

# UNIVERSITY OF DELHI

## MASTER OF SCIENCE

(Acronym for the Course): **FSC**

(Effective from Academic Year 2019-20)

**Forensic Science**

## PROGRAMME BROCHURE



XXXXXX Revised Syllabus as approved by Academic Council on XXXX, 2018 and

Executive Council on YYYY, 2018

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## **I. About the Department**

*One-page text to provide following details:*

- *Historical background of Department*

In 1947, the Department of Anthropology was founded in the Faculty of Science at the University of Delhi, with Dr. P.C. Biswas (M.Sc., Calcutta, Ph.D Berlin) as its Head, when Sir Maurice Gwyer was the Vice Chancellor of Delhi University. It was the second anthropological institute in the country. The Department started in two rooms in the old building of the Department of Zoology, then shifted to the new building of the Arts Faculty in 1949, and later came to occupy its present building- the erstwhile Prince's Pavilion facing Mughal Garden in 1966. Laboratories and lecture halls were added to meet the needs of the growing discipline. From a humble beginning of two rooms today it has 6 laboratories (general and specialized), lecture halls, teacher's rooms, library, and an ethnographic museum. The Museum when it was located in the Arts Faculty building had the distinction of having the visit and blessings of our beloved Prime Minister Pandit Jawaharlal Lal Nehru who regularly donated ethnographic specimen and cultural objects from his personal collection throughout his tenure. This tradition was continued by his distinguished daughter, Prime Minister Indira Gandhi. In its present location, Prince Charles, Prince of Wales, visited the museum in 1980. The Department which in 1947 had a faculty of two members has now 21 members and a number of research associates, DST women scientists, research fellows and scholars which include JRF, SRF and Inspire fellows. Now the Department is headed by Professor P. C. Joshi (2019) to give new focus on the teaching and research in Anthropology and Forensic Science.

- *Department Highlights in terms of its ranking, courses*

The Department has made an immense contribution with respect to the generation of Anthropological knowledge. The Department has featured among the top 100 in QS World University ranking by Subject 2016-2017, the only Anthropology department from India to achieve this status.

The department has developed and initiated one year Certificate course in Forensic Science (CCFS) since 1968. In 2015, the department expanded its educational provision and shaped a unique Master level course in Forensic Science (M.Sc.).

This course provides a platform in the field of forensic science to apply scientific principles for the criminal investigative procedures.

- *About the programme*

The Masters in forensic science is a two year programme with four semesters.

***About Post Graduate Attributes:***

The course explores the collection, analysis and interpretation of scientific evidence, in an integrated approach, with plenty of field studies. This exciting area of science is delivered with expertise from forensic faculty and practitioners. It gives understanding of the major branches of science including anthropology, biology, physics, chemistry biochemistry and medical sciences. It will develop key laboratory skills, and learn to give detailed scientific explanations for the theory and practices used in modern forensic science. The course gives an overview of types of forensic evidence, such as skeletal remains, insects, drugs, toxicology and poisons. IT. It will explain the DNA and human identification techniques, crime-scene processing, counterfeits and forgeries and the application of analytical techniques to analysis of evidence. The students will be introduced to criminal law, and police administration. The course provides with the opportunity to study analysis of body fluids, drugs, fibres, fire investigation and ballistics and advanced analytical techniques or Forensic investigations

***About the process of course development involving various stakeholders at different stages.***

The course was developed while taking the feedback from forensic science experts and the alumni and of the course. Various experts from different universities all across the nation were contacted and their suggestions were taken. The suggestion of the forensic science faculty, forensic experts from different research institutes and the alumni students were incorporated to revise the syllabus of forensic science

## **II. Introduction to CBCS (Choice Based Credit System)**

### **Choice Based Credit System:**

The CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising core, elective/minor or skill-based courses. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. Grading system provides uniformity in the evaluation and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations which enables the student to move across institutions of higher learning. The uniformity in evaluation system also enable the potential employers in assessing the performance of the candidates.

### **Definitions:**

(i) 'Academic Programme' means an entire course of study comprising its programme structure, course details, evaluation schemes etc. designed to be taught and evaluated in a teaching Department/Centre or jointly under more than one such Department/ Centre

(ii) 'Course' means a segment of a subject that is part of an Academic Programme

(iii) 'Programme Structure' means a list of courses (Core, Elective, Open Elective) that makes up an Academic Programme, specifying the syllabus, Credits, hours of teaching, evaluation and examination schemes, minimum number of credits required for successful completion of the programme etc. prepared in conformity to University Rules, eligibility criteria for admission

(iv) 'Core Course' means a course that a student admitted to a particular programme must successfully complete to receive the degree and which cannot be substituted by any other course

(v) 'Elective Course' means an optional course to be selected by a student out of such courses offered in the same or any other Department/Centre

(vi) 'Open Elective' means an elective course which is available for students of all programmes, including students of same department. Students of other Department will opt these courses subject to fulfilling of eligibility of criteria as laid down by the Department offering the course.

(vii) 'Credit' means the value assigned to a course which indicates the level of instruction; One-hour lecture per week equals 1 Credit, 2 hours practical class per week equals 1 credit. Credit for a practical could be proposed as part of a course or as a separate practical course

(viii) 'SGPA' means Semester Grade Point Average calculated for individual semester.

(ix) 'CGPA' is Cumulative Grade Points Average calculated for all courses completed by the students at any point of time. CGPA is calculated each year for both the semesters clubbed together.

(x) 'Grand CGPA' is calculated in the last year of the course by clubbing together of CGPA of two years, i.e., four semesters. Grand CGPA is being given in Transcript form. To benefit the student a formula for conversation of Grand CGPA into %age marks is given in the Transcript.

### **III. Forensic Science Programme Details:**

**Programme Objectives (POs):** The programs provides opportunity for learners to achieve the following objectives

- Make students familiar with the field of forensic science which includes investigating a crime by applying forensic science principles.
- Enhance knowledge, in depth understanding and application of forensic science, policing and criminal investigation by teaching and research.
- Develop critical and analytical subject specific skills involving the principles, practices and techniques of specific field.
- Develop competence in research methods and presentation of information.
- Develop skills in forensic identification, forensic problem solving either independently or as a team member.
- Keep abreast with all recent developments and emerging trends in Forensic science, Ethics and the law.

### **Programme Specific Outcomes (PSOs):**

PSO 1. Understand application of Forensic Science, Photography and Crime Scene Management

PSO 2. Techniques of Forensic Physics, Forensic Ballistics, Forensic Chemistry and Toxicology

PSO 3. Study Forensic Dermatoglyphics and other impressions. All PSOs are helpful in forensic identification with reference to various crimes.

### **Programme Structure:**

The Anthropology programme is a two-year course divided into four-semester. A student is required to complete **XXXX** credits for the completion of course and the award of degree.

		<i>Semester</i>	<i>Semester</i>
<b>Part – I</b>	First Year	Semester I	Semester II
<b>Part – II</b>	Second Year	Semester III	Semester IV

**Course Credit Scheme**

**Course Credit Scheme**

Semester	Number of Papers	Credits				Total Credit
		Theory  4 credit per Paper	Practical  2 credit per paper	Dissertation/ Report/Training Visit to Crime Scene	Open Elective	
<b>Semester-I</b>	4	4x4 papers= <b>16</b>	2x 2 practicals = <b>4</b>	-	-	20
<b>Semester-II</b>	4	4x4 papers= <b>16</b>	2x 2 practicals = <b>4</b>	-	-	20
<b>Semester-III</b>	4	4x3 papers= <b>12</b>	2x 2 practicals = <b>4</b>	-	<b>4</b>	<b>20</b>
<b>Semester-IV</b>	-	-	-	<b>6=6+4+4=20</b>	-	20
<b>Total Credits</b>						<b>80</b>

- \* For each Core and Elective Course there will be 4 lecture hours of teaching per week.
- \*\* Duration of examination of each paper shall be 3 hours.
- \* Each paper will be of 100 marks out of which 70 marks shall be allocated for semester examination and 30 marks for internal assessment.

