गृह मंत्रालय
MINISTRY OF
HOME AFFAIRS

सत्यमेव जयते

DFSS

STANDARD LIST OF EQUIPMENT FOR ESTABLISHING / UPGRADING OF FORENSIC SCIENCES LABORATORIES

To provide high quality, on-time & credible Forensic Services

STANDARD LIST OF EQUIPMENT FOR ESTABLISHING/UPGRADING OF FORENSIC SCIENCE LABORATORIES

First Edition: July 2020

Punya Salila Srivastava, IAS
Joint Secretary (Women Safety)

सत्यमेव जयते

भारत सरकार
GOVERNMENT OF INDIA
गृह मंत्रालय
MINISTRY OF HOME AFFAIRS
NORTH BLOCK
NEW DELHI - 110001

FOREWORD

Forensic Sciences play a very crucial role in scientific investigation of evidence in the criminal justice system. At a time when there is an increasing focus on timeliness in completion of investigation and justice delivery, adequate forensic sciences capacities in each State helps in timely and effective crime investigation.

The analytical procedures of investigating forensic evidence in the laboratories require not only a high degree of knowledge, competence and expertise in the forensic professionals, but it is also necessary that adequate forensic laboratory facility with basic forensic equipment and protocols for examination and formation of expert opinion on evidence are available. To this extent, the Government has proactively taken initiatives in this regard, and provides assistance to States/UTs in establishing/ upgrading the Forensic Sciences Laboratories. An e-Forensic module for online case management has been made available to the Forensic Sciences Laboratories under Inter-Operable Criminal Justice System. DFSS has also released Quality Manuals for accreditation of laboratories as per NABL standards (ISO 17025) and Working Procedure Manuals in nine disciplines of Forensic Sciences.

Taking this initiative further, in order to bring standardisation in the equipment available in forensic sciences laboratories in the country, the Directorate of Forensic Science Services has prepared a "Standard List of Equipment for Establishing/ Upgrading Forensic Sciences Laboratories". These guidelines would prove useful to all States/UTs to undertake a Gap-analysis of their forensic laboratory facilities and to plan for establishing or upgrading them. I congratulate DFSS and the various Experts involved in this exercise.

Punya Salila

Punya Salila Srivastava, IAS
Joint Secretary (Women Safety)
Ministry of Home Affairs, Govt. of India

डॉ. एस. के. जैन
निदेशक–सह–मुख्य न्यायालयिक वैज्ञानिक

Dr. S.K. Jain, M.Sc Ph.D
Director-cum-Chief Forensic Scientist

सत्यमेव जयते

न्यायालयिक विज्ञान सेवा निदेशालय,
गृह मंत्रालय, भारत सरकार
ब्लॉक–9, तल नं. 8 , केन्द्रीय कार्यालय परिसर
लोधी रोड, नई दिल्ली–110 003

Directorate of Forensic Science Services,
Ministry of Home Affairs, Govt. of India
Block No. 9, 8th Floor, C.G.O. Complex
Lodhi Road, New Delhi-110 003 (India)
Tel. : 011-24362676 Fax : 011-24362819
E-mail : cfs-dfss@nic.in

PREFACE

Forensic science is a major component of objective, fair and transparent criminal justice systems. Its capabilities and facilities provide accurate, objective and timely information to law enforcement agencies and the criminal justice delivery system. The constantly changing pattern in both conventional and organized crime, has led in recent years to increase interest on the part of Governments in establishing or strengthening quality forensic science services at the national level.

While examining existing resources to ensure the availability of equipment necessary for effective forensic science facilities, this Directorate receives a range of requests for technical advice and assistance concerning the selection of appropriate equipment and reference material.

This manual has been developed in response to these requests and aims to provide practical assistance for the establishment or upgrading of national or regional forensic science infrastructure. It provides checklists of basic recommended equipment for various divisions of forensic science laboratories. The assessment in this manual is fundamental as not all of the equipment listed in this manual is necessarily required in every forensic science laboratory. The equipment requirements for each laboratory may vary depending on the availability of manpower, on local crime trends, and on current workloads.

It is indispensable to ensure that available technical skills are commensurate with the choice, acquisition, use and maintenance of the equipment. The manual is designed to allow the user to focus on forensic science fields of their choice and to use only the corresponding, relevant sections.

I am pleased to mention that as per Charter of Duties of Directorate of Forensic Science Services, it has come out with the first edition of this manual in order to help the Forensic Science Laboratories to bring uniformity in case reporting and to develop/update their laboratories' quality system. The invaluable contribution of forensic experts of Central and State FSLs to this Manual/Protocol Document is gratefully acknowledged.

(Dr. S K Jain)

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INTRODUCTION

Forensic Science is the application of science which with its capabilities and facilities provides accurate and timely results for the dissemination of justice speedily. The main aim of Forensic setup is to link the crime with criminal on scientific grounds and thereby fair and transparent investigations and proceedings of the case.

The constantly changing pattern in the execution of crimes has also posed a challenge to Forensic Science Laboratories and necessitates the need to strengthen the laboratory examination practices. Directorate of Forensic Science Services (DFSS) under Ministry of Home Affairs is playing a vital role to strengthen the Forensic services in India by providing support to establish Hi-tech Forensic Science Laboratories and to upgrade their human as well as technical resources.

However, DFSS often receives requests from various state Forensic Science Laboratories and other stakeholders regarding basic requirements and infrastructure/equipment required to kick start the laboratory.

Keeping in view the requirement of all the stakeholders, Directorate of Forensic Science Services, MHA, Govt of India constituted a Committee by involving experts of Central and State FSLs vide letter No. 37(19)/2020-DFSS/6890-91 Dated June 5, 2020 (copy enclosed) to develop this manual with the sole aim to provide assistance for the establishment /up-gradation of Forensic Science Laboratories in the country. The forensic areas/fields addressed in this manual are broadly classified into six major groups which in turn have subgroups of specialized branches.

1. Forensic Chemical sciences:

- Forensic Chemistry
- Narcotics
- Toxicology
- Explosives

2. Forensic Biological sciences:

- Forensic Biology and Serology
- Forensic DNA typing

3. Forensic Physical sciences:

- Forensic Physics
- Forensic Ballistics

4. Forensic Electronics:

- Digital/Cyber forensics/computer forensics.
- Audio and Video forensics

5. Forensic Questioned Document examination:

6. Forensic investigation:

- Forensic Psychology examination
- Crime scene investigation

This manual provides information regarding establishment/upgradation of cited fields in terms of major and minor equipment. The specification of major equipment and checklist of general laboratory infrastructure is annexed in the manual.

1. FORENSIC CHEMICAL SCIENCES

1.1. Forensic Chemistry

Forensic chemistry deals with the chemical examination of liquors, identification of traces of fire accelerants from burnt materials in bide burning and arson cases, detection of adulterants in petroleum products, identification of corrosive chemicals in acid throwing incidents and identification of dyes in bribe trap cases.

Types of Examination/Tests:-

- Extraction of fire accelerant from burnt material/debris/partially burnt clothes/hairs etc.
- Identification of residue of fire accelerant in extracted material.
- Identification of Petroleum products by their hydrocarbon numbers.
- Identification of dyes from hand wash/pocket wash in Bribe trap cases.
- Determination of proof percentage and alcohol percentage in liquor cases.
- Determination of lethal alcohols/ methanol in hooch tragedies.
- Identification of gold in theft/burglary/fake ornament cases.
- Identification of corrosive chemicals in acid throwing incidents.

1.2. Forensic Narcotics

The cases received in this branch are the street drugs seized by investigating officers. Majority of the drugs are under NDPS Act 1985. The examination involves the identification and profiling of contraband substances.

Types of Examination/Tests:-

- Preliminary examination
- Absolute /Fingerprint identification of drugs of abuse and their profiling.
- Quantitative estimation of drugs of abuse.

1.3. Forensic Explosives

Explosives branch carries out the analysis of seized low and High explosive materials, analysis of post-blast residues and pyrotechnics.

Types of Examination/Tests:-

- Extraction of Post blast Explosive residue from Physical samples/debris.
- Preliminary examination of Explosive substances and post-blast explosive residue.
- Identification of Low explosives and their post-blast residue.
- Identification of High explosives and their post-blast residue.
- Determination of the composition of Pyrotechnics.
- Reconstruction of Improvised Explosive Devices.

1.4. Forensic Toxicology

Toxicology branch undertakes the examination of biological/visceral samples for identification of poisons in homicide, suicide and other unnatural death cases. The various types of samples received are stomach with its contents, small intestine, a portion of the kidney, spleen lungs liver, brain blood, gastric lavage, hairs, nails etc.

Types of Examination/Tests:-

- Extraction of poisons from body fluids, viscera etc.
- Preliminary examination
- Qualitative and Quantitative estimation of Alcohol in blood samples
- Determination of poisons and their metabolites in body fluids/gastric lavage /visceral samples/liquid samples.

The Major/ Minor equipment facilities required for such types of examination are:

S No	Major equipment	Application /Uses	Proposed Specifications
1.	Gas Chromatograph with an Auto sampler	For Qualitative and quantitative examination of drugs, poisons, explosives samples of volatile nature	Annexure-1
2	UV-Visible Spectrophotometer	For Qualitative/Quantitative examination of drugs such as LSD	Annexure-2
3	Gas Chromatography-Mass Spectrometer with Auto sampler	For Fingerprint Identification and profiling of drugs/poisons and explosive substances	Annexure-3
4	Fourier Transform Infrared Spectrometer (FT-IR)	For Absolute Identification of drugs/poisons and explosive substances	Annexure-4
5	High- Performance Liquid Chromatography /Ultra-high-Performance Liquid chromatograph with auto sampler	For Qualitative and quantitative examination of thermolabile drugs/poisons and explosive substances	Annexure-5 & 6
6.	Ion Chromatograph	For examination of inorganic explosives and pyrotechnics	Annexure-7
7	Gas Chromatography Headspace System (GC-HS)	For Qualitative and quantitative examination of blood alcohol and volatile liquids.	Annexure-8
8	Automated Accelerated Solvent Extraction System	For extraction of drugs/poison from Viscera/solid samples	Annexure-9

Minor Equipment	
TLC Apparatus	Muffle furnace
FiltrationApparatus	Digital hot plate with the stirrer
Analytical balance	Tissue homogenizer
Digital Balance	Microscope
Microwave	Ultra sonicator
pH meter	Water bath
Thermometer	Fractional distillation apparatus
Hot air oven	Thin Layer Chromatographic Apparatus
Rotary Shaker	Micropipettes
Vortex mixer	Kozelka Hine Apparatus

Note: The materials and accessories required for spot tests/chemical tests/Density measurement etc. are given in General Laboratory requirements –**Appendix**

2. FORENSIC BIOLOGICAL SCIENCES

2.1 Forensic Biology and serology

Biological and serological examinations are carried out to identify and characterize stains, hair, body tissues, and microorganisms for species typing, grouping for individualisation and examination of body fluids (semen, saliva, vaginal secretions etc.) for linkage purposes. Examination of insects in putrefied bodies, diatoms and plant materials in drowning cases is also carried out in Biology section.

Types of examination/tests:

- Location of stains and other microorganisms
- Identification of characteristic type of stains
- Identification of the origin of stains/ body fluids
- Blood grouping
- Identification of insects, Diatoms and plant materials in Drowning cases
- Blood Pattern Analysis in Homicide and Murder cases

2.2 Forensic DNA Profiling

DNA analysis, also known as DNA profiling, DNA testing, DNA typing, or genetic fingerprinting, involve the extraction, purification, amplification, sequencing and detection of unknown or suspected DNA traces in a laboratory and their comparison with known/unknown DNA profiles to determine their source.

Types of Examination/Tests:-

- Extraction of DNA molecule from cellular material /other materials/Bacteria etc.
- The quantisation of the DNA Molecule.
- Amplification of extracted DNA molecule
- Determination of DNA Sequence/profile
- Comparison of questioned DNA Sequence with authenticated profile
- Examination of paternity disputes
- Examination of unidentified bodies by DNA typing

The Major/ Minor equipment facilities required for such types of examination are:

S No	Major equipment	Application /Uses	Proposed Specifications
1	Auto DNA Extraction System	For Extraction of DNA molecule from cellular material of samples and other impurities/debris.	Annexure-10
2	PCR Thermal Cycler	For amplification of extracted DNA by making its millions of copies to make it suitable for analysis.	Annexure-11
3	Real-Time PCR (RTPCR)	Automated amplification of DNA and Mitochondrial RNA	Annexure-12
4	DNA Sequencer	For determination of DNA Sequences and comparison	Annexure-13

Minor Equipment	
PCR Kits	Micro centrifuge
DNA Sequencing Kits	Vortex mixer
DNA Extracting Kits	Magnetic stirrer and stirring bars
Dry bath	Biological hoods and chambers
Temperature controlled Water bath	Digital Microscope
Analytical Balance	Refrigerators
Mechanical shaker	Anthropological Measurement tools and kits
Handheld Forensic Light Source with UV and IR capability along with photographic filters	Stereomicroscope
UV sterilizer chamber	Gel Documentation System
Bio-safety Cabinet	pH Meter
Fume hood	Water Purification System
-80°C Deep Freezer	20°C Deep Freezer
Drying cabinet	Digital Autoclave
Tissue Lyser	Liquid handling System
Mini spin	Refrigerated centrifuge
Hot air oven	Vacuum pump
Mix mate	Thermo mixer
Gel electrophoresis system	Bone pulveriser
Microtome	Incubator

Note: The materials and accessories required for spot tests/chemical tests are given in General Laboratory requirements – **Appendix – A**

3. FORENSIC PHYSICAL SCIENCES

3.1. Forensic Physics

This branch conducts the examination of physical materials in cases of hit and run, burglary and homicides etc. The samples involve are glass, soil, paints, Fibres, Electric failures, Cement and mortar, Tool marks, tyre marks, Shoe Print analysis etc. The infrastructure required for the examination is:-

Types of Examination/Tests:-

- Examination of imprints (tool marks/tyre marks/shoe marks/bite marks/cheiloscopy etc.)
- Examination of soil samples.
- Examination of ligature material such as wires, ropes, cords, cloth etc.
- Examination of paint chips.
- Examination of glass samples.
- Analysis of short circuits/electric failures/component examination (circuitry concept, electronic timers, electronic relay, solid-state device components) etc.
- Analysis of cement and strength testing of building.
- Examination of Counterfeit currency/security documents.
- Examination of infringed products such as hologram stickers, lottery tickets, nano-bio products.
- Restoration of erased/tempered serial numbers of vehicle/other items.

3.2. Forensic Ballistics

Ballistics examination involves the examination of firearms, ammunition and GSR particles. It includes the determination of type, makes and calibre of firearm and ammunition and also to ascertain whether a bullet or cartridge recovered has been fired from a suspected firearm. The examination also includes identification of shooter based on GSR (Gunshot residue) particles recovered from target or suspect.

Types of Examination/Tests:-

- Test firing for comparison
- Comparison of questioned fired cartridge with a test cartridge
- