BHARATHIAR UNIVERSITY, COIMBATORE

B.Sc FORENSIC SCIENCE

(For the CPP /CPOP students admitted from the academic year 2017-18 onwards)

SCHEME OF EXAMINATION- CBCS PATTERN

Part	Study Components	Course title	Hrs/week	Examinations				Credits
				Dur. hrs	CIA	Marks	Total Marks	
	Semester - I							
I	Language –I		6	3	25	75	100	4
II	English- I		6	3	25	75	100	4
III	Core Paper I- General Forensic Science		4	3	25	75	100	4
	Core Paper II- Introduction to Psychology		4	3	25	75	100	4
	Allied A :General Chemistry		4	3	20	55	75	3
IV	Environmental Studies #		2	3	-	50	50	2
	Semester II							
I	Language- II		6	3	25	75	100	4
II	English- II		6	3	25	75	100	4
III	Core Paper III : Forensic Psychology		4	3	25	75	100	4
	Core Practical I : Introduction to Psychology &Forensic Psychology		3	3	40	60	100	4
	Allied A : Forensic Chemistry		4	3	20	55	75	3
	Allied Practical : General Chemistry &Forensic Chemistry		2	3	20	30	50	2
IV	Value Education – Human Rights #		2	3	-	50	50	2
	Semester III							
I	Language –III		6	3	25	75	100	4
II	English- III		6	3	25	75	100	4
III	Core Paper IV- Crime Scene Management		4	3	25	75	100	4
	Core Paper V- Instrumentation- I		4	3	25	75	100	4
	Allied B : ForensicPhysics		4	3	20	55	75	3
IV	Skill based subject I- Crime scene reconstruction		2	3	20	55	75	3
	Tamil @ / Advanced Tamil # (OR) Non- major elective- I (Yoga for Human Excellence # / Women's		2	3	50		50	2

	Rights# / Constitution of India #)						
	Semester IV						
I	Language- IV	6	3	25	75	100	4
II	English- IV	6	3	25	75	100	4
III	Core Paper VI- Questioned Documents and Fingerprint Examination	4	3	25	75	100	4
	Core Practical II- Crime scene Management, Questioned Documents and Fingerprint Examination	3	3	40	60	100	4
	Allied B : General Biology	4	3	20	55	75	3
	Allied Practical: General Biology	2	3	20	30	50	2
IV	Skill based subject II –Statistics for forensic science-Basic	2	3	20	55	75	3
	Tamil @ / Advanced Tamil # (OR) Non- major elective- II (General Awareness #)	2	3	50		50	2
	Semester V						
III	Core Paper VII- Forensic Toxicology	4	3	25	75	100	4
	Core Paper VIII- Forensic Ballistics	4	3	25	75	100	4
	Core Paper IX- Instrumentation- II	4	3	25	75	100	4
	Core Paper X- Forensic Biology	4	3	25	75	100	4
	Elective I	4	3	25	75	100	4
IV	Skill based subject III - Statistics for forensic science-Advanced	2	3	20	55	75	3
	Semester VI						
III	Core Paper XI- Forensic Serology	4	3	25	75	100	4
	Core Practical III- Forensic Biology &Forensic Serology	3	3	40	60	100	4
	Core Practical IV- Forensic Ballistics &Forensic Toxicology	3	3	40	60	100	4
	Elective II	4	3	20	55	75	3
	Elective III	4	3	20	55	75	3
IV	Skill based subject IV – Good laboratory practices	2	3	20	55	75	3
V	Extension Activities @	-	-	50	--	50	2
	Total					3500	140

Elective- I	**Elective- II**	**Elective- III**
Criminology and Criminal Justice Administration	Police Administration	Criminal Law
Forensic Audio-Video Analysis	General Physics	Research Methodology and Statistics
Forensic Medicine	Forensic Anthropology and Odontology	DNA Typing

SEMESTER I

GENERAL FORENSIC SCIENCE

UNIT I: Introduction to Forensic Science 12 Hours

Forensic Science: Definition, history and development - Scope and need of forensic science in criminal justice system- Development of forensic science in India- Locard's principle of exchange- Tools and techniques used in forensic science and various disciplines in forensic science- Organization setup of Forensic Science Laboratory: Structure and function of State, Regional and Central Forensic Science Laboratories. Role of Mobile Forensic Science Laboratory in crime scene investigation.

UNIT II: Forensic Organizations 12 Hours

Organization setup and functioning of Government Examiner of Questioned Document- Central Police Organization associated with forensic science: National Police Academy, Bureau of Police Research and Development, National Institute of Criminology & Forensic Science and Central Detective Training School- World Anti-Doping Agency and Defense Research and Development Organization- National Drug Testing Laboratory and Centre for Cellular & Molecular Biology- Fingerprint Bureau's in India- Drug Enforcement Administrator and INTERPOL etc.

UNIT III: Forensic Science and Criminal Justice System 12 Hours

Criminal Justice System: Law Enforcement Agency, Prosecution & Judicial Organization, Correctional Institutions- Introduction to crime scene investigation, definition and causation of Crime, Modus Operandi and its role in investigation; Crime scene - types and characteristics- Crime scene management: information management, manpower management, technology management, logistics management, protection, documentation, reconstruction, legal consideration at the crime scene.

UNIT IV: Physical Evidences and its significance 12 Hours

Physical Evidence: definition, types, significance, collection, preservation, packing and forwarding of different evidence to the forensic laboratory- Bloodstain Pattern Analysis: terminology, Blood physics, Spatter patterns, Motion and directionality, point of origin and point of convergence, preservation of blood evidence, procedures and precautions.

UNIT V: Forensic Science and Law 12 Hours

Education of Forensic Science, Ethics in Forensic Science and Role of Media- Duties & Qualification of Forensic Scientist- Forensic Scientist at the Crime Scene- Presentation of Expert Evidence, Evidence in The Court of Law, Report writing & Evidence presentation, Components of reports and report format (according to ISO/IEC 17025:2005).

REFERENCE BOOKS

- Bruce A. Arrigo; Introduction to Forensic Psychology, Academic press London, 2000.
- Bridges BC; Criminal Investigation, Practical Finger Printing, Thumb Impressions, Hand writing Expert testimony opinion Evidence, University Book Agency, Allahabad, 2000.
- Criminalistics- An Introduction To Forensic Science, Saferstein.R, Printice Hall Inc. USA, 2003.
- Criminalistics- The Foundation of Forensic Science, Fischer Berry, Tilstone William, Elsevier Publication, UK.
- Crime Scene Investigation, Dutelle, Aric W, Jones and Bartlette Learning, 2014.
- Encyclopedia of Forensic Science, Suzanne Bell, Viva Books Pvt. Ltd, 2010.
- Forensic Science in Criminal Investigation & Trail, Sharma B.R, Central Law Agency, Allahabad.
- Nanda, B.B. and Tewari, R.K; Forensic Science in India- A vision for the twenty first century, Select Publisher, New Delhi, 2001.
- James, S.H. and Nordby, J. J.; Forensic Science; an Introduction to Scientific and Investigative Techniques, CRC Press, USA, 2003.
- Saperstein: Criminalities – An Introduction to Forensic Science, Prentice Hall Inc. USA, 1995.
- C. G. G. Aitken and D. A. Stoney; the use of statistics in Forensic Science, Ellis Harwood Limited, England, 1991.
- Hess, A. K. and Weiner, I. B.; Handbook of Forensic Psychology, 2nd Ed., John Wiley & Sons, 1999.
- David L. Shapiro; Forensic Psychology Assessment and Investigative Approach, Allyn and Bacon Publisher, 1991.
- Mario Deva RGAS; the Total Quality Management, NCC Blackwell Pub., 1995.
- Jams St. Clair; Crime Laboratory Management, Academic Press/ Elsevier, 2002.

INTRODUCTION TO PSYCHOLOGY

UNIT I: Understanding Psychology 12 Hours

Psychology: definition, psychology as a discipline, psychology as science and social science, understanding mind and behavior- Evolution of psychology: philosophical and biological origin- Schools of psychology: Structuralism, Functionalism, Behaviorism, Psycho-dynamic and Gestalt psychology- Different branches of psychology: biological psychology, cognitive psychology, social psychology, developmental psychology, clinical psychology, counseling psychology, educational/school psychology, industrial/ organizational psychology, forensic psychology, military psychology and sports psychology- Scope and goals of psychology.

UNIT II: Physiological Psychology 12 Hours

Neurons: Structure of neurons, External, internal and supporting structures, types of neurons- Neural impulse transmission-electrical and chemical, role of neurotransmitters- The Anatomy of the Nervous system and The Peripheral Nervous system- Central Nervous system, Forebrain, Midbrain and Hindbrain, Hypothalamus, Cortex, Spinal cord. Autonomic Nervous system: Sympathetic and Parasympathetic Nervous system- The Endocrinesystem: The endocrine glands and hormones, hormonal influence on learning and memory, effects of hormones on human behavior.

UNIT III: Sensation and Perception 12 Hours

Sensation: Selection, Sensory Adaptation, Analysis & Coding- Perception: sensing, perceiving, classifying, Gestalt principles- Learning: nature and features of learning- Classical conditioning: Elements, principles, generalization, discrimination, second order conditioning- Operant conditioning: Reinforcement, punishment, shaping, chaining, stimulus control, schedules of reinforcement, partial reinforcement effect- Social learning theory.

UNIT IV: Altered State of Consciousness 12 Hours

States of mind: Nature of consciousness- Changes in consciousness: dream and sleep- Stages of sleep- Altered states: Hypnosis- facts and myths, meditation, drug induced states- Memory: Encoding, storage and retrieval processes- Three levels of memory- Sensory, short term and long term memories- Atkinson-Shiffrin Model of memory- Implicit and explicit memory- Semantic, episodic and procedural memory.

UNIT V: Human Personality 12 Hours

Motivation: model of motivation-need, drive, response and goal- Primary and secondary motives- Learned motives: affiliation, achievement and power motives- Maslow's theory of hierarchical motives- Human Personality and Assessment of Personality,Personality-categorizing by types, describing by traits. Freud's Psychoanalytical theory–levels of consciousness, structure of personality-id, ego & superego, psychosexual stages of development and defence mechanisms.

REFERENCE BOOKS

- Andreassi, J. L. (2000). *Psychophysiology: Human behavior and physiological response* (4th Ed.). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.
- Baron, R.A. (2004). *Psychology*, 5th Ed. New Delhi: Pearson Education.
- Bootzin, R., & Bower, G.H. (1991). *Psychology today-An Introduction*, 7th ed. New York: McGraw Hill Inc.
- Coon, D. (1983). *Introduction to psychology: Exploration and application*. New York: West Publishing Co.
- Feldman R.S (2011).*Understanding Psychology*, 10th edition. Delhi: Tata- McGraw Hill.
- Friedman, H. S. & Schustack, M.W. (2003). *Personality: Classic Theories and Modern Research*, 2nd Ed... Delhi: Pearson Education.
- Leukal, F. (1985). *An Introduction to Physiological Psychology*. (1st Ed.). New Delhi: CBS Publishers and Distributors.
- Levinthal, C.F. (1996). *Introduction to Physiological Psychology* (3rd Ed.) Prentice-Hall of India Pvt. Ltd.
- Morgan, C.T., King, R.A., Weisz, J.R., & Schopler, J. (1993). *Introduction to psychology*, 7th Ed. New Delhi: Tata McGraw Hill.
- Munn, N.L., Fernald, L.D., & Fernald, P.S. (1997). *Introduction to Psychology*. Delhi: Houghton Mifflin.
- Rosensweig, M.R., Leiman, A. L., Breedlove, & S. Marc, (1996). *Biological Psychology*, Sinauer Associates, lnc.
- Schneider, A.M. & Tarshis, B. (1986). *An Introduction to Physiological Psychology*.(3rd Ed.). New York: Random House, Inc.
- Weiten, W. (2002) *Psychology: Themes and variations*, 5th Ed. New York: Brooks/Cole Publishing Co.
- Zimbardo, P. G. *Psychology and Life* (12th Ed.). Glenview, IL: Scott, Foresman. 1988.

