography-UV, IR, close up, transmitted light, side light, trick photography, contact print photography, oblique light photography. Photography using scientific equipment and instruments, Development & printing process of photographs, different kinds of developers and fixers.

MODULE-2   Types of Forensic Photographical Techniques   Teaching Hours: 15 Hours

Photomicrography and macro photography, Digital photography, Scope of photography in various disciplines of forensic science-finger prints, foot prints, physics, chemistry, biology, ballistics, computer forensics etc. basic concepts of videography/high speed videography, application of videography in police work, Detection of manipulated digital image for identification, photography as secondary evidence. Crime scene and laboratory photography.

MODULE-3	**Photography in Forensics**	**Teaching Hours: 15 Hours**

Software for digital photography, file formats - jpg, gif, bmp, tiff, raw etc., digital watermarking, photogrammetry, radiography, image enhancement of mutilated/soiled/old documents., Faro technology for 3D documentation of crime scene CCTV image enhancement, processing of digital images and its manipulation. Case studies. Laws relating to digital evidence and its admissibility.

References and Suggested Readings:

1. Ang Tom; "The Complete Photographer", Dorling Kindersley Ltd., 2010.
2. Gernsheim Helmut; "A concise history of Photography", 3rdEd., Dover Publications, 1986.
3. Freeman Michael; "The Complete Guide to Digital Photography", 4thEd., Lark Books, 1945.
4. Farrell Ian; "Complete Guide to Digital Photography", Quercus Publications, 2017.
5. Edge Martin; "The Underwater Photographer", Focal Press, 2010.
6. Bergner Joachim, E. Gelbke, W. Mehliss; "Practical Photomicrography", Focal Press, 1966.
7. White Laurie; "Advance Infrared Photography", Amherst Media, 1995. Feininger Andreas; "The Complete Photographer", Prentice Hall, 1965.

Skill Based Elective

SE-1	Communication skill	L	T	P	Cr	2	0	0	2

Learning objectives:

At the end of course, students will be able to;

1. Improve the communication skills
2. Understand the importance of the body language and gesture

MODULE-1   Importance and process of Communication   Teaching Hours: 15 Hours

Verbal and Non-verbal process of Communication, How to face an interview, Group Discussion, How plan and conduct the Interviewer, importance of body language and gesture in interview, eye contact and appearance during interview process.

MODULE-2   Different skills and Its importance   Teaching Hours: 15 Hours

Listening, Developing Reading Skills, Developing Conversational skills, Technical Writing skills.

References and Suggested Readings:

1. Sreevalsan, MC; Spoken English, Vikash Publishing House, New Delhi.
2. Communication Skills; Sanjay Kumar, Pushphate, Oxford.
3. Krishna Mohan, Meera Banarjee, Developing Communication Skills.
4. Frank O' Connor, Phonetics, Pengiun.
5. Business Correspondence and Report Writing- Sharma and Krishna Mohan- Tata Mgraw.

SE-2	English	L	T	P	Cr	2	0	0	2

Learning objectives:

At the end of course, students will be able to;

1. Improve English speaking
2. Communicate official letters and circular

MODULE-1   Basic Grammar   Teaching Hours: 15 Hours

Articles , Verbs: Auxiliaries, Finite and Non Finites, Time and Tense , Subject: Verb Agreement (concord), Active and Passive Voice, Narration, Single word / verb substitution, Common Error, Comparison, Antonym, homonym, Sentence, Building (Vocabulary).

| MODULE-2 | Formal and Official Writing | | | Teaching Hours: 15 Hours |

Précis, Essay, Paragraph Writing and Comprehension, Official Correspondence, Memorandum; Circular Letter.

References and Suggested Readings:

1. English Grammar- N.D. Turton, ABC of Common Grammatical Error for learners and Teachers.
2. English Grammar- Dr. K.K. Ramchandran etal; business Communication.
3. Technical English- Sharon j Gerson and Steven M Gerson
4. Angela Burt, Quick Solutions to common Error in English.
5. W. Foulsham, The Complete letter writer.
6. John East wood- Oxford guide to English Grammar.

SE-3	Yoga and its benefits-I	L	T	P	Cr	2	0	0	2

Learning objectives:

At the end of course, students will be able;

1. To perform various Pranayam
2. To understand the power of meditaton
3. To understand the impact of yoga on health

| MODULE-1 | Self and Self Identity | Teaching Hours: 15 Hours |

- Concept of Self and Self-identity
- Indian Concept of Self with reference to Satva, Rajas and Tamas Guna
- Constituent of Panch Kosh
- Components of Self – Attitude, Beliefs, Values

| MODULE-2 | Pranayama | Teaching Hours: 15 Hours |

Foundations of Yoga: History, Evolution of Yoga and Schools of Yoga.

Perform any five;

1. Anulom vilom,
2. Bhrastika,
3. Kapalbhanti,
4. Shitali,
5. Sitkari,
6. Bhramari,
7. Surya bhedan
8. Chandra Bhedan

SE-4	Yoga and its benefits-II	L	T	P	Cr	2	0	0	2

Learning objectives:

At the end of course, students will be able;

1. To apply the knowledge yoga in the well-being of self and society
2. To explain the concept of Spiritualism and Integral Humanity
3. To perform various Asanas

MODULE-1   Development of Spiritual Self   **Teaching Hours: 15 Hours**

- Concept of Spiritual Self, Spiritualism and Integral Humanity

- Process of Self-awareness, Self-observation, Introspection and Austerity

- Concept of Sthitpragya (Bhagwad Geeta Ch-2)

- Yoga as a tool for Integration of Individual and Universal Self (Ashtang Yog)

MODULE-2   Perform Asanas, (Any Twelve)   **Teaching Hours: 15 Hours**

a) Sitting Posture: Matsyendrasana, Kukkutasana, Vakrasana, JanuShirshasana, Bakasana

b) Sleeping Posture: Ardha Salbhasana, Navkasana, Mandukasana, Matsyasana, Setubandhasana

c) Standing Posture: Katichakrasana, Ustrasana, Garudasana, Virbhadrasana, Adho mukhasana