**Semester wise Details of Forensic Science Course**

Semester	Paper type	Theory credits	Practical credits	Total credits
I	Core (Paper 1: Forensic Science, Photography, Crime Scene Management)	4	2	6
	Core (Paper 2: Forensic Physics)	4	2	6
	Core (Paper 3: Criminology, Criminal Law and Police Administration)	4	-	4
	Core (Paper 4: Forensic Dermatoglyphics and other impressions)	4	-	4
<b>Total</b>		<b>16</b>	<b>4</b>	<b>20</b>
II	Core (Paper 5: Forensic Chemistry and Toxicology)	4	2	6
	Core (Paper 6: Forensic Ballistics)	4	2	6
	Core (Paper 7: Instrumental Techniques (Physical, Chemical, Biological))	4	-	4
	Core (Paper 8: (Questioned Documents))	4	-	4
<b>Total</b>		<b>16</b>	<b>4</b>	<b>20</b>
III	Core (Paper 9: Forensic Anthropology)	4	2	6
	Core (Paper 10: Digital Forensic and	4	2	6

	Cyber Crime)			
	Elective (Paper 11: Forensic Biology and DNA Profiling)	4	-	4
	Elective open: Forensic Medicine and Psychology)	4	-	4
<b>Total</b>		<b>16</b>	<b>4</b>	<b>20</b>
IV	Dissertation	-	6	6
	Visit to crime scene/Court room/FSL	-	6	6
	Project report	-	4	4
	Training	-	4	4
<b>Total</b>		<b>-</b>	<b>20</b>	<b>20</b>
<b>Grand Total</b>		<b>48</b>	<b>32</b>	<b>80</b>

### **Selection of Elective Courses:**

Provide details about Department policy for selection of elective courses.

### **Teaching:**

The faculty of the Department is primarily responsible for organizing lecture work for Forensic Science. The instructions related to tutorials are provided by the respective registering units under the overall guidance of the Department. Faculty from some other Departments and constituent colleges are also associated with lecture and tutorial work in the Department.

There shall be 90 instructional days excluding examination in a semester.

(Add details about Projects/Dissertation and role of supervisor)

Semester IV includes six month Dissertation/Project work Case study/Specialized training in Court of Law and Police station or forensic investigation laboratories. Every candidate pursuing M.Sc degree course is required to carry out research work on a selected research project. The student can choose dissertation topic in consultation with the allotted supervisor in any of related forensic science paper covered till semester III. The guides for the dissertation shall be the recognised PG guides in the respective Specialisation. The dissertation is aimed to train a postgraduate student in research methods and techniques. It includes identification of a problem, formulation of hypothesis, search and review of literature, getting acquainted with recent advances, designing of a research study, collection of data, critical analysis, making results and drawing conclusions and compilation of final report.

### **Eligibility for Admissions:**

Qualification for M.Sc. Forensic Science is B.Sc. (Hons.)/B.Sc. in any Branch of Science.

The syllabus for the entrance examination of each postgraduate course is the corresponding B.A./B.Com/B.Sc. (or equivalent) syllabus of the University of Delhi.

[The syllabus of BSc. \(H\) Forensic Science is available at website of University of Delhi.](#)

## **Assessment of Students' Performance and Scheme of Examinations:**

1. English shall be the medium of instruction and examination.
2. Assessment of students' performance shall consist of:  
(Point wise details of internal assessment and end semester examination, their weightage and scheme to be given)  
(Assessment will be based on Learning Outcomes for the course)

## **Pass Percentage & Promotion Criteria:**

Minimum marks for passing the examination in each semester shall be 40% in each paper and 45% in aggregate of a semester

## **Part I to Part II Progression:**

(Provide department policy about semester to semester progression, policy for re-appearance, policy in case of failing in one or more papers)

## **Conversion of Marks into Grades:**

(specify the formula for conversion of marks into grades)

## **Grade Points:**

Grade point table as per University Examination rule

## **CGPA Calculation:**

As per University Examination rule.

## **SGPA Calculation:**

## **Grand SGPA Calculation:**

## **Conversion of Grand CGPA into Marks**

As notified by competent authority the formula for conversion of Grand CGPA into marks is: Final % age of marks = CGPA based on all four semesters  $\times$  9.5

## **Division of Degree into Classes:**

Post Graduate degree to be classified based on CGPA obtained into various classes as notified into Examination policy.

## **Attendance Requirement:**

(specify components for marking attendance of students)

## **Span Period:**

No student shall be admitted as a candidate for the examination for any of the Parts/Semesters after the lapse of **four** years from the date of admission to the Part-

I/Semester-I of the **Forensic Science** Programme.

### **Guidelines for the Award of Internal Assessment Marks **Forensic Science** Programme (Semester Wise)**

(Mention the components of Internal Assessment and the scheme for awarding marks for students' attendance)

30 marks are allotted for internal assessment out of 100 marks for each paper for semester I, semester II and semester III. Out of the 30 marks, 25 marks are allotted for the tutorial / assignment / presentation prepared by the student in the concerned paper and 5 marks are assigned for the attendance in that paper in specific semester. The marks assigned to student for attendance are calculated according to number of classes attended by student for the specific paper out of the total classes. Accordingly their attendance percentage is converted to score out of 5

## IV: Course Wise Content Details for Forensic Science Programme:

### MASTER OF SCIENCE

#### Semester I

Course Code: Paper 1-Forensic Science, Photography, Crime Scene Management

#### Theory

Marks: 100 (I.A. =30 and Theory =70) Duration: 14 weeks (L= 4 hours per week)

Practicals=2 Credits (50 Marks)

#### Course Objectives:

The objective of this course is to introduce the concept of forensic science, its development and progress over time. It will also familiarize students with the organizational setting and working set up of forensic laboratories. It aims to introduce different techniques used in forensic investigations with the principles involved. The course would apprise students with the basics of forensic photography techniques with management of crime scene in different situations.

#### Contents:

##### Unit 1

##### *Forensic Science Unit*

Introduction, Need, Scope, Concepts and Significance of Forensic Science, History and Development of Forensic Science, Laws and Basic principles of Forensic Science, Branches of forensic science, Organizational set-up of a Forensic Science Laboratory. Investigative strategies. Expert testimony and eye-witness report.

##### Unit 2

##### *Tools and techniques in Forensic Science*

Basic principles of microscopy, spectroscopy, chromatography. Electrophoresis, Enzyme-Linked Immunosorbent Assay (ELISA), Radio Immuno Assay (RIA). Measuring and optical instruments. Research methodologies. Formation of research design on a specific problem. Central tendency and Dispersion. Test of significance. Analysis of variance. Correlation and Regression.

##### Unit 3

##### *Forensic Photography*

Basic principles of Photography, Techniques of black & white and color photography, cameras, lenses, shutters, depth of field, film; exposing, development and printing techniques; Different kinds of developers and fixers; UV, IR, fluorescence illumination guided photography; Modern development in photography- digital photography, working and basic principles of digital photography; Surveillance photography. Videography and Crime Scene & laboratory photography.

##### Unit 4

***Crime Scene Management***

Crime scene investigations, protecting and isolating the crime scene; Documentation, sketching, field notes and photography. Searching, handling and collection, preservation and transportation of physical evidences. Chain of custody and Reconstruction of scene of crime. Report writing.

**Course Learning Outcomes:**

CO 1 Understand the basic concept, meaning, significance and development of Forensic science.

CO 2 To elucidate research methodologies and techniques used in the formation of research design on a specific problem.

CO 3 Describe Crime scene investigations, Reconstruction of scene of crime, basic principles of photography and its relevance.

**Suggested Readings:**

1. Houck, M.M & Siegel, J.A; Fundamentals of Forensic Science, Academic Press, London, 2006.
2. Sharma, B.R; Forensic Science in Criminal Investigation & Trials, Universal Publishing Co., New Delhi, 2003
3. Nanda B.B and Tewari, R.K; Forensic Science in India- A vision for the Twenty First Century, Select Publisher, New Delhi, 2001.
4. James, S.H and Nordby, J.J; Forensic Science- An Introduction to Scientific and Investigative Techniques, CRC Press, USA, 2003.
5. Saferstein; Criminalistics- An Introduction of Forensic Science, Prentice Hall Inc, USA, 2007.
6. Barry, A.J. Fisher; Techniques of Crime Scene Investigation, 7th Ed, CRC Press, New York, 2003.
7. Mordby, J. & Reckoning, D; The Art of Forensic Detection, CRC Press New York, 2003.
8. G.R. Chatwal; Analytical Spectroscopy 2nd Edn, Himalaya Publishing House New Delhi, 2002.
9. Aitken and Stoney; The Use of Statistics in Forensic Science, Ellis Horwood, New York, 1991.
10. Robertson and Vignaux; Interpreting Evidence, John Wiley, New York, 1995.
11. H.L. Blitzer and J. Jacobia; Forensic Digital Imaging and Photography, Academic Press, London, 2002
12. David R. Redsicker; The Practical Methodology of Forensic Photography- 2nd Ed. CRC Press, New York, 2001.
13. R.E. Jacobson, S.F. Ray, G.G. Attridge; The Manual of Photography- Photographic and Digital Imaging, N.R. Oxford

**Practical: Crime scene management and criminology :**

**2 Credits**

1. Descriptive study of organizational structure of a forensic science laboratory.
2. To carry out photography of indoor and outdoor crime scenes
3. Crime scene photographic processing and development in different light sources and using different filters.
4. To carry out digital photography of various forensic evidences
5. Mock crime scene investigation and writing a report on evaluation of crime scene.
6. Interpretation of crime scene notes, photos, sketches and reconstruction of crime scene
7. Microscopy of various physical evidences
8. Study the theories of crime

9. Criminal profiling
10. Portrait parley
11. Expert testimony in a mock court case scenario.

## **Semester I**

### **Course Code: Paper 2: Forensic Physics**

#### **Theory**

**Marks: 100 (I.A. =30 and Theory =70)**

**Duration: 14 weeks (L= 4 hours per week)**

**Practical: 2 Credits**

#### **Course Objectives:**

The objective of this course is to introduce the concept of forensic examination of various evidences like soil, cement, fiber, glass etc. at crime scene. It will also explain students with the specific techniques to be used for the examination of forensic evidences especially paint, fiber, soil, glasses and tool marks involved with the crime.

#### **Unit 1**

##### ***Soil, Cement and Concrete***

Types and composition of soil, sample preparation, removal of contaminants, colour, molecular particle size distribution, turbidity test, pH measurements, microscopic examination, density gradient analysis, ignition-loss test, elemental analysis, interpretation of soil evidence. Spectroscopic methods for organic materials of soil, XRD analysis. Cement bromoform test, fineness test, ignition-loss test. Identification of adulterated cement. Mortar and concrete analysis.

#### **Unit 2**

##### ***Paint and Fibre***

Types of paint and their composition, macroscopic and microscopic analysis of paint pigments, pigment distribution, micro-chemical analysis- solubility test, pyrolysis gas chromatography, TLC, colorimetric analysis, IR spectroscopy and X-ray diffraction, elemental analysis, mass spectrometer, interpretation of paint evidence.

Types of fibres, forensic aspects of fibre examination- fluorescence, optical properties, refractive index, birefringence, dye analysis. Physical fit and chemical testing. TLC, IR-micro spectroscopy, Py-GCMS. Difference between natural and man-made fibres. chemical compositions of papers, examination of wood and paper fibers, elemental analysis.

#### **Unit 3**

##### ***Glass***

Types of glass and their composition- soda-lime, boro-silicate, safety glass, laminated, lightsensitive, tampered/ toughened, wire glass, coloured glass. Matching and comparison. Forensic examinations of glass fractures- rib marks, hackle marks, cone fracture, wavy, backward fragmentation, concentric and radial fractures. Colour, fluorescence, physical measurements, refractive index, density gradient, becke-line, specific gravity examination and elemental analysis of glass evidence.

#### **Unit 4**

##### ***Toolmarks***

Types of toolmarks- compression marks, striated marks, combination of compression and striated marks, repeated marks, class characteristics and individual characteristics, tracing and lifting of marks, skid marks and their analysis, Photographic examination of tool marks and

cut marks on clothes and wall etc. Restoration of erased / obliterated marks- Method of making-cast, punch, engrave; methods of obliteration, method of restoration- etching (etchings for different metals), magnetic, electrolytic etc., recording of restored marks – restoration of marks on wood, leather, polymer etc.

### **Course Learning Outcome**

CO 1 To identify types and composition of soil, microscopic examination, Mortar and concrete analysis.

CO 2 To analyse types of paint and fibres, their composition, their macroscopic and microscopic analysis.

CO 3 To learn about the different types of glass and their composition.

CO 4 To elucidate the use of tool marks their restoration and method of recording those restored marks.

### **Suggested Readings**

**2 Credits**

1. Caddy, B; Forensic Examination of Glass and Paint Analysis and Interpretation, CRC Press, New York, 2001.
2. Shaw, D; Physics in the Prevention and Detection of Crime, Contem Phys. Vol.17, 1976.
3. Saferstein, R; Forensic Science Handbook. Vol. I,II, (Ed.), Prentice Hall, New Jersey, 1988.
4. Working Procedure Manual; Physics BPR&D Publication, 2000.
5. Sharma, B.R; Forensic Science in Criminal Investigation and Trials (3rd Ed.), Universal Law Publishing Co., New Delhi, 2001.
6. Working Procedure Manual- Physics, BPR&D Publication. 2000
7. Hess, K.P; Textile Fibers and their Use, 6th Edn, Oxford and IBH Publishing Co., 1974.

### **Practical: Forensic physics and impression**

1. Preliminary examination of glass, soil, fibre, paint and cloth evidences.
2. Examination of physical properties of glass, soil, fibre and paint evidences.
3. Develop latent fingerprints using different powder and chemical methods.
4. Comparison of fingerprints and palm prints by individual and class characteristics.
5. Restoration techniques of tool mark impressions and casting footprints.
6. Comparison and identification of individuals from lip print evidence.
7. Gait pattern recognition

**Semester I**

**Course Code: Paper 3: Criminology, Criminal Law and Police Administration**

**Theory**

**Marks: 100 (I.A. =30 and Theory =70)**

**Duration: 14 weeks (L= 4 hours per week)**

**Course Objectives:**

The objective of this course is to introduce the concept and scope of crime. It will familiarize students with types of crime and its effects as well its prevention. The course would highlight about criminal behavior and related theories. The course aims to discuss the concept of Juvenile delinquency and Victimology. It will disseminate information to students with specific criminal Law, Indian Penal Code: sections, Criminal Procedure Code and police Administration.

**Unit 1**

***Crime***

Definition, concept and scope of crime.Types of crime.Causes, effects, control and prevention of crime.Recent developments.

**Unit 2**

***Criminology and criminal anthropology***

Aim and scope of criminology; Criminal behavior and theories of criminal behavior: classic, positivist, sociological. Organized crimes, white collar crime.Juvenile delinquency.Role of correctional institutions.Criminal profiling and modus operandi, portrait parley, voice stressanalysis.Victimology.

**Unit 3**

***Criminal Law***

Indian Penal Code: sections-23, 24, 25,39,44,52,76-79,84-86.

Criminal Procedure Code: sections-2, 6-35, 41-60, 61-90,154-176, 293, 294. Charges: bailable/non-bailable offences, cognizable/ non-cognizable, summon case and warrant cases.

Indian Evidence Act: sections- 3, 24-30, 45, 135-138, 141. Expert testimony.

NDPS Act, Food and Adulteration Act, Drugs and Cosmetic Act, Arms Act, Explosives Act.

**Unit 4**

***Police Administration***

History and development of police administration; Police duties, responsibilities and powers.Organization and structure of police station; maintenance of crime records and accountability of police to law.People and society.Custodial deaths, Police and Human Rights.

**Course Learning Outcome**

CO 1 To understand concept of crime and recent development in its control and prevention.

CO 2 To study the aim and scope of criminology.

CO 3 to elucidate Criminal profiling and modus operandi, portrait parley, voice stress analysis

CO 4 To describe History and development of police administration; Police duties, responsibilities and powers.

**Suggested Readings**

1. Swanson, C.R, Terrbles, L & Taylor,R.W; Police Administration, Prentice Hall, USA,1998.

2. Gross.H; Criminal Investigation- A Practical Textbook for Magistrates, Police Officers, and Lawyers; Universal Law Publishing Co., New Delhi, 2000.
3. Lyman, M.D; Criminal Investigation – The Art &the Science, Prentice Hall, New Jersey, 2002.
4. O'Hara CE &Osterburg, JW; An Introduction to Criminalistics., Indiana University. Press, London, 1972.
5. Swansson,C.R, Chamelin, N.C, &Territ, L; Criminal Investigator, McGrawhill, New York, 2000.
6. The Indian Evidence Act,(1872), Amendment Act (2002); Universal Law Publishing Co., 2003.
7. The Code of Criminal Procedure (1973) Amendment Act, (2001); Universal Law Publishing Co., 2002.
8. Rattan Lal&DhirajLal; The Indian Penal Code, 28th Ed. Wadhwa& Co. Nagpur, 2002.

### **Semester I**

#### **Course Code: Paper 4: Forensic Dermatoglyphics and other impressions**

##### **Theory**

**Marks: 100 (I.A. =30 and Theory =70)**

**Duration: 14 weeks (L= 4 hours per week)**

##### **Course Objectives:**

The objective of this course is to explain the concept of dermatoglyphics and other impression with their forensic implication. It will also familiarize students with the biometrics, technology involved and multibiometric systems. The course also aims to discuss the foot/ footwear/tyre impressions lip prints, ear prints and their significance in forensic investigations

##### **Unit 1**

###### ***Fingerprints and Palm prints***

History and development of Dermatoglyphics , formation of ridges, pattern types, pattern area. Classification of fingerprints- Henry's system of classification, single-digit classification, Extension of Henry's classification, filing, searching and fingerprint bureau. Composition of sweat, development of chance, latent, visible and plastic prints. Conventional methods of development of latent prints- fluorescent methods, magnetic powder method, fuming method, chemical method etc. Application of laser and other radiations to develop latent fingerprints, metal deposition method and development of latent prints on skin.Taking of fingerprints from living and dead person, preserving and lifting of fingerprints, photography of fingerprints.Ridge counting and ridge tracing, class and individual characteristics, various types of ridge characteristics. Comparison of palm prints on the basis of individual ridge characteristics. Automated Fingerprint Identification System (AFIS).Modern methodologies in fingerprinting.

##### **Unit 2**

###### ***Biometrics***

Biometric evidences such as finger impressions, retina, iris pattern, voice, gait pattern, face recognition, 3D face recognition, automatic forensic dental identification, hand vascular pattern technology, Multibiometric systems, Recent developments, biometric databases.

### **Unit 3**

#### ***Foot/ Footwear/Tyre impressions***

Importance, Gait pattern, Casting of footprints in different medium, electrostatic lifting of latent footprints. Taking of control samples. Collection, tracing, lifting, casting of impressions, enhancement of footwear impressions, analysis and comparison of foot impressions, moulds, identification characteristics.

### **Unit 4**

#### ***Lip prints, Ear prints and their significance***

Nature, location, collection and evaluation of lip prints. Forensic Significance, photography, location, collection and evaluation, taking of control samples of footprints, lip prints and Ear prints for comparison. Modern techniques and developments.

#### **Course Learning Outcome**

CO 1 To understand the history and development of Dermatoglyphics, different classifications used and Modern methodologies in fingerprinting.

CO 2 This paper furthermore addresses the use of biometric evidences.

CO 3 To learn methods of taking footprints, their collection and identification of characteristics.

CO 4 To analyse lip prints and their forensic significance.

#### **Suggested Readings**

1. Bridges, B.C; Criminal Investigation, Practical Fingerprinting, Thumb Impression, Handwriting expert Testimony, Opinion Evidence., Univ. Book Agency, Allhabad, 2000
2. Mehta, M.K; Identification of Thumb impression & cross examination of Fingerprints, N.M. Tripathi Pub. Bombay, 1980.
3. Chatterjee, S.K; Speculation in Fingerprint Identification, Jantralekha printing Works, Kolkata, 1981.
4. Cowger James F; Friction Ridge Skin- Comparison & Identification of Fingerprints, CRC Press, NY, 1993
5. Cossidy, M.J; Footwear Identification, Royal Canadian, Mounted Police, 1980.
6. Iannavelli, A.V; Ear Identification, Forensic Identification Series, Paramount, 1989.
7. Henry, C.L. & Ganesslen, R.E; Advances in Fingerprint Technology, CRC Press, London, 1991.
8. Jain, A.K., Flynn, P. & Ross A.A., Handbook of Biometrics, Springer, New York 2008

### **Semester II**

#### **Course Code: Paper 5: Forensic Chemistry and Toxicology**

#### **Theory**

**Marks: 100 (L.A. =30 and Theory =70)**

**Duration: 14 weeks (L= 4 hours per week)**

**Practicals=2 Credits (50 Marks)**

#### **Course Objectives:**

The objective of this course is to introduce the forensic chemistry basics with special focus on arson chemistry, details of adulterants in petroleum products and analytical tools for examination of alcoholic and non-alcoholic beverages. It will explain types of explosives,

their synthesis and characteristics, concept of forensic toxicology and pharmacology. The students would be taught about different drugs of abuse including natural and synthetic drugs of abuse.

### **Unit 1**

#### ***Forensic Chemistry***

Introduction to Forensic chemistry, sampling of chemical evidences, presumptive, screening (colour/ spot test), inorganic analysis. Detective dyes- cases and importance in trap cases. Arson Chemistry of fire, searching of fire scene, collection, preservation and examination of arson evidences. Adulteration in Petroleum products. Examination procedures involving standard methods and instrumental techniques, analysis of beverages- alcoholic and nonalcoholic, country made liquor and medicinal preparations containing alcohol as constituents. Significance of alcohol in breath and breath screening devices. Forensic analysis of Fertilizers/ insecticides/ pesticides/ biocides.

### **Unit 2**

#### ***Explosives***

Classification of explosives, synthesis and characteristics of Tri-nitro toluene (TNT), Pentaerythritol tetranitrate (PETN) and Research and Development Explosives (RDX). Explosion process, blast waves, searching of scene of explosion. Post blast residue collection and analysis, blast injuries and detection of hidden explosives. Improvised explosive devices.

### **Unit 3**

#### ***Forensic Toxicology and Pharmacology***

Definition, classification of poisons- organic, inorganic, metallic, non-metallic etc. Acute and chronic poisoning, Accidental, homicidal and suicidal poisoning, Extraction and identification of commonly used poisons. Dosage, Frequency, Route of administration, Absorption, distribution and metabolism and factors affecting metabolism and excretion. Toxicological techniques.

### **Unit 4**

#### ***Drugs of Abuse***

Natural and synthetic drugs of abuse. Drug dependence, classification of drugs- Narcotics, Hallucinogens, Depressants, Stimulants, Anabolic steroids. Psychotropic and Psychedelic drugs of abuse. Field and laboratory tests of drugs of abuse. Instrumental methods of analysis, collection, preservation and transportation of drug evidences.

### **Course Learning Outcome**

CO 1 This paper intends to acquaint the students with the concept of Forensic chemistry, sampling of chemical evidences and their examination procedure.

CO 2 To understand the classification of explosives.

CO 3 To know the Definition and classification of different types of poisons.

CO 4 To learn the methods of analysis, collection, preservation and transportation of drug evidences.

### **Suggested Readings**

1. Niesink, RJM; Toxicology- Principles and Applications, CRC Press, 1996
2. Modi, JP, Textbook of Medical Jurisprudence & Toxicology, N.M. Tripathi Pub, 2001
3. Chadha, PV; Handbook of Forensic Medicine & Toxicology, Jaypee Brothers, New Delhi, 2004

4. Parikh, C.K; Text Book of Medical Jurisprudence, Forensic Medicine & Toxicology, CBS Pub. New Delhi,1999
5. Morrison R.T and Boyd R. N;Organic Chemistry 6th Ed Prentice Hall, 2003
6. Laboratory Procedure Manual : Petroleum Products ,Directorate of Forensic Science, MHA, Govt. of India, 2005
7. Working Procedure Manual on Chemistry ; Directorate of Forensic Science MHA Govt. of India
8. Bureau of Indian Standard Specifications related to Alcohols and Petroleum Products.
9. Welcher F; Standard Methods of Chemical Analysis, 6th Ed.VanNostrand Reinhold, New York, 1969
10. Watson C. A; Official and Standardised Methods of Analysis, Royal Society of Chemistry, UK,1994.
11. Central Excise Act ; Universal Law Publication.
12. Essential Commodity Act, 1955
13. Feigl, F; Spot Test in Inorganic Analysis , Elsevier Publ. New Delhi, 2005.
14. Curry A.S ; Analytical Methods in Human Toxicology : Part II ,CRC Press Ohio, 1986.
15. Curry, A.S : Poison Detection in Human Organs, C Thomas Spring field, CRC Press, Costa Rica, 1976
16. Clark E.G.C; Isolation and Identification of drugs, Academic Press, London, 1986
17. Sunshine I : Handbook of Analytical Toxicology, CRC Press, Costa Rica,1969.

### **Practical: Forensic Chemistry and Instrumentation**

1. TLC and spot test of alkaloids of drugs of abuse and toxic substances.
2. Isolation and instrumental analysis of different toxic substances and drugs.
3. Thin layer chromatography of explosive substances
4. Examination of petroleum products as per BIS standards.
5. Detection and identification of doping drugs from- hair, blood, saliva, urine and other body fluid and estimation of alcohol from breath, urine and blood.
6. UV-Visible Spectroscopic analysis of Drugs
7. Fourier transform infrared spectroscopic (FTIR) analysis of physical evidences
8. Gas chromatography (GC) and High performance liquid chromatography (HPLC) analysis of poisons, explosives, amino acids and proteins

## **Semester II**

### **Course Code: Paper 6: Forensic Ballistics**

#### **Theory**

**Marks: 100 (I.A. =30 and Theory =70)**

**Duration: 14 weeks (L= 4 hours per week)**

**Practicals=2 Credits (50 Marks)**

#### **Course Objectives:**

The objective of this course is to explain the history and background of firearms, their classification and characteristics. The course also aims to discuss different types of ammunitions, their identification, origin etc. with focus on improvised/ country made/ imitative firearms and their constructional features. It also highlight the identification and examination of internal, external and terminal ballistics.

#### **Unit 1**

##### ***Forensic Ballistics-I***

History and background of Firearms, their classification and characteristics, various components of small arms, smooth bore and rifled firearm, different systems and their functions, rifling – various class characteristics, types of rifling and methods to produce rifling. Trigger and firing mechanism, cartridge-firing mechanism. Projectile velocity determination, Theory of recoil, methods for measurement of recoil. Techniques of dismantling/assembling of firearm. Types of ammunitions, classification and constructional features of different types of cartridges, types of primers and priming composition, propellants and their compositions, velocity and pressure characteristics under different conditions, various types of bullets and compositional aspects, latest trends in their manufacturing and design, smooth bore firearm projectile, identification of origin, improvised ammunition and safety. Identification of origin, improvised/ countrymade/ imitative firearms and their constructional features.

## **Unit 2**

### ***Internal and External Ballistics***

Definition, ignition of propellants, shape and size of propellants, manner of burning, various factors affecting the internal ballistics: lock time, ignition time, barrel time, erosion, corrosion and gas cutting, equation of motion of projectile, principal problems of exterior ballistics, vacuum trajectory, effect of air resistance on trajectory, base drag, yaw, shape of projectile and stability, trajectory computation, ballistics coefficient and limiting velocity, Ballistics tables, measurements of trajectory parameters, introduction to automated system of trajectory computation and automated management of ballistics data.

## **Unit 3**

### ***Terminal Ballistics***

Effect of projectile on hitting the target: function of bullet shape, striking velocity, striking angle and nature of target, Tumbling of bullets, effect of instability of bullet, effect of intermediate targets, influence of range, Cavitation – temporary and permanent cavities, Ricochet and its effects, stopping power, Wound Ballistics; Threshold velocity for penetration of skin/flesh/bones, preparation of gel block, penetration of projectiles in gel block and other targets, nature of wounds of entry, exit, initial track with various ranges and velocities with various types of projectiles, explosive wounds, evaluation of injuries caused due to shot-gun, rifle, handguns and country made firearms, methods of measurements of wound ballistics parameters, post-mortem and anti-mortem firearm injuries.

## **Unit 4**

### ***Examination and identification***

Firearms, ammunition and their components identification and examination, different types of marks produced during firing process on cartridge-firing pin marks, breech face marks, chamber marks, extractor and ejector marks and on bullet number/direction of lands and grooves, striation marks on lands and grooves, identification of various parts of firearms, techniques for obtaining test material from various types of weapons and their linkage with fired ammunition, class and individual characteristics, determination of range of fire-burning, scorching, blackening, tattooing and metal fouling, shots dispersion and GSR distribution, time of firing – different method employed, and their limitations, stereo & comparison microscopy, automatic bullet and cartridge comparison system.

GSR analysis: Mechanism of formation of GSR, source and collection, spot test, chemical test, identification of shooter and instrumental methods of GSR Analysis, Management and reconstruction of crime scene; suicide, murder and accidental and self defence cases.

## **Course Learning Outcome**

CO 1 This paper intends to give an overview on Firearms, their classification and characteristics.

CO 2 To describe concept of propellants, their ignition, shape and size of propellants, manner of burning, various factors affecting the internal ballistics.

CO 3 To analyse Firearms, ammunition and their components identification and examination.

### **Suggested Readings**

1. Sharma, B.R.; Firearms in Criminal Investigation & Trials, 4th Ed, Universal Law Publishing Co Pvt Ltd, New Delhi, 2011.
2. Mathews, J.H; Firearms Identification, Vol I, II and III, Charles C. Thomas, USA, 1977.
3. Hatcher, Jury and Weller; Firearms Investigation, Identification and Evidence, Stackpole Books, Harrisburg, Pennsylvania, 1997.
4. Heard, B.J; Handbook of Firearms and Ballistics, John Wiley, England, 1997.
5. Warlow, T.A.; Firearms, The Law and Forensic Ballistics, Taylor and Francis, London, 1996.
6. Schooeble, A.J. and Exline, L.D; Current methods in Forensic Gunshot Residue Analysis, CRC Press, New York, 2000.
7. Wilber; Ballistic Science for the Law Enforcement Officer, Charles C. Thomas, USA, 1977
8. Carlucci, D.E & Jacobson, S.S; Ballistics, CRC Press, London, 2008.
9. Sellier, K.G; Wound Ballistics and the Scientific Background, Elsevier Pub. Co., London, 1994.
10. Jauhari M; Identification of Firearms, Ammunition, & Firearms Injuries, BPR&D, New Delhi.
11. Ordog, G.J; Management of Gunshot wounds, Elsevier Pub. Co., New York, 1983.
12. Schooeble, A.J. and Exline, L.D; Current methods in Forensic Gunshot Residue Analysis, CRC Press, New York, 2000.
13. Beyer, J.C; Wound Ballistics, US. Printing Office, Washington, 1962.
14. Wilber; Ballistic Science for the Law Enforcement Officer, Charles C. Thomas, USA, 1977.
15. Di Maio, JM; Gunshot Wounds, CRC Press, New York, 1999.

### **Practical: Ballistics and Questioned Documents**

**2 Credits**

1. Forensic identification of class and individual characteristics of handwriting
2. Analysis of signature forgery
3. Examination of anonymous letters and disguised writing
4. To detect and decipher alterations in a document
5. To decipher secret writings, indentations and charred documents
6. To study the handwriting of ethnic and population groups
7. To examine forgery in currency notes, passports and credit cards under Visual Spectral Comparator
8. Linkage of suspected bullet and cartridge case with the firearm on the basis of class and individual characteristics.
9. Classification and designation of ammunition using physical measurements
10. GSR collection and analysis of various components of GSR.
11. Estimation of Range.
12. Determination of velocity and energy of projectiles.

**Semester II**

**Course Code: Paper 7: Instrumental Techniques (Physical, Chemical, Biological)**

**Theory**

**Marks: 100 (I.A. =30 and Theory =70)**

**Duration: 14 weeks (L= 4 hours per week)**

**Course Objectives:**

The objective of this course is to introduce specialized techniques and their application in forensic science. The students will be able to understand the atomic & molecular spectroscopy, physical instrumentation techniques, radiochemical and nuclear techniques, biological and biochemical techniques with their general principles involved as well as their applied aspects.

**Unit 1**

***Atomic & Molecular Spectroscopy***

Spectroscopy, electromagnetic spectrum, sources of radiation, their utility and limitations. Conventional sources for UV, visible and infrared rays, sources for shorter wavelength radiations (X-ray tubes), radioactivity, Laser (He, Ne Argon, ion, dye lasers, semiconductor lasers) a source of radiation, interaction of radiation with matter:- reflection, absorption, transmission, fluorescence, phosphorescence and their forensic applications, radiation filters. Detection of radiations; photographic detectors, thermal detectors, photoelectric detectors etc. Atomic spectra, energy levels, quantum numbers and designation of states, selection rules, qualitative discussions of atomic spectra. Elements of X-ray spectrometry, fluorescence, energy dispersive X-ray analysis (EDX), wavelength dispersive X-ray analysis (WDX), X-ray diffraction, Auger effect. Application of these techniques in forensic science.

**Unit 2**

***Physical instrumentation techniques***

IR spectroscopy- correlation of infrared spectra with molecular structure, Fourier transform, infrared (FTIR) and Raman spectroscopy, fluorescence and phosphorescence spectrophotometry, Ultra violet and visible spectrophotometry: Types of sources, filters-cells and sampling devices, detectors, resolution, qualitative and quantitative methods for detection.

Fluorescence and phosphorescence spectrometry: Types of sources, structural factors, instrumentation, comparison of luminescence and UV-visible absorption methods. Atomic absorption spectrometry: Instrumentation and techniques, interference in AAS, background correction methods, quantitative analysis. Atomic emission spectrometry: Instrumentation and techniques, arc/spark emission, ICP-AES, comparison ICP vs AAS methods, quantitative analysis, applications. Techniques -RBS (Rutherford Back Scattering spectrometry) Application of these techniques in forensic science.

**Unit 3**

***Radiochemical and Nuclear techniques***

Radiochemical techniques: Basic principles and theory, introduction about nuclear reactions and radiations, neutron sources, neutron activation analysis (NAA), Thermal analysis methods: Basic principles and theory, differential scanning calorimetry and differential analysis, thermogravimetry. Nuclear Magnetic Resonance spectroscopy: Basic principles, theory and instrum, Mass Spectrometry, GCMS, LCMS, Secondary Mass Spectrometry, Laser Mass spectrometry, Fast Atom bombardment and liquid secondary Ion Mass

spectrometry, High performance liquid chromatography, Electrospray Ionization mass spectrometry. Application of these techniques in forensic science.

#### **Unit 4**

##### ***Biochemical techniques***

Biological and biochemical techniques: General principles of Biological/ Bio-chemical Analysis, pH and buffers, Physiological solution, cell and tissue culture, Cell fractionation, Biological variations etc. Centrifugation Techniques, Immuno-chemical Technique, General principles, Production of antibodies, Precipitin reaction, Gel immune-diffusion, Immunoelectrophoresis, complement fixation, Radio Immuno Assay (RIA), Enzyme-linked ImmunoSorbent Assay (ELISA), Fluorescence immune assay. Chromatographic Techniques, Electrophoretic Technique: General principles, Factors affecting electrophoresis, Low voltage thin sheet electrophoresis, High voltage electrophoresis, Sodium dodecylsulphate (SDS) polyacrylamide gel electrophoresis, Isoelectric focusing (IEF), Isoelectrophoresis, Preparative electrophoresis, Horizontal and Vertical Electrophoresis. Application of these techniques in forensic science.

#### **Course Learning Outcome**

CO 1 To know about the concept of Spectroscopy, electromagnetic spectrum, sources of radiation, their utility and limitations.

CO 2 This paper tends to describe the different Physical instrumentation techniques.

CO 3 To understand basic principles and theory of radiochemical techniques.

CO 4 To highlight general principles of biological and biochemical techniques.

#### **Suggested Readings**

1. Robinson, J.W; Atomic Spectroscopy, 2nd Ed. Revised & Expanded, Marcel Dekkar, Inc, New York, 1996.
2. Workman, J; Art Springsteen; Applied Spectroscopy- A compact reference for Practitioners, Academic Press, London, 1997.
3. Subrahmanyam, N. & Lal B; A text Book of Optics, S. Chand & Company, New Delhi, 2004.
4. Willard, H.H. Lynne L. Merrett, J. Dean, A. Frank, A. Settle. J; Instrumental Methods of Analysis, 7th Edn. CBS pub. & Distributors, New Delhi, 1986.
5. Khandpur, R.S; Handbook of Analytical Instruments, Tata McGraw Hill Pub. Co. New Delhi, 2004.
6. Thomson, K.C. & Renolds, R.J; Atomic Absorption Fluorescence & Flame Emission Spectroscopy, A Practical Approach, 2nd Edn. Charles Griffith & Company, New South Wales, 1978.
7. Dudley, H. Williams & Fleming, I; Spectroscopic Methods in Organic Chemistry, 4<sup>th</sup> Edn, Tata McGraw- Hill Publishing Company, New Delhi, 1994.

### **Semester II**

#### **Course Code: Paper 8: Questioned Documents**

#### **Theory**

**Marks: 100 (I.A. =30 and Theory =70)**

**Duration: 14 weeks (L= 4 hours per week)**

#### **Course Objectives:**

The objective of this course is to disseminate the knowledge about various types of forensic documents including genuine, forged and holographic documents. It also aims to discuss the

principles of handwriting, its identification, tools needed for forensic document examination & their use in forensic science. The course will explain the typewritten, printed documents and forgery detection techniques to students

### **Unit 1**

#### ***Introduction to Document Examination***

Nature and problems of document examination, classification of forensic documents, Specimen/Admitted writings/type writings etc: handling, preservation and marking of documents, importance of natural variations and disguise in writing, various types of forensic documents- genuine and forged documents, holographic documents, principles of handwriting identification, basic tools needed for Forensic Document Examination & their use, analysis of paper and inks.

### **Unit 2**

#### ***Handwriting and Signature examination***

Various writing features and their estimation, general characteristics of handwriting, individual characteristics of handwriting, ethnic and gender variability of handwriting, various types of forgeries and their detection, examination of signatures – characteristics of genuine and forged signatures, identification of forger, identification of writer of anonymous letters and application of Forensic Stylistics/Linguistics in the identification of writer, examination of built-up documents and determination of sequence of strokes.

### **Unit 3**

#### ***Typewritten and Printed Documents***

Identification of typescripts-identification of typist, various types of printing processes, identification of printed matter including printing of security documents and currency notes, identification of electronic typewriters, dot matrix, inkjet and laser jet printers, examination of black and white and color photocopies, fax messages and carbon copies.

### **Unit 4**

#### ***Forgery Detection***

Determination of age of documents by examination of signatures, paper, ink etc., Examination of alterations, erasures, over writings, additions and obliterations, decipherment of secret writings, indentations & charred documents, physical matching of documents, examination of seal, rubber and other mechanical impressions, examination of counterfeit currency notes,

Indian passport/visas, stamp papers, postal stamps etc., examination of fake credit cards, e documents, digital signatures, an introduction of computer forensics, preliminary examination of documents, opinion writings and reasons for opinion.

### **Course Learning Outcome**

CO 1 The paper tends to introduce students to document examination. Also describes classification, variation, nature and problems of document examination.

CO 2 To learn writing features, their estimation, general characteristics, individual characteristics, ethnic and gender variability of handwriting, various types of forgeries and their detection.

CO 3 To identify typescripts, various types of printing processes and their examination.

CO 4 To Determine identification of age of documents by examination of signatures, paper, ink etc.

### **Suggested reading:**

1. Hilton, O; Scientific Examination of Questioned Documents. Revised Edition, Elsevier, New York, 1982.
2. Osborn, A.S; Questioned Documents, 2nd Ed., Universal Law Publications, Delhi, 1998.
3. Osborn, A.S; The Problem of Proof, 2nd Ed., Universal Law Pub. Delhi, 1998.
4. Thomas, C.C; Identification System for Questioned Documents, Billy Prior Bates Springfield, Illinois, USA, 1971.
5. Harrison, W.R; Suspect Documents Their Scientific Examination, Universal Law Publication, Delhi, 2001.
6. Morris, R.N; Forensic Handwriting Identification, Academy Press, London, 2001.
7. Sheila, K; Graphotypes a new Plant on Handwriting Analysis, Crown Pub. Inc., USA, 1983.
8. Lerinson, J; Questioned Documents, Academy Press, London, 2001.
9. Katherine, M. K; CDE-Forensic Document Examination-Humana Press, New Jersey, 2007.

### **Semester III**

#### **Course Code: Paper 9: Forensic Anthropology**

#### **Theory**

**Marks: 100 (I.A. =30 and Theory =70)**

**Duration: 14 weeks (L= 4 hours per week)**

#### **Course Objectives:**

The objective of this course is to explain the relevance of personal identification and its application using somatometric and somatoscopic observation, tattoo marks, deformities and genetic traits in forensic investigations. It will also explain the basic principles of human growth and development with focus on methods of assessing age-especially dental age and skeletal age. The course would highlight the forensic morphometry of skeletal remains, skeletal analysis and details of forensic odontology

#### **Unit 1**

##### ***Personal Identification***

Genesis and development of forensic anthropology. Personal identification of living persons- Identification through somatometric and somatoscopic observation, nails, occupation marks, scars, tattoo marks and deformities; handwriting and mannerisms. Genetic traits of forensic significance: Colour blindness, ear lobe, brachydactyly, polydactyly, widow's peak, eye colour, hair colour, face form, frontal eminences, nasal profile, nasal tip, lips, chin form. Identification of the recently dead and decomposed bodies.

#### **Unit 2**

##### ***Human Growth and Development***

Major stages of human growth and development- Prenatal growth, Postnatal growth and their characteristics, Factor affecting growth- Genetic and Environmental. Methods of studying Human

Growth, Significance of age in growth studies Methods of assessing age-chronological age, dental age, skeletal age, secondary sex character age and morphological age .

#### **Unit 3**

##### ***Forensic Morphometry of Skeletal Remains***

Techniques for recovering skeletonised human remains. Laboratory analysis of skeletal and decomposing remains; maceration, skeletal analysis. Human and Animal remains. Bone fragments, Attribution of sex, estimation of age and reconstruction of stature from skeletal remains. Trauma analysis and identifying skeletal pathology. Antimortem, perimortem, post-

mortem and pseudo mortem trauma. Pathological changes in bone. Establishment of partial and complete identity of skeletal material and dead bodies-morphometric techniques.

**Unit 4**

***Forensic Odontology***

Tooth structure and growth. Estimation of age from odontological evidences. Population differences in size and morphology. Individualisation of tooth pulp. Bite marks and its forensic significance. Photography, lifting and preservation of bite marks. Comparison and evaluation of bite mark evidences.

**Course Learning Outcome**

CO 1 To understand genesis and development of forensic anthropology.

CO 2 To discuss major stages of human growth and development and different methods of assessing age.

CO3 To describe techniques for recovering skeletonised human remains and their laboratory analysis.

CO 4 To learn methods of age estimation from odontological evidences.

**Suggested Readings**

1. Reddy, V.R; Dental Anthropology, Inter-India Publication, New Delhi, 1985.
2. Singh, I.P. & Bhasin M.K; A manual of biological Anthropology, Kamla Raj Enterprises, New Delhi, 2004.
3. Kroeber; Anthropology, Oxford & IBH Publishing Company, New Delhi, 1972.
4. Pickering, R. & Bachman D; The use of Forensic Anthropology, CRC Press, Costa Rica, 2009.
5. Bose, N K; Anthropology, Narayana Press, Denmark, 1972.
6. James, R; Forensic examination of hair, Taylor & Francis, 2ND Ed. London, 1999.
7. Shubhra, G; Introduction to forensic examination, Selective Scientific Books, New Delhi, 2008
8. Michael, W. Haney, H.A. & Freas, L.E; The Forensic Anthropology Laboratory, CRC Press, 2008.
9. Eveleth, P.B. & Tanner, J.M; Worldwide Variation in Human Growth, Cambridge University Press, London, 1976.

**Semester III**

**Course Code: Paper 10: Digital Forensic and Cyber Crime**

**Theory**

**Marks: 100 (I.A. =30 and Theory =70)**

**Duration: 14 weeks (L= 4 hours per week)**

**Practicals=2 Credits (50 Marks)**

**Course Objectives:**

The objective of this course is to explain the principles of computer and data storage, hardware and encryption techniques and investigation on imaging methods. It also aims to discuss the types of cyber-crimes, audio-video examination and speaker identification and their application in forensic investigations.

## **Unit 1**

### ***E-data analysis***

Principles of computer and data storage, Hardware, passwords and encryption techniques, seizure of computers, Preparations to be made before seizure, Actions at the scene, treatment of exhibits, bit stream of original media, Investigation on imaging methods, acquisition, collection and seizure of magnetic media, Legal and privacy issues, Preparing and verifying forensically sterile storage media

## **Unit 2**

### ***Types of cyber crimes***

Definition and types of cyber crimes, Digital signal processing overview of several operating systems, html and other internet protocols, internet history, e-mail and header interpretation, virus and Trojan infections, different type of attacks, internet research and investigative tools

## **Unit 3**

### ***Audio-video examination***

Forensic audio video analysis, voltage, decibels, audio line levels, frequency measurements, spectrum analysis, noise characteristics, digital filters and audio enhancement, authentication of recorded audio, speech spectrographic analysis, magnetic developing and optical methods Falsification in video recording, video frame sequence, method – waveform – vectroscope, videogrametry and photogrametry techniques, video image analysis, facial image recognition from video frame image

## **Unit 4**

### ***Speaker Identification***

Basic factors of sound in speech, components of speech, analogue and digital speech signal, Fourier analysis, Fourier transforms, acoustic speech production, speech anatomy, mechanism of speech production, phonetic aspects of speech, principles of speaker recognition, methods of speaker recognition, various approaches in forensic speaker identification, concept of test and error in speaker identification, application in automatic speaker identification and verification system.

## **Course Learning Outcome**

CO 1 To understand the principles of e-data analysis.

CO 2 To know about the definition and types of cybercrimes, different type of attacks, internet research and investigative tools.

CO3 To learn about the forensic audio video analysis.

CO4 To elucidate identification, application in automatic speaker identification and verification system.

## **Suggested Readings 2 Credits**

1. Blitzer, H.L. & Jacob J; Forensic Digital Imaging and Photography, Academic Press, London, 2002
2. Henry, H; Color photography – A Working Manual, Little Brown Co. Boston, 1995.
3. Vacca, J. R; Computer Forensic, Firewall Media Pub. New Delhi, 2002
4. Rose, P; Forensic Speaker Identification, Taylor & Francis, Forensic Science Series, London,2002.
5. Sharma, B.R., Forensic Science in Criminal Investigation & Trials, Universal Publishing Co., New Delhi, 2003.
6. James, S.H. & Nordby, J.J; Forensic Science- An Introduction to Scientific and investigative Techniques, CRC Press, New York, 2003.
7. Seigel, J.A, Sukoo, R.J, & Knupfer, G.L; Encyclopaedia of Forensic Science, Academic Press, London, 2000.

8. Swansson, C.R. Chamelin, N.C. & Territ, L; Criminal Investigator, McGrawhill, New York, 2000.
9. Becker, R; Criminal Investigation, ASPEN Publishing, Inc. Maryland, 2000.

**Practical: Digital Forensics**

1. Recovery of data, copying and imaging
2. Tracking of IP address
3. Encrypting and decrypting files
4. Audio, video and image authentication
5. Speaker identification using voice spectrograph

**Semester III**

**Course Code: Elective Paper 11: Forensic Biology and DNA Profiling**

**Theory**

**Marks: 100 (I.A. =30 and Theory =70)**

**Duration: 14 weeks (L= 4 hours per week)**

**Course Objectives:**

The objective of this course is to discuss the principles of serology and immunology and to explain the bloodstains investigations techniques. It also aims at informing the students about various protected and endangered species of animals and plants and introduction of wildlife (protection) act 1972. The student would be able to understand the forensic DNA profiling and its application in criminal and civil investigations.

**Unit 1**

***Serology and Immunology***

Cell structure and functions. Structure and function of carbohydrates, fats and proteins, serum proteins, haemoglobin and its variants, haptoglobins, HLA, polymorphic enzymes, blood groups-history, biochemistry and genetics of ABO, Rh, Mn and other systems, Methods of ABO blood grouping from fresh blood and biological stains, body fluids, determination of secretor status, polymorphic enzyme typing, serogenetic markers, determination of origin of species, immunology, immune response, antigens, haptens and antibodies, function and rising of antisera, lectins. Bloodstains investigations: Blood pattern analysis, ageing of bloodstains, difference between human and animal bloodstains, spectroscopic analysis.

**Unit 2**

***Forensic Biology***

General plant classification schemes. Sub specialisation of forensic botany- plant morphology, plant anatomy, plant systematic, palynology, plant ecology. Wood and timber analysis. Diatoms and their forensic importance. Study and identification of various diatoms. Paper and pulp identification. Introduction and importance of wild life. Protected and endangered species of animals and plants. Sanctuaries and their importance. Introduction to Wildlife (Protection) Act 1972 and CITES, Relevant provision of wild life and environmental act. Types of wildlife crimes, different methods of killing and poaching of wildlife animals. Collection and preservation of hair samples. Morphological and microscopic examination of human and animal hair. Hair growth and development, determination of origin, race, sex, site from hair. Comparison between human and non-human hair. Macroscopic and microscopic features of hair.

**Unit 3**

**DNA Profiling**

Double helical structure of DNA, alternate forms of DNA double helix, denaturation and renaturation of DNA, DNA binding proteins, factors affecting DNA stability, types and structure of RNA. Chemical nature of DNA and RNA. Nature and structure of human genome and its diversity. mt-DNA, Y-Chromosomes and the peopling, migration, of modern humans, Forensic DNA profiling and its application in criminal and civil investigations.

**Unit 4**

**DNA Polymorphism**

Concept of gene – Conventional and modern views. Concept of sequence variation - VNTRs, STRs, Mini STRs , SNPs. Detection techniques - RFLP, PCR amplifications, Amp-FLP, sequence polymorphism, Y-STR, Mitochondrial DNA. Disputed paternity cases. Missing person identity, population genetics and legal admissibility of DNA evidence. Concepts of length and sequence DNA polymorphism, DNA markers (VNTRs, Stars, SNPs, Y-STRs, mt DNA)- their importance and detection. DNA extraction, it's qualitative and quantitative assessment, Polymerase chain reaction (PCR), Generation and assessment of DNA profiles, Statistical interpretation of DNA profiles, evaluation and presentation of DNA evidence, Kinship testing and lineage markers DNA databanks and their utility in various criminal investigations.

**Course Learning Outcome**

CO 1 The paper intends to talk about various serological techniques used to analyse blood samples for criminal investigation.

CO 2 To analyse microscopic and macroscopic examination of biological samples like plant, hair recovered from crime scene.

CO3 To learn the techniques used in DNA Profiling.

CO 4 To understand the Concept of gene and sequence variation.

**Suggested Readings**

1. Brown, T; Gene cloning and DNA analysis: An Introduction , 5th ed. Blackwell publishing, London, 2006 .
2. Butler, J; Advanced Topics in Forensic DNA Typing: Methodology, 1st Ed., Academic Press, London, 2009.
3. Eastel, S. McLeod, N. & Reed, K; DNA Profiling: Principles, Pitfalls and Potential, Harwood Academic Publishers, New Jersey, 1991.
4. Primorac, D. & Schanfield, M; Forensic DNA Applications: An Interdisciplinary Perspective, CRC Press, New York, 2014.
5. Rudin, N. & Inman, K; An Introduction to Forensic DNA Analysis, Second Ed., CRC press, New York, 2001.
6. Spencer, C; Genetic testimony: a guide to forensic DNA profiling, Pearson, New Delhi, 2004.

**Semester III**

**Course Code: Open Elective Paper: Forensic Medicine and Psychology**

**Theory**

**Marks: 100 (I.A. =30 and Theory =70)**

**Duration: 14 weeks (L= 4 hours per week)**

**(4 Credits)**

**Course Objectives:**

The objective of this course is to introduce the medico legal aspects of death with early and late changes after death. It will also explain the types of injuries and related investigations

focusing the abrasions, bruises, lacerations, incised wounds, stab wounds, firearm injuries, defence injuries, fabricated injuries. Traffic accident injuries: vehicular injuries etc. It aims at explaining the concept of forensic entomology and forensic psychology with details involved and their application in forensic investigations.

### **Unit 1**

#### ***Medico legal aspects of death***

Death: Signs of death and changes after death. Somatic death, molecular death, early changes after death - Algor mortis, rigor mortis, cadaveric spasm, heat stiffening, cold stiffening, changes in blood, chemical changes in cerebrospinal fluid, changes in vitreous humour, post mortem lividity, fluidity of blood,. Late changes – putrefaction- external and internal changes. Adipocere, mummification, gastric content and bladder content and time of death from growth of hair and nails. Destruction of body and tissues by maggots and other insects, rodents, fish and crabs, moulds. Sudden death, post-mortem demonstration of myocardial infarction. Medico legal aspects of death- Asphyxia, syncope, coma, death by starvation, drowning, hanging and strangulation. Causes and mechanism of traumatic death, manner of death. Classification of traumatic deaths.

### **Unit 2**

#### ***Injuries and investigations***

Mechanical Injuries: Abrasions, Bruises, Lacerations, Incised wounds, Stab wounds, Firearm injuries, Defence injuries, fabricated injuries. Traffic accident injuries: vehicular injuries, railway injuries and aircraft injuries. Thermal injuries: Burn and scalds, Lightning, Electricity, Explosions. Chemical trauma. Injuries- Accidental, self-inflicted, or inflicted by others. Ante-mortem and post-mortem, artificial injuries and aging of injuries. Fractures, Dislocations. Secondary causes of death. Regional injuries- wound of the scalp- incised, contusions, lacerations, firearm injuries. Fractures of the skull from direct & indirect impact.

### **Unit 3**

#### ***Forensic Entomology***

Forensic Entomology- History, significance, determination of time since death- Dipterean larval development & successional colonization of body, determining whether the body has been moved, body disturbance, presence and position wounds, linking suspect to the scene, identification of drugs and toxins from the insects and larvae feeding on the body, entomology as an evidentiary tool in child and senior abuse cases and animal abuse cases, collection of entomological evidence.

### **Unit 4**

#### ***Forensic Psychology***

Lie detection, brain fingerprinting, narco analysis, hypnosis, neuro-anthropological and psychological testing. Ethical issues in forensic psychology, mental disorders, eye witness testimony, memory recovery, psychological assessment, hypnosis, current research in detection of deception/truth finding mechanisms, legal and ethical aspects of human rights of individual.

### **Course Learning Outcome**

CO 1 This paper able to understand the Medico legal aspects of death, signs of death and changes after death.

CO 2 To learn different types of injuries and their forensic investigations.

CO3 To understand the concept of Forensic Entomology their history and significance.

CO 4 To analyse different methods used in forensic psychology like Lie detection, brain fingerprinting, narco-analysis, hypnosis, neuro-anthropological and psychological testing.

### **Suggested Readings**

1. Mclay, W.D.S; Clinical forensic medicine, Cambridge University Press, London,1990.
2. Shepherd, R; Simpson's forensic medicine, Oxford University press, London, 2003.
3. Mant, A.K; Taylor's principles& practice of medical jurisprudence, Wingking Tong company ltd., Hong Kong, 2003
4. Maio, D.J. &Maio V.J; Forensic pathology, CRC press, Costa Rica, 1993.
5. Wecht, C.H; Legal medicine annual, Academic Press Publisher, Massachussets, 1970.
6. Polson C.H; Essentials of forensic medicine, Pergamon press, London, 1973.
7. Lahiri, S.K; Elements of medical jurisprudence ,Prabasi press, Calcutta, 1973.
8. Flzinga, R.J; Fundamentals of Entomology, Prentice hall of India pvt ltd, New Delhi, 1978.
9. Smith, D.G.V; A manual of Forensic Entomology, Ithaca New York Camstock Univ. Press, New York, 1986.
10. Byrd, J.H. &Castner, J.L; Forensic Entomology, The utility of Anthropods in legal Investigation, CRC Press, New York, 2000.
11. <http://www.apa.org/practice/guidelines/forensic-psychology.pdf>
12. [http://www.uk.sagepub.com/upm-data/39927\\_1.pdf](http://www.uk.sagepub.com/upm-data/39927_1.pdf)
13. <http://www.blackwellpublishing.com/intropsych/pdf/chapter21.pdf>
14. W.O.Donohue&E.Levensky; Handbook of Forensic Psychology, Elseiver AcademicPress, 2004.

### **Semester IV**

#### **1. Dissertation**

**Marks: 150 (100 marks for dissertation report and 50 marks for viva voce)**

**(Credit=6)**

The students are supposed to prepare a Dissertation based on field work or laboratory work (for 2-3 weeks) in a specialize field chosen by the student in consultation with their supervisor. Two hard copies of the dissertation to be submitted by the student for its evaluation by the end of month of April.

#### **Course Learning Outcome**

CO 1 To learn about field work techniques

CO 2 To understand pilot survey relevance

CO 3 To teach about specific laboratory techniques chosen by the student.

#### **2. Project**

**Marks: 100 (100 marks for project Report and 50 marks for viva voce)**

**(Credit=6)**

A student will submit a project report on the basis of forensic anthropology/ forensic physics/ forensic chemistry/ document examination pertaining to one case starting from police station to court room and final forensic analysis to be done by the student.

#### **Course Learning Outcome**

CO 1 To train for basic principles in forensic anthropology/ forensic physics/ forensic chemistry/ document examination

CO 2 To conduct primary data collection for a specific topic in one specific field.

CO 3 To teach various analysis techniques.

CO 4 To prepare report on the basis of data and analysis undertaken.

### **3. Field visits**

**Marks: 100 (70 marks for Field visits Report and 30 marks for viva voce)**

**(Credit=4)**

The students are supposed to prepare a report of the field visits to crime scenes, police stations, FSLs, court rooms etc. and submit a specific report on the same for the evaluation.

#### **Course Learning Outcome**

CO 1 To visit crime scenes/ police stations/ FSLs / biological laboratories/ court rooms for a specified duration.

CO 2. To record day to day event of the specific visit site.

CO 3 To prepare a detailed report of cases evidences during the visits.

### **4. Out House Trainings**

**Marks: 100 (70 marks for Out House Trainings Report and 30 marks for viva voce)**

**(credit=4)**

The students are supposed to prepare a report on the basis of the out- house trainings at FSLs/ CFSLs/University and Research laboratories/ GEQD's for 2-3 weeks and submit a brief report on the work done.

#### **Course Learning Outcome**

CO 1 To Visit forensic laboratory or forensic institutes in NCR Delhi

CO 2 To learn specific techniques from the allotted/ selected laboratory/ institute for 2-3 weeks.

CO 3 To prepare a brief report of the training undertaken at Forensic Laboratory/ Institute.