GENERAL CHEMISTRY

UNIT I: Organic chemistry 12 Hours

Basic concepts in organic chemistry- Bond cleavage: homolytic and heterolytic- Types of reagents – electrophilic and nucleophilic reagents- Reactive intermediates - generation and relative stabilities of carbocation, carbanion, carbon free radicals and carbenes – explanation for stability and reactivity based on inductive, resonance and hyper conjugation effects- Types of reactions - addition, substitution and elimination- Concept of isomerism - structural isomerism, stereo isomerism - geometrical and optical isomerism- Aliphatic Hydrocarbons: Alkanes, cyclo - alkanes, alkenes and alkynes- Aromatic compounds: Stability and general features.

UNIT II Stereochemistry 12 Hours

Stereochemistry: Elements of symmetry in chiral and achiral molecules, chirality, stereogenic center. Fischer projection formulae. - Enantiomers: Optical activity; use of +/–, D/L and D/L notations. Properties of enantiomers, chiral and achiral molecules with two stereogenic centers. Meso compounds. Cahn-Ingold-Prelog sequence rules: R, S system of nomenclature.- Diastereomers: Threo and Erythro isomers. Racemisation and resolution. Relative and absolute configuration.-Geometric isomerism: Determination of configuration of geometric isomers. Cis &Trans, E, Z system of nomenclature.

UNIT III Bio molecules 12 Hours

Carbohydrates: Introduction and classification. Monosaccharide's: Aldoses, structures of all the D-aldohexoses. - Elucidation of open chain structure of D-glucose. Mechanism of mutarotation and anomeric effect. - Elucidation of ring structure of D-glucose in detail. Ketoses: Fructose, interconversion of glucose and fructose.-Disaccharides: Glycosidic bond. Structures of maltose, lactose and sucrose-Haworth and conformational structures. Terpenes and terpenoids: Occurrence, classification and isoprene rule. Elucidation of structure and synthesis of citral and zingiberene. Structures of limonene, menthol, □-terpineol, camphor, □- carotene, Vitamins-A and their uses.-Alkaloids: Introduction, classification and general characteristics. Structural elucidation and synthesis of nicotine.Structures and uses of ephedrine, caffeine, cocaine, atropine, quinine and morphine.

UNIT IV: Organo-metallic compounds 12 Hours

Organo-metallic compounds: Definition and Classification with appropriate examples based on nature of metalcarbon bond (ionic, s, p and multicentre bonds). Structures of methyl lithium, Zeiss salt and ferrocene. EAN rule as applied to carbonyls. Preparation, structure, bonding and

properties of mononuclear and polynuclear carbonyls of 3d metals. p - acceptor behaviour of carbon monoxide. Synergic effects (VB approach)- (MO diagram of CO can be referred to for synergic effect to IR frequencies).-A brief introduction to bio-inorganic chemistry. Role of metal ions present in biological systems with special reference to Na+ , K+ and Mg2+ ions: Na/K pump; Role of Mg2+ ions in energy production and chlorophyll. Role of Ca2+ in blood clotting, stabilization of protein structures and structural role (bones).

UNIT V: Introduction to analytical techniques12 Hours

Errors: Classification, minimization of determinate errors, accuracy and precision.- Significant figures and their computations. -Equivalent weights of acids, bases, salts, oxidising and reducing agents. Methods of expressing concentration of solutions in terms of Normality and Molarity. Numerical problems.-Solvent extraction: Distribution law, Determination of distribution ratio - Batch extraction, continuous extraction, discontinuous extraction, counter current extraction.

REFERENCE BOOKS

- Organic Chemistry, Paula YurkanisBruice, Prentice Hall, 2005.
- Advanced Organic Chemistry F. A. Carey and R. J. Sundberg, Plenum, 1990.
- Advanced Inorganic Chemistry, 6thEdition.
- F. A. Cotton, G. Wilkinson, C. A. Murillo and M. Bochmann-John Wiley & Sons, 1999.
- Concise Inorganic Chemistry, 5th Edition J. D. Lee, Blackwell Science, 2001.
- Physical Chemistry, 7th Edition P. W. Atkins and Julio de Paula, Oxford Univ. Press, 2002.
- The Elements of Physical Chemistry, 3 rd Edition Peter Atkins, OxfordUniv. Press, 2000.
- Concise Text Book of Biochemistry T. N. Pattabhiraman, All India Publishers, 2000.
- Biochemistry A. L. Lehningeret. al., CBS, 2000.

SEMESTER II

FORENSIC PSYCHOLOGY

UNIT I: Introduction to Forensic Psychology 12 Hours

Forensic Psychology: definition and sub-specializations of forensic psychology- History of Forensic Psychology, Ethical Issues in forensic psychology, Relationship between psychology and law and Relationship of forensic psychology with criminology and criminal psychology- Scope and future of forensic psychology- Mac Naughten rule- Insanity in Indian penal code (IPC 84) : Legal insanity and medical insanity.

UNIT II: Normality and Abnormality 12 Hours

The concept of normality and abnormality- Historical view of abnormal behavior- Abnormal behavior: Current status and classification systems- ICD and DSM- Merits and demerits of classification- Causes and risk factors, Biological viewpoints, Psycho-social viewpoints: Major perspectives, Socio-cultural viewpoint- Alcohol abuse and dependence, Clinical picture and Causal factors- Drug abuse and dependence, Opium and its derivatives, Barbiturates, Amphetamines, Cocaine, Hallucinogens, Marijuana, Caffeine and nicotine- Factors affecting drug abuse.

UNIT III: Psychological Disorder 12 Hours

Mood disorders: Mania and depression, Unipolar and bipolar disorders- Causal factors in mood disorders: Biological, Psychological, and Socio-cultural factors- **Anxiety disorders**- Phobic disorders, Panic disorder and agoraphobia, Generalized Anxiety Disorder and Obsessive-Compulsive Disorder- **Personality disorders:** Clinical features of personality disorders- Types ofPersonality disorders- Paranoid, Schizoid, Schizo-typal, Histrionic, Narcissistic, Antisocial, Borderline, Avoidant, Dependent, Obsessive-compulsive, Passive-aggressive and Depressive personality disorder- Causal factors in personality disorders: Biological, Psychological and Socio-cultural- **Schizophrenia and delusional disorder,** The clinical picture in schizophrenia, Subtypes of schizophrenia- Paranoid, Catatonic, Disorganized, Residual and undifferentiated type- Causal factors in schizophrenia- Biological, Psychological, and Socio-cultural factors- The clinical picture in delusional disorder, Causal factors in delusional disorder.

UNIT IV: Psychopathy and Sociopathy 12 Hours

Eye witness testimony: its importance and significance- Violence and aggression: biological factors, psychological factors and social factors- Childhood disorders and criminality- The Criminal Psychopath-general behavioralcharacteristics of psychopaths, difference between psychopath and sociopath- Antisocial Personality Disorder and Psychopath and Offending patterns of criminal psychopaths- Criminal Homicide-Multiple Murder, Serial Killers, Mass Murders.

UNIT V: Criminal Profiling 12 Hours

Criminal Profiling: inductive and deductive approaches and criminal profiling methods- Polygraph: instrument and its parameters, scientific basis and techniques: relevant-irrelevant techniques, CQT, Card test- BEOS: introduction to BEOS instrument, Procedure- suspect interview, designing of probes-audio & visual, recording and its analysis- Narco – Analysis: History and Procedure and its forensic importance.

REFERENCE BOOKS

- Alloy,L.B., Riskind,J.H., Manos,M.J. – *Abnormal Psychology- Current Perspectives*,9th Edition(2005), Tata Mcgraw –Hill.
- Bartol, C.R& Bartol, A.M. (2008).*Introduction to Forensic Psychology: Research and Application*.USA: SAGE publications.
- Carson, R.C., Butcher, J.N. & Mineka, S. (2000). *Abnormal Psychology and Modern Life*. (11th Ed). New York: Alleyn& Bacon.
- Durand, V.M., Barlow, D.H., *Essentials of Abnormal Psychology*, 4th Edition (2006), Thomson Wadsworth.
- Huss, M.T. (2008).*Forensic Psychology: research, clinical practice, and applications*. 2nded.USA: John Wiley & Sons.
- Kendall, P.C. - *Childhood Disorders*, Illustrated Edition (2000), Psychology Press.
- Nagle, Y.K. Srivastava, K &Gupta. (2014). A *Handbook of Forensic Psychology*. India: Author House.
- Petherick, W.(2009). *Serial Crime: Theoretical and Practical Issues in Behavioral Profiling*. USA: Elsevier Academic Press.
- Sarason, I.G. & Sarason, B.R. (2006). *Abnormal Psychology*, Prentice Hall.
- Veeraraghavan. (2009*). Handbook of forensic psychology.* Amity University.
- Wrightsman, Lawrence S. &Fulero, S. (2008). *Forensic Psychology*. California: Wadsworth/ Thomason Learning.

INTRODUCTION TO PSYCHOLOGY &FORENSIC PSYCHOLOGY – PRACTICAL

1. Internal –External Locus of control
2. Life Satisfaction Scale
3. Sodhi's Attitude Scale
4. Self -Concept Questionnaire
5. General Health Questionnaire
6. Guidance Need Inventory
7. Parenting Scale
8. Immediate Memory Span
9. Paired Associate Learning
10. Family Environment scale.
11. Adolescent Problem Checklist.
12. Type A/B Behavioural Pattern Scale.
13. Beck's Depression Inventory.
14. Raven's Standard Progressive Matrices.
15. Buss-Perry Aggression Questionnaire.
16. Barrat Impulsiveness Scale.
17. Suicidal Ideation Scale.
18. Eysenck Personality Questionnaire (EPQ).
19. Illinois Rape Myth Acceptance Scale (IRMA).
20. Demonstration of hypnosis.

FORENSIC CHEMISTRY

UNIT I: BASICS OF CHEMISTRY 12 Hours

Organic chemistry: Introduction, classification, IUPAC Nomenclature.-Basic properties: isomerism, resonance.-Basic reactions: addition, substitution, oxidation, reduction, hydrogenation and hydrolysis.-Buffer: preparation, capacity buffer equation Importance.

UNIT II: PETROLEUM PRODUCTS 12 Hours

Petroleum products: types, by products, uses and importance.-Examination of petroleum products: distillation and fractionation-Commercial uses of petroleum. Standard methods of analysis of petroleum products for adulteration.-Scope, importance and forensic importance of analysis for the adulterants in petroleum products.

UNIT III: ARSON AND FIRE INVESTIGATION 12 Hours

Chemistry of fire, pyrolysis, combustion, fire tetrahedron, flash point and ignition temperature.-Fire categories, burn patterns, finding the igniter.-Investigation of arson cases, functions of a fire investigator, collection preservation and packing of fire evidences.-Lab analysis of the evidence, instrumental techniques used.

UNIT IV: EXPLOSIVES 12 Hours

Introduction, classification, composition and characteristics.-Synthesis and actions of explosives (TNT, PETN and RDX, IED).Explosion process and affect types of explosions, post blast residue collection. Examination of explosion residues in laboratory (chemical and instrumental).

UNITV: QUANTITATIVE AND QUALITATIVE ANALYSIS 12 Hours

Industrial products: insecticides, fertilizers, metallic products, non metallic products.Consumer products: alcohol, gold, silver, acids, alkalies.Trace evidences: paint, soil, industrial dust, oil, dyes. Analysis and forensic importance.-Importance, actions and forensic importance of products.-Analysis: chemical and instrumental for the verification of purity, adulterants.

REFERENCE BOOKS

- Advanced inorganic chemistry; B R Puri, L R Sharma and Shoban Lal Nagin; S Chand and Sons 31st edition.
- Standard methods of chemical analysis; Welcher Frank; Van Nostrand Reinhold; 6th edition.
- Mute witness: trace evidence analysis; Houck M M; Academic Press (2001)
- Fire scene evidence; Almirall J R & Furton K G; CRC Press (2004)
- Practical: Fire and arson investigation; redsickerr D R & Cannor J J.
- Criminalistics: an introduction to Forensic Science; Safferstein R; Prentice Hall; 9th edition.

GENERAL CHEMISTRY &FORENSIC CHEMISTRY-PRACTICALS

1. Estimation of potassium permanganate using standard sodium oxalate solution.
2. Estimation of ferrous ammonium sulphate using standard potassium dichromate solution with potassium ferricyanide as an external indicator.
3. Determination of the density using specific gravity bottle and viscosity of a liquid using Ostwald's viscometer.
4. Preparation of buffers and determination of their pH values using pH meter.
5. Analysis of organic compounds using tests prescribed by DFS.
6. Preparation of standard solution of different compounds in ppm and ppb levels.
7. Analysis of anions (Chloride, Iodide, sulphates) by methods/tests prescribed by DFS.
8. Analysis of anions (Nitrate, Phosphate, Oxalate) by methods/tests prescribed by DFS.
9. Analysis of cations (Arsenic, Copper, Lead) by methods/tests prescribed by DFS.
10. Analysis of cations (Zinc, Barium, Aluminium) by methods/tests prescribed by DFS.
11. Preparation of standard solution of different compounds in ppm and ppb levels.
12. Preparation of standard solution of ferrous ammonium sulphate and estimation of potassium permanganate solution.
13. Analysis of organic acids.
14. Analysis of mineral acids.
15. Analysis of anions by methods prescribed by DFS.
16. Analysis of cations by methods prescribed by DFS.
17. Analysis of alcohols.
18. Collection, preservation packaging of evidences in fire and arson cases.
19. Determination of density and viscosity of a liquid using Ostwald's viscometer.
20. Analysis of organic compounds.

Semester III

CRIME SCENE MANAGEMENT

UNIT I: Crime Scene Investigation 12 Hours

Definition of crime and crime scene- Types of crime scenes: Primary, Secondary, Indoor and Outdoor- Concept of evidence- evidence classification: direct, circumstantial, physical, biological, corroborative, conclusive, trace and testimonial- Locard's principle of exchange- Elements of crime scene: Information from victim, witness, crime scene, suspects, databases and records- Agencies involved in crime scene management: Police, Medico legal experts, Judicial officers- Actions of first responding officer: Objectives, documentation, officer safety, emergency care, secure and control, release scene to appropriate authorities.

UNIT II: Documentation of Crime Scene 12 Hours

Documenting crime scene: Crime scene photography and videography and notes- Search: definition, objectives and search patterns – Strip method, grid method, zone/quadrant method, spiral method (inward and outward), Point to point method, wheel method- Crime scene sketching: Indoor and outdoor, triangulation method, baseline method, polar coordinate method.

UNIT III: Collection of Physical Evidences 12 Hours

Crime scene photography: Location and scene, long-range mid-range and short range photographs- Importance of scale- Use of L scale- Collection, packaging and preservation of physical evidence and general considerations- Evidences: fingerprints, impressions (tyreprints, footprints, lipprints, bitemarks), hair and fiber, trace evidences (glass, soil, paint), firearms and tool marks, biological evidences (blood, bloodstain patterns, body fluids, tissue), explosive materials, questioned documents.

UNIT IV: Arson Investigation 12 Hours

Cases of special consideration: arson, mass disasters- their scene management and evidence- Crime scene reconstruction: Introduction, importance, nature and principles: recognition, identification, individualization and reconstruction- Stages of investigation: data collection, analysis, hypothesis formulation, testing, and theory formation.

UNIT V: Documentation of evidences 12 Hours

Forwarding of evidences: Packing and sealing of evidences, preparation of questionnaire- Chain of custody: Importance and maintenance- Documents to be submitted to FSL along with evidences.

REFERENCE BOOKS

- "Techniques of Crime Scene Investigation", Barry. A. J. Fisher, David .R.Fisher, Eighth
- "Blood Stain Spatter Analysis", Tom. Bevel, Ross.M.Gardner, Third Edition, CRC Press,
- "An Introduction To Forensic Scientific and Investigative Techniques", Stuart.H.James and
- Jon. J. Nordby, Third Edition, CRC Press, 2007.
- "Crime Reconstruction", W.Jerrychisum and Brent and Turvy, Elsevier Academic Press,
- "A Scientific Method Approach", Robert.C.Shaler, CRC Press, 2012.

INSTRUMENTATION – I (PHYSICAL)

UNIT I: 12 Hours

- General Physical Concepts: Concept of electromagnetic radiation, Light as wave and particle, type of radiation (classification with frequency and wavelength)
- Interaction between matter and radiation – absorption, emission, reflection, refraction and scattering.
- Fluorescence and phosphorescence – principle and application in Forensic science.
- Density gradient analysis and refractive index in Forensic Science.

UNIT II: 12 Hours

- Spectroscopy: Instrumentation: source, variable (filter) and detector.
- UV – Visible Spectroscopy: Principle- Beer Lambert's Law and electron transition, working, application and drawbacks.
- IR Spectroscopy: Principle, instrumentation and application. IR and FTIR
- RAMAN Spectroscopy and their applications in Forensic Science.
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UNIT III: 12 Hours

- Atomic Spectroscopy: Atomic absorption Spectroscopy (AAS) and Atomic Emission Spectroscopy- Principle working, application, drawbacks.
- X-Ray Diffraction (XRD): Principles, Working, Application,
- X-Ray Fluorescence (XRF) – Working, Application and Drawbacks.

UNIT IV: 12 Hours

- NAA (Neutron Activation Analysis): Introduction, Basic Theory and Principles, neutron sources, Detection, measurement, and applications.
- NMR (Nuclear Magnetic Resonance): Principle, working, instrumentation, application, drawbacks.
- Differential thermal analysis: Working and application.
- Concept of electrochemistry: Polarography and voltammetry.

UNIT V: **12 Hours**

- Mass Spectrometry: Principle, Components- Sample inlets- Batch Inlet, probe inlet, direct inlet, chromatographic inlets, Ionization- ionization types and ionization sources- EI, ESI, CI, FAB; vacuum system.
- Magnetism- mass analyzers- Quadrupole, Time of Flight, Ion trap.
- Detectors- faraday cup, electron multiplier, Scintillation counter.
- Interpretation of Mass spectrograph.
- Applications of mass spectrometry in forensic science.

REFERENCE BOOKS

- Lundquist and Curry, Methods in Forensic Science, 1983.
- Yinon, Forensic Application of Mass Spectrometry, 1994.
- Borrow, Molecular Spectroscopy, 1980.
- Moonesens A.A. et al., Scientific Evidence in Criminal Cases, 1973.
- Gilbert, GC-MS guide to Ignitable Liquids, 1997.
- Grahm D., The use of X-ray Techniques in Forensic Investigation, 1973.
- Settle F.A., Handbook of Instrumental Techniques for Analytical Chemistry, Prentice Hall, 1997.
- Crowle, Immuno Diffusion, 1977

FORENSIC PHYSICS

UNIT I: Glass **12 Hours**

Glass: Types of glass and their composition-Forensic examination of glass fractures; Determination of direction of impact: concentric fracture, cone fracture, radial fracture, rib marks, hackle marks, backward fragmentation;Examination of glass: colour, fluorescence, physical matching, density comparison, refractive index, elemental analysis, Interpretation of glass evidence; -Case studies related to glass

UNIT II: Soil **12 Hours**

Soil: Formation and types of soil; Composition and colour of soil-Forensic examination of soil: particle size distribution, turbidity test-microscopic examination, density gradient analysis, ignition loss, differential thermal analysis, elemental analysis-Interpretation of soil evidence; Case studies.

UNIT 3: Toll marks **12 Hours**

Tool Marks: Types of tool marks: compression marks, striated marks, combination of compression and striated marks, repeated marks.Class characteristics and individual characteristics; Tracing and Lifting of tool marks.-Photographic examination of tool marks and cut marks; Forensic examination and comparison of tool marks.-Expert testimony in tool marks.-Comparison microscope and its applications in tool mark analysis.

UNIT IV: Paint **12 Hours**

Paints: Types of paint and their composition; Forensic examination of paints: microscopic and macroscopic studies-pigment distribution- micro-chemical analysis, physical matching, solubility test, elemental analysis-pyrolysis, Cyclic voltammetry, AAS**.** Chromatographic technique- TLC, colorimetry. IR spectroscopy, X-ray diffraction; Interpretation of paint evidence; Case studies.

UNIT V **12 Hours**

Restoration of erased or obliterated marks: Method of marking-cast, punch and engrave; Methods of Obliteration; Method of restoration- etching, magnetic, electrolytic; Recording of restored marks on different surfaces.Building Materials: Types of cement and their composition.Determination of adulterants by physical, chemical and instrumental methods.Examination of brick; Analysis of Bitumen and road material.-Analysis of cement mortar, cement concrete and stones.

REFERENCE BOOKS

- C.E.O Hara and J.W. Osterburg; an Introduction to Criminalistic, Indiana University Press, Blomington, 1972.
- Working Procedure Manual: Physics BPR&D Publication, 2000.
- R. Saferstein; Forensic Science Handbook, Vol.-I, II, 2004.
- B. Caddy; Forensic Examination of Glass and Paints Analysis and Interpretation ISBN 0784 05749, 2001.
- James Michael Curran, Tachia Natilie Hicks and John S. Buckleton; Forensic Interpretation of Glass Evidence, CRC Press, 2000.
- David A. Crown; the Forensic Examination of Paints and Pigments, Taylor & Francis, NY, 2001.
- Jay A.Siegel, Pekka J Saukko and Geoffrey C. Kooupfer; Encyclopedia of Forensic Science, Academic Press, 2000.

Skill based subject-I

CRIME SCENE RECONSTRUCTION

30 Hours

UNIT I 06 hours

Crime scene-Types of crime scenes. Identification of location of crime, photography, videography,coverage, photogrammetric, latest trends in crime scene documentation.

UNIT II 06 hours

Crime scene sketching, rough sketch, measurements, identification of evidences, sketching of 3D crime scene in 2D paper.

UNIT III 06 hours

Measuring and sketching of various crime scenes, preparation of rough and fare sketch.

UNIT IV 06 hours

Visit to indoor and outdoor crime scenes, setting up of crime sconces, mock crime scenes, demonstration of crime scene investigation.

UNIT V 06 hours

Latest trends in crime scene reconstruction, Computer assisted crime scene reconstruction, 3D modeling of crime scene, 3D modeling using Google sketch-up.

Reference books

- Gardner, R., & Bevel, T. (2009). *Practical crime scene analysis and reconstruction*. Boca Raton, Fla.: CRC Press.
- Ogle, R. (2012). *Crime scene investigation and reconstruction*. Upper Saddle River, N.J.: Pearson Prentice Hall.

SEMESTER IV
QUESTIONED DOCUMENT AND FINGERPRINT EXAMINATION

UNIT I: Introduction to questioned documents 12 Hours

Introduction to questioned documents- History of questioned documents- Classification of questioned documents and various classes of questioned documents- Scope and application of questioned documents- Preservation and handling of questioned documents: Do's and Don'ts- Tools and techniques used for the examination of questioned documents- Ethics for Questioned Document experts.

UNIT II: Handwriting and Signature examination 12 Hours

Introduction to handwriting and signature examination- Class characteristics and individual characteristics of handwriting- Forgery and types of forgeries- Forensic examination and identification of forgeries- Examination of additions, alterations and obliterations in the documents- Examination of mechanical and chemical erasures on the documents.

UNIT III: Examination of documents 12 Hours

Examination of security documents (Currencies, coins, passports and stamp papers)- Examination of Ink and Paper- Determination of age of documents- Destructive method and non-destructive methods used in examination of ink and paper- Importance of typewriters and printers in forensic document examination- Examination of charred documents and secret writings.

UNIT IV: Introduction to Fingerprints 12 Hours

Fingerprints: Introduction, definition and scope- History and development of Fingerprint Science- Structure of skin and formation of fingerprints in human- Basics of taking inked prints, taking inked prints of living and dead: Plain and rolled prints, other devices and material for recording prints- Types of evidentiary fingerprints: Visible, latent and plastic prints and Elements of fingerprinting: ridge patterns and ridge characteristics.

UNIT V: Classification systems of fingerprints 12 Hours

Classification of fingerprints: Arch, Loop and whorl and its sub-types- Ridge counting and Whorl tracing- Battley's Single digit Classification and Henry Ten digit classification- Development of latent fingerprints- Physical and chemical methods. Physical methods: Metallic powders, Magnetic powders and Fluorescent powders. Chemical Methods: Ninhydrin method,

Silver nitrate method, Iodine fuming and Cyno-acrylate fuming methods- Photography- Preservation and lifting of fingerprints.

REFERENCE BOOKS

- Ordway, Hilton. (1928). *Scientific Examination of Questioned Documents*. Rev. ED: New York.
- Albert S. Osborn. (1928). *Questioned Documents*. Ed. Universal Law, Publishing, Delhi.
- Albert S. Osborn. (1998). *the problem of Proof.* Second Ed, Universal Law, Publishing, Delhi.
- Charles C. Thomas, Billy Prior Bates. (1971). *Typewriting Identification*. Springfield, Illinois.
- Wilson R. Harrison. (1997). *Suspect Documents – Their Scientific Examination*. Universal Law Publishing,
- Hard Less, H.R. (1988*). Disputed Documents, Handwriting and Thumbs – Print Identification*. Profusely Illustrated, Law Book Co., Allahabad.
- Morris, Ron. (2001). *Forensic Handwriting Identification*. N. Acad. Press, London.
- Jay Levinson. (2001). *Questioned Documents*. Acad. Press, London.
- K.M. Koppenhaver. (2007). *Forensic document examination: Principles and practices*. Humana press Inc, Totowa, NJ.
- Bridges (1942): *Practical Finger Printing*, Funk and Washalls Co. New York.
- Cherril, F.R.(1954) : The Finger Prints. System at Scotland Yard, Her Majesty's office, London.
- Cummins & Midlo: *Finger Prints, Palms and Soles*, 1943, The Blakiston office London.
- David R. Ashbaugh; *Quantitative and Qualitative Friction Ridge Analysis*, CRC Press, 1999.
- E. Roland Menzel*; Fingerprint Detection with Laser*; Second edition; Marcel Dekker, Inc. 1999.
- Hawthrone,M.R. *Fingerprint: Analysis and understanding*.CRC Press, 2009
- James, S. H. and Nordby, J. J.*: Forensic Science: An Introduction to Scientific and Investigative Techniques*, CRC Press, 2003 & 2005.
- James F. cowger*; Friction Ridge skin*, CRC Press London, 1993.
- James, S. H. and Nordby, J. J.: *Forensic Science: An Introduction to Scientific and Investigative Techniques*, CRC Press, 2003 & 2005.
- Mehta, M. K. (1980):*Identification of Thumb Impression & Cross Examination of Finger Prints*, N. M. Tripathi (P) Ltd. Bombay.
- Moenssens (1975): *Finger Prints Techniques*, Chitton Book Co., Philadelphia, New York.
- Saferstein, Richard. *Criminalistics. An Introduction to Forensic Science*, 5th ed., Prentice Hall, 1998.
- Saferstein, R., *Handbook of Forensic Science* (Vol 1, 2, 3), 2004.

- Siegel, J. A., Sukoo, R. J, and Knupfer, G. C: *Encyclopedia of Forensic Science*, Vol I, II and III, Academic Press, 2000.
- Wentworth & Wilder(1948):*Personal Identification*,. R. G. Badger. Boston.

CRIME SCENE MANAGEMENT, QUESTIONED DOCUMENT AND FINGERPRINT- PRACTICALS

1. To prepare a report on evaluation of crime scene.
2. Seizure of the premises of the crime scene, clothing, accessibility and chronology of investigation.
3. Photography of crime scene.
4. Searching and Listing of evidences at indoor crime scene.
5. Searching and Listing of evidences at outdoor crime scene.
6. Sketching of Crime scene by triangulation method.
7. Sketching of Crime scene by baseline method.
8. Evidence collection, packaging, sealing and labeling.
9. Estimation of height and direction of blood spatter at crime scene.
10. Analysis of blood stains pattern using photograph.
11. Comparison and examination of handwriting with exemplars.
12. Comparison and examination of signatures with exemplars
13. Detection of forgeries. Comparison with exemplars.
14. Examination of security documents- Currency notes, Indian Passports, Stamp Papers, etc.
15. Examination of alterations: additions, overwriting and obliteration in the documents.
16. To take plain and rolled inked fingerprints in FBI card and to identify patterns.
17. Comparison of fingerprint using ridge characteristic or minutiae from a given fingerprint samples.
18. To perform ridge counting and whorl tracing from a given fingerprint sample.
19. Classification of fingerprints using Henry Ten Digit System.
20. Development of fingerprints from porous/ non-porous surface using powdering method and chemical methods.

GENERAL BIOLOGY

UNIT I: Cytology and micro organisms12 Hours

Cytology: cell wall, protoplasm, mitochondria, chloroplast, endoplasmic reticulum, Golgi complex, lysosomes, endosomes, micro bodies, ribosome's, centrioles, nucleus, nucleolus- Membrane structure, solute transport techniques: simple diffusion, facilitated diffusion, active transport- Chemical composition of cell.

UNIT II: Bio-molecules12 Hours

Proteins: classification, Properties, and functions- Carbohydrates: classification, structure and configuration. Biological importance of monosaccharide's (glucose& fructose), di saccharides (Maltose& sucrose) and polysaccharides (Starch and Cellulose) -Lipids: Classification, types and structure with examples.

UNIT III: Micro Organisms12 Hours

Micro organisms: History, identification. Micro organisms of forensic importance- Microbial role in diseases- Kochs postulates- Micro Biology: - advent of sterilization, cultural techniques- Microbial Forensics: Scope and Importance.

UNITIV:Antigen - Antibody Reaction 12 Hours

Antigen, antibody, Production of antibody. Structure and functions of antigen and antibody complex- Antigen antibody reactions: types, principle- Agglutination, precipitation and flocculation- Immunochemistry: importance and scope- Immunochemical techniques: characteristics, roles and methods- particle and label methods.

UNIT V: Physiology 12 Hours

Physiology: introduction,molecular, cellular and tissue physiology- Systems: control and regulation, support and movement, fluids and transport, environmental exchange and reproductive- Characters, functions and importance of the system.

REFERENCE BOOKS

- Molecular biology of cell, Bruce Alberts et al, ninth edition, CBS Publishers, 2002.
- Cell and Molecular Biology, Gerald Karp, Third edition, John Wiley and sons.inc,, 2002.
- The Cell – A Molecular Approach, Geoffery M Cooper, Roberte Hauseman, Fourth edition, American Society For Microbiology.
- Fundamentals of Biochemistry, Voet and Voet, Third edition, John Wiley and sons publishers 2007.
- Principles of Biochemistry, Lehninger Albert, Fifth edition, W H Freeman Publishers 2005.
- Principles of Anatomy and Physiology, Tortora, G. & Grabowski, S. ninth edition. Wiley page 733, 2000.
- Advanced immunochemistry, Eugene D Day.
- Handbook of Immunochemistry, Miroslav Ferencik.

GENERAL BIOLOGY- PRACTICALS

1. Safety precautions in laboratory.
2. Introduction to biochemical instrumentation.
3. Examination of plant cell.
4. Examination of animal cell.
5. Examination of micro organisms.
6. Blood Grouping- agglutination method.
7. Blood grouping- absorption elution method.
8. Microscopic examination of blood cells.
9. Electrophoresis technique.
10. Culturing of microbes from saliva/blood.

Skill based subject-II

STATISTICS FOR FORENSIC SCIENCE-BASIC

30 HOURS

Unit I: Introduction to forensic statistics 06 HOURS

Statistical methods: definition and scope of statistics. Concept of statistical population of data: Qualitative and Quantitative, attributes and variables. History of use of statistics in forensic science - Crime statistics in India – Source of crime statistics.

Unit II: Statistical Presentation 06 HOURS

Scales of Measurements: Nominal, Ordinal, Interval and Ratio.
Tabular and graphical, including histogram and *o*gives, consistency and independence of data with special reference to attributes.

Unit III: Measures of Central Tendency 06 HOURS

Mean, Median and Mode – Measures of Dispersion: Range, quartile deviation, mean deviation and standard deviation and coefficient of variations

Unit IV: Measure of symmetry 06 HOURS

Kurtosis and skewness, Sheppard's corrections. Bivariate data: Definition, Scatter diagram, simple, partial and multiple correlations.

Unit V: Correlation and Regression 06 HOURS

Definition; types of correlation. Karl Pearson correlation and Spearman Rank Correlation; Regression: definition and Regression analysis. Simple linear regression, principle of least squares and fitting to polynomials and exponential curves.

Reference

- Goon, A.M; Gupta, M.K. (2002). *Fundamentals of Statistics.* The World Press, Kolkata
- Mood, A.M; Graybill, F.A (2007). *Introduction to theory of Statistics*. Tata Mcgraw-Hill Pub.Co.Ltd.

SEMESTER V

FORENSIC TOXICOLOGY

UNIT I: Introduction to Forensic Toxicology 12 Hours

Forensic toxicology: Introduction, Role of the toxicologist, significance of toxicological findings- Poisons, definition, classification on the basis of their origin, physiological action and chemical nature, types of poisoning- Modes of administration- Signs and symptoms of poisoning, its effect on vital functions- Medico legal and post-mortem findings and report writing.

UNIT II: Drugs and its actions 12 Hours

Drugs: definition, classification and scope and forensic importance- Commonly consumed drugs, their mode of actions, symptoms, street names, methods of consumption- Analysis of drugs: chemical and instrumental. Spot tests and qualitative analysis- Importance of physical and biochemical instrumentation in the field of dug analysis.

UNITIII: Extraction, Collection and Analysis of Toxins 12 Hours

Extraction, isolation and clean up procedures: conventional and modern techniques- Application of chromatography for the separation of poison and drugs- Spectrophotometric techniques for the quantification of poisons and drugs- Examination of metallic poisons, snake venom, insect bites.

UNIT IV: Introduction to Pharmacology 12 hours

Forensic pharmacology: definition, introduction- Absorption, distribution, metabolism, pathways of drug metabolism, drug metabolism and drug toxicity-Population and clinical pharmacokinetics and bio analytical techniques.

UNIT V: Collection of Evidences and Report Writing 12 Hours

Management of Toxicological cases in the hospital: Signs and symptoms of common poisons, antidotes and Stomach washing-Collection and preservation of viscera for various types of poisons: Choice of preservatives, containers and storage- Report writing in toxicological cases.

REFERENCE BOOKS

- Modi's: Medical Jurisprudence & Toxicology, M. M. Trirathi Press Ltd. Allahabad, 1988.
- S.N. Tiwari: Analytical Toxicology, Govt. of India Publications, New Delhi, 1987.
- Saferstein, R: Forensic Science Hand Book, Vol I, II and III, Pretince Hall, NI, 1982. Saferstein, R: Criminalistics, 2002.
- O Hara &Osterburg: Introduction to Criminalistics, 1949.
- Sharma, B.R.: Forensic Science in Criminal Investigation & Trials, 2003.
- Narayana Reddy K.S, Introduction to Forensic Medicine and Toxicology, 13th edition.

FORENSIC BALLISTICS

UNIT I: Introduction to Ballistics 12 Hours

Introduction to Ballistics- Scope of forensic ballistics- History of firearms: lock mechanism of various firearms- Firearms: Classification: Based on riffling, action mechanism and loading- Parts of firearms: Butt, chamber, magazine, firing mechanism and barrel- Concept of bore and calibre- Improvised, country made & imitative firearms.

UNIT II: Internal Ballistics 12 Hours

Ammunition – Cartridge case, Primer, Propellant, Bullets, Pellets and Wads. Use of lead as bullet material- Internal Ballistics: Definition, Chemical composition of primer and propellant (black powder, single base, double base, chordite) -Ignition and burning of propellants- Degressive and progressive burning- Pressure developed inside the barrel- Theory of recoil- Intermediate Ballistics: Definition, effects on the motion of projectile by firearm, gas flow field near the muzzle, muzzle flash, muzzle blast and silencers.

UNIT III: External Ballistics 12 Hours

External Ballistics: Definition, vacuum trajectory, Equations of motion of projectile, gyroscopic equilibrium of bullets, vacuum trajectory- calculation, effect of air resistance on trajectory and nature of air-resistance phenomena- Terminal Ballistics: Definition. Physics of shock waves, shock waves within the body; Cavitations-temporary and permanent cavities- Behaviour of various types of bullets on hitting the target, Ricochet and its forensic aspects- Arms Act, 1959 (Important sections), Examination and reporting of cases under Arms Act. Various court ruling relevant to forensic ballistics.

UNIT IV: Wound Ballistics 12 Hours

Preparation of gelatine gel block and its use in wound ballistics studies- Calculation of trigger pull- Test for the possibility of accidental discharge of firearm- Determination of range of firing for shotguns: Burning, scorching, blackening and Tattooing- characteristics of contact shots, Walker's test- Effective, killing and extreme ranges.

UNIT V: Examination of Gun Shot Residues 12 Hours

Evidentiary clues: Types, occurrence, collection and packing- Matching of crime & test Bullets and cartridge cases in regular firearms & improvised firearms- Framing of opinion in ballistics cases and the challenges of it- Comparison microscope, Identification of bullets and their comparison- Factors affecting the formation of striations- Gun Shot Residues (GSR): Formation

of GSR, composition of GSR, Positioning of GSR, collection, chemical methods of analysis and instrumental methods of analysis.

REFERENCE BOOKS

- J. Howard Mathews, Charles C. Thomas; Firearms Identification, Vol.-I, II & III, Springfield Illinois, 1973.
- Hatcher, Jury and Weller; Firearms Investigation, Identification and Evidence, Stackpole Books, Harrisburg, PA, 1977.
- Vincent Di Maio; Gunshot Wounds, CRC Press, Washington, DC, 1999.
- Brain J. Heard; Hand book of Firearms and Ballistics, John Willey England, 1997.
- TA. Warlow; Firearms- The Law and Forensic Ballistics Taylor and Francis London, 1996.
- M. Johari; Identification of Firearms Ammunition and Firearms Injuries, BPR&D New Delhi, 1980.
- I.V. Hogg; The Cartridges Guide - A small arms Ammunition Identification Manual, The Stackpole Pub. Co., Harrisburg, PA, 1982.
- Working Procedures Manual, Ballistics, BPR &D New Delhi, 2000.
- Schlooeble A J and Exline L.D; Current Methods in Forensic Gunshot Residue Analysis, CRC Press NY, 2000.
- Andrasko J and Stalong S; Time since discharge of Rifles, Journal of Forensic Science, Vol-45, No-6, pp, 1250-1255, 2000.

INSTRUMENTATION – II (BIO-CHEMICAL)

UNIT I: Basic principles of sampling 12 Hours

- Sample preparation: Stock solution, standard solution and serial dilution- Qualitative and quantitative estimation.General Principles of Biological and Biochemical analysis: pH and Buffers, pH Meter, Physiological Solution. Centrifugation: Basic principles of centrifugation, Svedberg's unit, density gradient centrifugation, types of centrifuges - (based on size, type of rotors and usage), ultra-centrifugation, refrigerated centrifuges, - safety maintenance of centrifuge.

UNIT II: Microscopy 12 Hours

- Microscopy: Lens systems and it's working. Principle of microscopy, Abbe equation-Principle, ray diagrams, working, sample preparation and applications of following in Forensic Science-Simple microscope and Compound microscope, Stereo microscope, Comparison microscope, Phase contrast microscope,

UNIT III: Advanced microscopy 12 Hours

Principle, ray diagrams, working, sample preparation and applications of following in ForensicScience:Polarized light microscope, Fluorescent microscope,Infrared microscope, Scanning electron microscope (SEM), Transmission electron microscope (TEM) -Atomic force microscope (AFM)

UNIT IV: Chromatography 12 Hours

Chromatography: General principles of chromatography, classification-Paper chromatography, Column chromatography, Thin Layer Chromatography (TLC), High Performance Thin Layer Chromatography (HPTLC)-Concept of mutual miscibility and preparation of mobile phase. Liquid Chromatography (LC), High Performance Liquid Chromatography (HPLC), Liquid Chromatography- Mass Spectrometry (LC-MS), Gas Chromatography (GC), Gas Chromatography- Mass Spectrometry (GC-MS),

UNIT V: Immuno-chemical techniques 12 Hours

Immuno-chemical Techniques and electrophoresis: General principles and introduction to antigen and antibody, Antigen-antibody reaction, precipitin reaction, production of antibodies. - Enzyme Assay Techniques: Visible and UV spectrophotometry methods, ELISA, Automated enzyme analysis, Immobilized Enzymes, Fluorescence Immuno-assay.Electrophoresis- General

Principle, factors affecting electrophoresis, Horizontal and vertical electrophoresis, SDS, PAGE, cross over electrophoresis, capillary electrophoresi

REFERENCE BOOKS

- Peterson, Clinical and Forensic Application of Capillary Electrophoresis, 2001.
- Willard, H.H., Instrumental Methods of Analysis, 1974.
- Wilson, K. and Goulding, K.H., A Biologists guide to Principles and Techniques of Practical Biochemistry, 1991
- Curry, Analytical Methods of Human Toxicology, 1986.
- Lurie and Witturer, High Performance Liquid Chromatography in Forensic Chemistry, 1983.
- Peterson, Clinical and Forensic Application of Capillary Electrophoresis, 2001.
- Gilbert, GC-MS guide to ignitable liquids, 1997.
- Brown, P.R., Advance in Chromatography, 2004
- Howard, Forensic Analysis by Gas Chromatography, 2012

FORENSIC BIOLOGY

UNIT I: Introduction to Forensic Biology 12 Hours

Forensic biology: History and scope, divisions- Nature and importance of biological evidences- Fundamentals of Biology, Biochemistry and its importance in Forensic Biology- Importance of Forensic Anthropology & Odontology, Forensic Serology- Collection, preservation and packaging of biological evidences.

UNIT II: Hair and Fibers 12 Hours

Hair – structure of human hair: Inner and Outer morphology, biochemistry of hair and growth stages- Comparison of human and animal hair: medulla, Medullary index calculation, Cuticle examination- Fibre – Classification: Natural, semi-synthetic and synthetic fibres and their properties- Structure analysis for different types of fibers and their Forensic significance.

UNIT III: Forensic Botany 12 Hours

Wood: Structure and Properties. Types, Identification with Forensic Importance- Leaves: Morphology, types based on arrangement and venation with structures and examples- Pollen: Structure, function, Reproduction and Forensic importance- Diatoms: Location, Structure, types, reproduction identification and Forensic Significance.

UNIT IV: Forensic Entomology 12 Hours

Entomology: Introduction, areas and importance- General anatomy of arthropod- Insects of Forensic significance: Order- dipteral, Coleoptera, collembola etc- Estimation of time since death and insect succession- Collection, packing and preservation of entomological evidence.

UNIT V: Wildlife Forensics 12 Hours

Wild life Forensics: Introduction, History and Importance- Laws related to wildlife protection- Wild life protection Act: History, importance and supporting acts and laws. Red data book and wildlife crimes- Pug Marks: features and methods for collection- Methods of analysis to identify: species, gender, age, individual characters from pug marks.

REFERENCE BOOKS

- Forensic Biology, S. Chowdhuri, BPRD, New Delhi (1971).
- Forensic Science Handbook, R. Saferstein, Vol III, Prentice Hall, New Jersey (1993).
- Criminalistics and Scientific Investigation, Peter B Piaza, Frederick Cunliffe.
- Forensic Science in Wildlife Investigation, Taylor & Francis (2009)
- Principle of Anatomy and Physiology, Tortora. G, & Grabowski, S. Ninth Edition. Wiley (2000)
- Forensic Science in Crime Investigation, B S Nabar.

Skill based subject -III

STATISTICS FOR FORENSIC SCIENCE-ADVANCED

30 HOURS

UNIT I: Uncertainty in forensic science **06 hours**

Probability: Introduction, standard for uncertainty, events, subjective probability, dependent events, law of total probabilities, updating of probabilities.

UNIT II: Variations **06 hours**

Populations, samples and estimates, counts-binomial distribution, multinomial distribution, hyper geometric distribution, Poisson distribution, beta binomial distribution.

UNIT III: Transfer of evidence **06 hours**

Likelihood ratio: Probability of guilt, justification, combination of evidences, correspondence probabilities, Direction of transfer-from criminal to scene and from scene to criminal. Transfer probabilities, presence of non matching evidences.

UNIT IV: Evaluation of evidences **06 hours**

Complimentary events and examples. Bayes' theorem and examples. Errors in interpretation-fallacy of transposed conditional, source probability error, false positive fallacy, empirical errors in interpretation.

UNIT V: Value of evidence **06 hours**

Odd form of Bayes' theorem- likely hood ratio, logarithm of likely hood ratio. Value of evidence: evaluation of forensic evidence, summary of competing propositions, qualitative scale for value of evidences, misinterpretations. Transposed conditional and defence fallacies-probability of guilt.

References:

- Lucy, D. (2006). *Introduction to statistics for forensic scientists*. Chichester: J. Wiley.
- Adam, C. (2010). *Essential Mathematics and Statistics for Forensic Science.* John Wiley & Sons Ltd.

SEMESTER VI

FORENSIC SEROLOGY

UNIT I: Biological Evidences 12 Hours

Biological evidence: location, importance, collection, preservation, packing and identification- Hair: identification, analysis, medullary index calculation and importance of root and individualisation from root bulb- Fibres: classification, identification, structure, importance and forensic significance- Identification forensic significance of pollen and seeds.

UNIT II: Antigen Antibody and Its Reactions 12 Hours

HumanBlood groups: General Principles, theory of their inheritance, Blood group determination from fresh blood, titer, raulax formation and Bombay blood group- Definition of antigen and antibody, Various Antigen-antibodyreactions- Difference between precipitation, agglutination and flocculation- Immunochemical techniques: principle, function and forensic significance.

UNIT III: Blood and Its Functions 12 Hours

Blood: composition, functions. Collection, packaging and preserving techniques for different types of cases- Analysis of blood: identification, confirmatory for fresh blood stains- Takayama and Teichmann test for dried blood stains- Identification of blood group from stain of blood, Semen, saliva and sweat: absorption elution, absorption inhibition and mixed agglutination.

UNIT IV: Identification of Other Body Fluids 12 Hours

Semen: location, collection, packing, evaluation and tests for identification and forensic significance- Urine: location, collection, packaging, preservation, evaluation and tests for identification and forensic significance- Forensic significance of other body fluids like sweat, saliva, milk and it’s collection and identification.

UNIT V: Enzymatic Reactions and Paternity Disputes 12 Hours

DNA: definition, characteristics, polymorphism- Polymorphic enzymes: Forensic significance, identification from fresh blood and stains- Paternity disputes: Causes, Various serological and biochemical methods, calculation of paternity index and probability for paternity and maternity- Case studies: paternity and maternity disputes.

REFERENCE BOOKS

- Modi, J.K. (1988): Medical Jurisprudence and Toxicology, N.M. Tripathi Pvt. Ltd.
- Fraser, Roberts J.A (1965): An introduction to Medical Genetics.
- Chatterjee, C. C- (1975): Human Physiology.
- Boorman, K. E: Blood Group Serology, Churchill, and Lincolin, P. J. (1988)
- Saferstein, R. (1982): Science Handbook, Vol. I, II and III, Prentice Hall, New Jersey.
- Barris, H. and Hopkinson, D. A. (1976): Handbook of Enzyme, Electrophoresis, Elsevier, North, Holland, New York.
- Gilblet, E. (1969): Marker's in Human Blood, Davis, Pennsylvania.
- Culliford, B. E. (1971), the examination and Typing of Blood Stains, US Dep't. Of Justice, Washington.

FORENSIC BIOLOGY &FORENSIC SEROLOGY-PRACTICALS

1. Safety precautions in lab.
2. Introduction to Microscope.
3. Collection, preservation, packaging of samples.
4. Microscopic examination of human hair.
5. Comparison of human and non human hair.
6. Analysis of fiber.
7. Microscopic examination of structure of wood.
8. Microscopic examination of structure of leaves.
9. Analysis of pollen grains
10. Analysis of diatoms.
11. Analysis and comparison of human and animal hair.
12. Blood grouping of fresh blood stains.
13. Presumptive test for blood stains.
14. Microcrystal tests for dried blood stains.
15. Blood grouping for dried blood stains: Absorption elution and absorption inhibition.
16. Analysis of urine samples.
17. Analysis of salivary stains.
18. Separation and analysis of macromolecules using gel electrophoresis.
19. Microscopic analysis of diatoms.
20. Collection preservation and packaging of serological samples.

FORENSIC BALLISTICS &FORENSIC TOXICOLOGY-PRACTICALS

1. Identification of parts of firearms.
2. Preliminary examination of various characteristics of fired bullets and shots.
3. Preliminary examination of various characteristics of fired cartridge cases.
4. Chemical tests for powder residues and barrel wash.
5. Examination and comparison of fired and test bullets and shots.
6. Examination and comparison of fired and test cartridge cases.
7. Collection and packing of Gun Shot Residues.
8. Identification of bullet using holes physical and chemical examination.
9. Demonstration of preparation of Gelatin Gel block for wound ballistics studies.
10. Reconstruction of sequence of events in shooting incidents.
11. Analysis of organic acids.
12. Analysis of mineral acids.
13. Analysis of anions as prescribed by DFS manual.
14. Analysis of cations as prescribed by DFS manual.
15. Thin layer analysis for ink analysis.
16. Collection, preservation and packaging of toxicological evidences.
17. Report writing in toxicological cases.
18. Analysis of alcoholic poisons.
19. Detection of metallic poisons.
20. Analysis of vegetable poisons.

Skill based subject-IV

GOOD LABORATORY PRACTICES

30 Hours

UNIT I 06 hours

Definition of good laboratory practices (GLP), History and purpose of GLP, Compliance with GLP regulations, objectives of GLP and its principles.

UNIT II 06 hours

Components of GLP: Test facility management, quality assurance programs, meeting the requirements of the test facilities-equipments, personals. Handling, sampling and storage of analytes, standard operational protocols.

UNIT III 06hours

Performance of the study-Reagents and solutions, test and control articles, study implementation and method validation, data recording

UNIT IV 06 hours

Reporting of study results, archiving of records and materials, enforcement of GLP-audits, non-compliance and consequences, facility disqualification and reinstatement.

UNIT V 06 hours

National accreditation board for testing and calibration laboratories (NABL): requirement for accreditation, benefits, scope and proficiency testing.

Reference books

- Anderson, M. (2007). *GLP essentials*. New York, NY.:Informa Healthcare.
- Weinberg, S. (1995). *Good laboratory practice regulations*. New York: Marcel Dekker.

ELECTIVE I

CRIMINOLOGY AND CRIMINAL JUSTICE ADMINISTRATION

UNIT I: Introduction to Crime and Criminology 12 Hours

Introduction to Crime: Definition, Characteristics and Crime Triangle- Criminology: definitions, historical perspectives, nature, origin and scope- Schools of Criminology:Demo logical, Classical, Neo-Classical, Positive, Cartographic, Biological and Constitutional Schools of thought- Theories of Criminology: Laws of Imitation, Social Learning Theory, and Differential Association theory, Differential Reinforcement Theory, Containment Theory, Labelling Theory and Routine Activity Theory.

UNIT II: Juvenile Delinquency 12 Hours

Juvenile Delinquency: Definition, nature and patterns of delinquency- Causal factors: Biological, Sociological and cognitive factors- Salient features of the Juvenile Justice Care and Protection of Children (amended) Act, 2006- Juvenile delinquency and urban areas – Crime, unemployment, poverty, economic inequality and relative deprivation.

UNIT III: Penology and Correctional Administration 12 Hours

Meaning, aims and philosophy of punishment; Types of punishment and objectives of punishment- Sentencing: Principles, policies and procedures- Evolution and development of prison system in India- Classification of Correctional Institution in India: Central Jails, Sub- jails and Juvenile Institutions- Probation: Concept and scope – Historical development in India –Probation procedures: Pre-sentence investigation report, supervision and revocation- Parole: Provisions, rules and supervision- Pre-release and Pre-mature release.

UNIT IV: Prevention of Crime 12 Hours

Crime Prevention: Definition of concepts – History of crime prevention – Primary, secondary and tertiary crime prevention- Concept of Recidivism, Fear of crime and Dark Figure- Methods of crime prevention: punitive methods, defenceMethods, intervention method, mechanical method, mass method, clinical method and group relations methods- Crime prevention by police: community policing, patrolling and beats Intelligence collection and Surveillance- Crime prevention strategies in urban and rural areas.

UNIT V: Victimology 12 Hours

Victimology: Definition, Origin, development and scope- Dimensions of victimization- Typology of victims and concept of Victim precipitation, Victim facilitation, Victim provocation and indirect victimization- Retributive justice and Restorative justice- Victim assistance and victim service organizations in India.

REFERENCE BOOKS

- Barnes, E. H., & Teeters, N. K. (1966). *New horizons of criminology.* New Delhi: Prentice Hall.
- Bhattacharya, S. K. (1986). *Probation system in India*. New Delhi: Manas Publications.
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- Carney, Louis P. (1981). *Corrections: Treatment and philosophy*. Englewood Cliffs, New Jersey: Prentice Hall Inc.
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- Fattah, E. A. (1991). *Understanding criminal victimization*. Scarborough: Prentice Hall.
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- Paranjepe, N. V. (2002). *Criminology and penology.* Allahabad: Central Law Publications.
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- Sutherland, E. H., &Cressey, D. R. (1974). *Principles of criminology*. Philadelphia: Lippincott.
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- Reckless, Walter C. (1967). *The crime problem*. Bombay: Vakols, Feffner& Simons P. Ltd.
- Siddique, Ahmed (1993). *Criminology: Problems and perspectives* (3rd ed.) Lucknow: Eastern Book House.

FORENSIC AUDIO-VIDEO ANALYSIS AND SPEAKER IDENTIFICATION

UNIT I: Basic Circuits **12 Hours**

Basic Electric Circuits-LR, CR, LCR circuits, Conventional Filters and Digital Filters (high pass filters, low pass filters).Noise Characteristics: Properties of Noise, Acoustic Characteristics of Environments-Diffraction, Reverberation and Diffusion.Recording Formats-Analog and Digital, Audio and Video file formats.Linear and Non –linear Editing.

UNIT II: Introduction to video technology **12 Hours**

Concept of Video film production-Introduction to video technology component of Digital Image Processing. Concept of Digital Water Marking. Visual examination technique on video frame image- Facial Image Recognition from video frame image.

UNIT III: Forensic audio and video analysis **12 Hours**

Introduction to Forensic Audio & Video Analysis: A basic understanding of forensic audio and video technology-Audio and Video Evidence handling procedures. Authentication of recorded audio and video.Scientific methodology of forensic audio-video analysis.Recovery of digital audio-video / Deleted Video & Audio Files recovery- Exporting evidence as video or still image files-Software used for audio and video analysis.-Admissibility of audio and video evidence in court.

UNIT IV: Basics of speaker identification **12 Hours**

Introduction: Forensic Speaker Identification, Forensic Phonetics-Forensic challenges in Voice recognition.Forensic Phonetic Parameters: Acoustic vs. Auditory Parameters, Linguistic vs. Non-Linguistic Parameters. Forensic Significance: Linguistic Analysis- Requirements on forensic-phonetic parameters. The human vocal tract and the production and description of speech parameters: Vocal tract structures.Forensic Significance – Vocal cord activity, Nasals and Nasalization.-Phonetic Aspects of Speech: Articulators – Active/Passive, Phonemes –Segmental

and Supra segmental, Prosodic features- Stress, Intonation, Duration, Syllables, Nasalization, and Accent features.

UNIT V: Forensic speaker identification **12 Hours**

Characterizing Forensic Speaker Identification: Speaker Recognition – Speaker Identification and Verification, Forensic Significance .Components of Speaker Recognition.-Approaches to Speaker Recognition System of Auditory Analysis, Spectrographic approach or Voice Print Identification. Automatic Approach: Gaussian Mixture Models, Long Term Averaging, Vector Quantization, Hidden Markov Models, Neural Networks. Expressing Results in Forensic Speaker Recognition–Likelihood Ratio, Objective/Subjective Methods.Concept of Test and Error in Speaker Identification.-Admissibility of Voice evidence in Court.

REFERENCE BOOKS

- Forensic Speaker Identification, Philip Rose: CRC Press Book, (2002).
- A Simplified Guide to Forensic Audio and Video Analysis (PDF Notes).
- The Physics of Speech, D.B. Fry: Cambridge University Press, (1979).
- The Complete Book of Video Techniques Subjects Equipment, David Cheshire: Dorling Kindersley Publication London, (1992).
- Audio video analysis by B.R. Sharma, Universal Publishers, Luck now.
- Audio and video systems by R. G. Gupta, Tata McGraw Hill (1995).

FORENSIC MEDICINE

UNIT I: Introduction to Forensic Medicine 12 Hours

Forensic Medicine: Introduction, History, Scope- Legal Procedure: Inquest, Summons. Medical Evidence: types, definition with legal sections- Witness: Types and duties with sections. Recording of Evidences. Importance of medical records- Duties of medical practitioner, Malpraxises, Euthanasia- Conduct of doctor: In scene of crime and witness box.

UNIT II: Death and Its Causes 12 Hours

Death: Definition, types, brain death- Suspended animation- Modes of death: coma, syncope and asphyxia, determination of time since death- Identification: methods to identify living person for gender, race, and age- Bite marks: scope and forensic significance.

UNT III: Infanticide and Foetal Age 12 Hours

Infanticide: definition, foeticide and still birth- Signs of intrauterine death, signs of live birth, viability of foetus, age determination of foetus, demonstration of ossification centres, precipitate labour, haase's rule, hydrostatic test, maceration, sudden infant death syndrome- Foetal age determination, identification of criminals, unknown persons, dead bodies from the remains hairs, fibers, teeth etc.

UNIT IV: Medico Legal Autopsy 12 Hours

Autopsy: introduction, legal requirements to conduct autopsy, preparation of autopsy report- Examination of dead body: types and methods- Examination of bones- Exhumation- Signs of death: Immediate, Early and Late. Rigor mortis, algor mortis, post mortem hyptosis, muscle changes, putrefaction, saponification and mummification.

UNT V: Injuries 12 Hours

Injury: definition, classification, ante mortem and post mortem injuries, estimation of age of different types- Mechanical injuries: definition, classification- Causes of death by injuries- Medico legal aspects of injuries, vehicular injuries- Medico legal aspects in cases of burns and scalds- Identification of injuries by torture- Sexual offenses: introduction, types, examination of accused and victim- Thermal deaths: types, post mortem appearances. Flash burns, scalds

establishment of identity- Electrical injuries: factors influencing, effects, properties, Post mortem appearences- Lightning stroke: types of burns, Post mortem appearences, radioactive substances, action on an individual.

REFERENCE BOOKS

- Text book of Forensic Medicine and Toxocology: V VPillay, 15th edition, Paras Medical Publishing, Hyderabad.
- Fundamentals of Forensic Medicine and Toxicology: R. Basu, Publishers- Books and Allie (P) LTD, Kolkata.
- Guharaj Forensic Medicine: P V Guharaj, Edited by M R Chandran, Orient Longman, 2nd Edition, Hyderabad.
- Modi's Medical Jurisprudence and Toxicolgy: edited by K. Mathiharan and A K Patnaik, Eastern book company, 23rd edition, Lucknow.
- Internet: Journal of Indian Congress of Forensic Medicine and Toxicolgy.
- Forensic dentistry: Whitaker D. K & Wolfe Medial Publication Ltd (1989)

ELECTIVE II

POLICE ADMINISTRATION

UNIT I: History of Indian Police **12 Hours**

History of Indian Police: Ancient period, Medieval period and British period- Modern policing- Community policing- Police Act, 1861- Police Commission Reforms and Recommendations- National Police Commission recommendations (NPC), 1979

UNIT II: Police Organization and Structure **12 Hours**

State police organization and structure – Urban and rural policing- Hierarchy in city police, district police and police battalion- Functioning of State Police: Law and Order, Intelligence and Special Unit- Central police organizations: RAW, IB, NIA, CBI, CISF, CRPF, RPF- Police research and Crime Statistics Organizations: BPR&D, NCRB.

UNIT III: Criminal Investigation **12 Hours**

Crime prevention: Patrolling, beat, surveillance, traffic regulation and maintenance of law & order- Collection of intelligence and its use- Use of scientific methods to tackle crime- Examination of crime scene and investigation- Methods of Investigation: Information, Modus Operandi and Interrogation, Recording of FIR, Case Diary, NC register, Collection of Evidence, Examination of Witnesses and Suspects, Confession of the accused and filing of charge Sheet.

UNIT IV: Records Maintained in police Stations **12 Hours**

Police Station Routine: Roll Call, Duties of Prevention of Crime, Station Guards, Weekly routine duties of police men in cities and villages- Records maintained in police stations : General Diary, KD register, Prisoners Search Register, Duty Roaster, Sentry Relief Book, Duty Roster, Gun license register, Tapal register, arrest card and bail bond- New challenges faced by police: Cybercrime, financial frauds, terrorists, coastline security and organized crime- Community policing models and initiatives.

UNIT V: Public Image on Police **12 Hours**

Public perception of police – Measures to improve police image in urban and rural areas- Measurements to improve police-public relationship through community policing- Measures to tackle corruption – Treatment of victims and offender by the police- Campaign to prevent drug abuse and to ensure safety of women in cities.

REFERENCE BOOKS

- Aleem, S. (1991). *Women in Indian police* (15th ed.). Chicago: Sterling Publishers Private Limited.
- Barker, M., &Petley, J. (2001). *Ill effects: The media/violence* (2nd Ed.). London: RoutledgeBelson.
- Fisher, Barry A. J. (2000). *Techniques of crime scene investigation* (6th Ed.). New York: CRC Press.
- Diaz, S. M. (1976). *New dimensions to the police role and functions in India*. Hyderabad: National Police Academy.
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- Krishna Mohan Mathur. (1994). Indian*Police: Roles and Challenges*. Gyan Publishing House, New Delhi.
- Krishna Mohan Mathur.(1989). Internal *Security Challenges and Police in a Developing Society*. RBSA Publishers.
- Mathur, K. M. (1994). *Indian police: Role and challenges*. New Delhi: Gyan Publishing House.
- Mathur, K. M. (1994). *Internal Security challenges and police in a developing society*. Jaipur: RBSA Publishers.
- Parmar M.S. (1992). *Problems of Police Administration*. Reliance Publishing House, New Delhi.
- Potter, W. James (1999). *On media violence*. London: Sage Publications.
- Ramanujam, T. (1992). *Prevention and detection of crime*. Madras: Madras Book Agency.
- Snyman, R. (1997). *Policing and human rights.* Kenwyn, UK: Juta.
- Subramanian, S. (1997). *Human rights: International challenges.* New Delhi: Manas Publications.
- Swanson, Charles, R. (1983). *Police administration: Structure, processes and behavior*. New York: MacMillan Publishing Co., Inc.
- Thurman, Q., &McGarrell, E. (1997). *Community policing in a rural setting*. Cincinnati: Anderson.
- Nehad Ashraf. (1992*). Police and Policing in India*. Common Wealth Publishers, New Delhi.

GENERAL PHYSICS

UNIT – I: Waves 12 Hours

Wave Motion, General Equation of Wave Motion and Plane Progressive Harmonic Wave-Energy Density for a Plane Progressive Wave, Intensity of a Wave.Transverse Waves in Stretched Strings, Modes of Transverse Vibrations of Strings and Longitudinal Waves in Rods and Gases, Fourier's Theorem, Wave Velocity and Group Velocity

UNIT-II: Sound 12 Hours

Intensity of Sound- Decibel and Bell, Loudness of Sound, Noise Pollution.Ultrasonic's: Production of Ultrasonic Waves – Piezo- Electric Crystal Method. Determination of Velocity of Ultrasonic Waves in a Liquid - Acoustic Grating and Application of Ultrasonic Waves. Reverberation, Sabine's Formula (Derivation not required) and Absorption Coefficient-Acoustics of Buildings

UNIT-III: Wave dynamics12 Hours

Waves in one dimension, the wave equation and sinusoidal waves**.** Boundaryconditions: reflection and transmission and Polarization**.** Electromagnetic waves in vacuum, Wave equation for E and B, monochromatic plane waves in vacuum, energy and momentum of Electromagnetic waves. Pointing vector - Electromagnetic waves in matter, Propagation through linear media, reflection and transmission at normal incidence.

UNIT-IV:Electronics 12 Hours

Growth and decay of current in LR and CR circuits – measurement of high resistance by leakage – growth of charge and discharge of a capacitor through LCR circuit. Theory of Base Ground (BG) – experiment to determine charge sensitiveness of BG- AC through L, C, R, LC, CR, LR and LCR, resonance and resonant circuits, repulsion between coil and conductor, application to AC circuits and AC bridges. Anderson and Rayleigh bridge.

UNIT- V: Quantum Mechanics12 Hours

Electromagnetic waves, black body radiation, ultraviolet catastrophe. Photoelectric effect, nature of light, wave particle duality, Compton Effect.De Broglie waves, waves of probability, phase velocity & group velocity and particle diffractionUncertainty principle I, Uncertainty principle II, Application of the uncertainty principle, Energy and time uncertainty. The Bohr atom-energy levels and spectra, correspondence principle, nuclear motion and atomic excitation- Quantum mechanical model of atom.

UNIT-VI: Elasticity 12 Hours

Elasticity: Hooke's law - Relationship between three moduli of elasticity (qualitative) and stress -strain diagram. Poisson's ratio –Factors affecting elasticity, Bending moment and depression of a cantilever. Young's modulus by uniform bending. Modes of heat transfer- thermal conductivity, Newton's law of cooling and linear heat flow, Lee's disc method, Radial heat flow and Rubber tube method. Conduction through compound media.

REFERENCE BOOKS

- P.K.Srivatsava, *Mechanics*, New Age International (P) Ltd. - 1997.
- Physics through experiments Vol. I & I,B. Saraf et al. Vikas Publishers, India, 1992
- Halliday and Resnick, *Fundamentals of Physics*, sixth edition, John Wiley and son, 2005.
- A.K.Ghatak and K.Thyagarajan, *Contemporary Optics* –MacMillan India Ltd., 1984.
- A.K.Ghatak and K.Thyagarajan, *Optical Electronics* - Cambridge University Press, 1989.
- Subramanyam and Brijlal, *Optics*, S Chand & Company, New Delhi, 1983.
- AjoyGhatak, *Optics*, Tata McGraw Hill Publishing Company Ltd., III Edition, 2009, New Delhi.
- D.P. Khandelwal, *Optics and Atomic Physics* – Himalaya Publishing House, Mumbai. 2003.
- Jenkins and White, *Fundamentals of Optics*- Tata McGraw Hill Publishing Company Ltd., New Delhi 2001.

FORENSIC ANTHROPOLOGY AND ODONTOLOGY

UNIT I: Introduction to Forensic Anthropology 12 Hours

Forensic Anthropology: introduction, definition, history, scope and importance- Human skeletal system: Structure and functions- Classification of bones- Characteristics of bones. Anatomy of bones: general aspects for human and non human skeletal systems- Forensic importance of bones: estimation of age, identification of gender.

UNIT II: Ossification and Its Importance 12 Hours

Ossification: Introduction, definition- Important Ossification points in human skeletal system: For estimation of age and gender- Rate of ossification: estimation and comparison with non human ossification points for gender identification- Anatomy of different bones- the skull, clavicle, scapula and ribs, vertebral coloumn, Humerus radius ulna, carpals, metacarpals and phalanges, pelvis, Femur tibia, fibula, patella, tarsals, metatarsals.

UNIT III: Chemistry of Bones 12 Hours

Chemistry of bones: Biochemical aspects, chemical constituents in ligaments- Field and laboratory management of skeletal remains- Collection, preservation and packaging of osteological evidence- Biological profiling of skeletal remains: Demography, sex, age, stature and race estimation.

UNIT IV: Application in Investigation 12 Hours

Facial reconstruction: two and three dimensional methods, facial anatomy of humans- Estimation of facial tissue thickness with MRI and other methods- Facial superimposition: Comparison and analysis of facial features of human skull and the ante-mortem photograph- Superimposition: photographic and computerized methods.

UNIT V: Forensic Odontology 12 Hours

Forensic Odontology: Introduction, definition, history and scope- Teeth: types and structures- Eruption of teeth in different agesRole in personal identification: Age and gender- Importance of teeth evidence in mass disasters- Recovery of forensic evidences from graves and skeletal variation.

REFERENCE BOOKS

- Forensic Anthropology: Current Methods and Practice.
- Forensic Odontology: Principles and Practice, Editor(s): Jane A. Taylor, Jules A. Kieser .
- The human bone manual, Tim D White, Peiter A Folkens.
- Forensic anthropology training maznual, Karen Ramey Burns.
- Atlas of Human Anatomy by Mark Nielsen; Shawn D. Miller.
- Anatomy at a Glance by Omar Faiz; Moffat David.
- Understanding Anatomy and Physiology: a Visual, Auditory, Interactive Approach by Gale Sloan Thompson.

ELECTIVE III

CRIMINAL LAW

UNIT I: Indian Constitution **12 Hours**

Constitution of India and its supremacy - History of Indian Constitution - Preamble - Citizenship – Fundamental Duties - Fundamental Rights - Directive Principles of State Policy - Executive, Legislature and Judiciary- Meaning and Concept of society, culture, informal means of social control (norms, mores, folkways, taboos), social deviance, groups, community, social organization and disorganization, social structure and process – Family disorganization and its relationship with crime.

UNIT II: Origin of Criminal Law **12 Hours**

Definitions: vices, sin, tort - History of criminal law – Major Criminal Laws: Indian Penal Code, Criminal Procedure Code and Indian Evidence Act - Nature and Scope of criminal laws - Doctrine of *Actus Reus* and *Mens Rea*- Definition of crime – Fundamental elements of crime – Stages of crime: Intention, preparation, attempt and commission – Theories: Deterrent, retributive, preventive, expiatory and reformative.

UNIT III: Introduction to Criminal Justice System **12 Hours**

Introduction to criminal justice in India: Police, Prosecution, Judiciary and Correctional departments – Co-operation and co-ordination among the various sub-systems of the Criminal Justice System- Fundamental concepts –Rule of law – Concept of practice – Fair trial – Important provisions of the Indian Penal Code, 1860 – Extent and operation of the Indian Penal Code – Punishment under IPC: Fine, life imprisonment and death sentence.

UNIT IV: IPC Offences **12 Hours**

Crimes against property – Theft, Robbery and Dacoity. Crimes against persons- Culpable Homicide, Murder, Rape, Hurt. Crimes against public tranquility- Riot, Unlawful assembly- Organizational set up of courts in India – Complaint- Inquiry - Investigation - FIR - public prosecutor - defence counsel - Arrest, Bail, Search and Seizure .

UNIT V: Indian Evidence Act **12 Hours**

Evidence - Meaning, principles and concept of relevancy and admissibility- Confessions and Dying Declaration- Presumption of fact and law- Burden of proof- Examination in Chief, Cross Examination and Re- examination- Special and Local Laws – Need and Objectives of special and local laws – Special laws vs. local laws – Conventional laws vs. Special and local laws.

REFERENCE BOOKS

- Allen, Harry E., Friday, Paul C., Roebuck, Julian B., &Sagarin, Edward (1981). *Crime and punishment: An introduction to criminology.* Free Press: New York.
- Crime in India. (2002). National Crime Records Bureau. New Delhi: Ministry of Home Affairs.
- Don, G. (1973). *Society, crime & criminal careers.* Bombay: Prentice Hall.
- Edelston, C. D., & Wicks, R. I. (1977). *An introduction to criminal justice.* New York: Gregg Division, McGraw-Hill.
- Gaur, K. D. (2013). *Criminal law: Cases and materials* (7th Ed.). Gurgaon, Haryana, India: LexisNexis.
- Hall, J. (1960). *General principles of criminal law* (2nd Ed.). Indianapolis: Bobbs-Merrill.
- Gibbons, Don C. (1973). *Society, crime and criminal careers: An introduction to criminology*. New York: Prentice Hall.
- Nigam, R. C. (1965). *Law of crimes in India*. Asia Pub. House.
- Pande, G. S. (2002). *Constitutional law of India* (8th Ed.). Allahabad: Allahabad Law Agency.
- Paranjepe, N. V. (2002). *Criminology and penology.* Allahabad: Central Law Publications.
- Ratanlal&Dhirajlal (1984) the Indian Penal Code, Nagpur:Wadhwa& Co.
- Ratanlal&Dhirajlal (2000) the Code of Criminal Procedure, Nagpur:Wadhwa& Co.
- Sarathy, V.P. (1994) Elements of Law of Evidence, Lucknow : Eastern Book Co.
- Siddique, Ahmed. (1993). *Criminology: Problems and perspectives* (2nd Ed.). Lucknow: Eastern Book House.
- Singh, A., (1995) Law of Evidence, Allahabad Law Agency.
- Thakore, D. (2011). *Ratanlal&Dhirajlal's the Indian Penal Code (Act XLV of 1860)* (33rdEd.). Gurgaon, Haryana, India: LexisNexis ButterworthsWadhwa Nagpur.
- Vibhute, K. I. (2012). *P. S. A. Pillai's criminal law* (11th Ed.). Lexis Nexis.

RESEARCH METHODOLOGY AND STATISTICS

UNIT I: Introduction to Research 12 Hours

Research: Definitions, Characteristics and Objective of research- Epistemology and ontology of research- Types of research: Descriptive vs. Analytical, Applied vs. Fundamental, Qualitative vs. Quantitative, Conceptual vs. Empirical, and other kinds of research- Research methods vs. Research Methodology - Inductive and deductive research- Ethics in Criminal Justice Research.

UNIT II: Research Problem 12 Hours

Formulation of the research problem– Research process – Overview of the stages in research (hypothesis formation to analysis and report writing) -Research design: Meaning of research design – Need for research design- Hypothesis: Definition – Types of hypothesis.

UNIT III: Data Collection 12 Hours

Data collection – Types of Data's- Modes of collection of primary data: Observation, Interviews, interview schedules, Questionnaires – Modes of collection of secondary data- Population and unit of analysis - Sampling Techniques: Definition – Criteria for selecting a sampling design- Types of sampling: Probability sampling and non-probability sampling – Types of probability sampling: simple random sampling, systematic sampling, stratified sampling, cluster sampling, area sampling and multi-stage sampling – Types of non-probability sampling: purposive sampling, convenience sampling, judgment sampling and snowball sampling. - Advantages of sampling – Requirements of a good sample.

UNIT IV: Introduction to Statistics 12 Hours

Variables – Discrete and Continuous - Independent and Dependent- Scales of measurement- Nominal, ordinal, Interval and ratio- Frequency for grouped and ungrouped data- Class Interval and Class width - Continuous and discontinuous data- Graphical representation of data- bar chart, pie-chart and histogram- Significance of statistics in forensic science.

UNIT V: Measures of Central Tendency 12 Hours

Measures of Central Tendency: Mean, Median and Mode- Measures of Dispersion: Range, quartile deviation, mean deviation and standard deviation and coefficient of variations- Measure

of symmetry: Kurtosis and skewness- Introduction to Statistical Package for Social Science Research (SPSS).

REFERENCE BOOKS

- Mc Burney, H. H (2002). *Research Methods. Singapore*: Thomson AsisPvt Ltd
- Raulin, M.L. &Graziano, A. M. (2010). *Research Methods- A Process Of Inquiry*. London : Pearson
- Sapsfor, R &Jupp.V (1996). *Data Collection and Analysis*. New Delhi: Sage Publications.
- C.G.G. Aitken and D.A Stoney (1991). *The use of statistics in Forensic Science*, Ellis Horwood Limited, England.
- Dane, F. C. (1990). *Research methods.* California: Brooks/Cole Publishing Company.
- Denzin, N. K., & Lincoln, Y. S. (2003). *Strategies of qualitative data.* London: SAGE.
- Dixon, B., Bouma, G., & Atkinson, G. (1987). *A handbook of social science research.* New York: Oxford University Press.
- Kothari, C. R. (1996). *Research methodology: Methods & techniques* (2nd ed.). New Delhi: Wiley Eastern.
- Agarwal, B. (2012). *Basic statistics*. Tunbridge Wells: Anshan.
- Argyrous, G. (2000). *Statistics for social science research: With a guide to SPSS*. London: SAGE.
- Gupta, S. P. (2008). *Statistical methods.* New Delhi: Sultan Chand & Sons.
- Leabo, D., & Smith, C. (1968). *Basic statistics* (3rd ed.). Homewood, Illinois: R. D. Irwin.

DNA TYPING

UNIT I: Introduction to Human Genetics 12 Hours

History: discovery, development in the findings. Definition, structure, properties and forensic importance- Human genetics- definition and explanations for Heredity, alleles, mutations and population genetics- Molecular biology of DNA, variations in DNA, Biochemical aspects- Genomics and medical genetics.

UNIT II: DNA Profiling 12 Hours

Mitochondrial DNA- definition, structure, biochemical activity-DNA Profiling**:** Introduction, definition, history and importance in the field of forensic science- Types of samples used for DNA analysis- Collection, packaging and preservation of blood, saliva, semen, sweat and hair- Paternity and maternity index: equation, derivation and calculation.

UNIT III: DNA typing Systems 12 Hours

DNA typing systems- Polymorphism, RFLP analysis, PCR amplifications, sequence polymorphism- Analysis and functioning of SNP and Y- STR- Evaluation of results, frequency estimate calculations, allele frequency determination- Interpretations of results. Match probability- database, quality control, certification and accreditation.

UNIT IV:Application of DNA Profiling 12 Hours

Forensic Significance of DNA profiling: Applications in disputed paternity cases, child swapping- Missing person's identity- civil immigration, job disputes- Application in veterinary, wildlife and agriculture cases- Case studies related to paternity and maternity disputes and child swapping.

UNIT V: Legal Perspective of DNA Profiling 12 Hours

Legal perspectives- legal standards for admissibility of DNA profiling, procedural and ethical concerns- Medical perspective: duties of a medical practitioner on conducting DNA profiling- Status of development of DNA profiling in India and abroad- New and future technologies: DNA chips, SNPs and limitations of DNA profiling.

REFERENCE BOOKS

- DNA Structure and functions by Richard R. Sinden; Academic Press, Inc. 1994.
- DNA Profiling and DNA fingerprinting; Edited by Jorg T. Epplen and Thomas Lubjuhn; BirkhauserVerlag, Switzerland, 1999.
- Forensic DNA Profiling Protocols edited by Patrick J. Lincoln and Jim Thomson; Humana Press, Inc. 1998.
- DNA and other Polymorphism in Forensic Science by Henry C. Lee and R.E. Gaensslen; Year book Medical Publishers, Inc. 1990.
- DNA Technology in Forensic Science by committe on DNA Technology in Forensic Science, Board on Biology, Commission on Life Sciences, National Research council; National Academy Press, Washington, D.C. 1992
- Keith In man and Norah Rudin; An Introduction to Forensic DNA Analysis, CRC Press; Ny. 1997.
- DNA structure and functions by Richard R. Sinden; Academic Press, Inc. 1994.
- Kirby: DNA Fingerprinting Technology.
- Furley, M.A. & Harrington, J.J. (1991) Forensic DNA Technology
- National Research Council (1992): DNA Technology in Forensic Science, Washington DC National Academy Press.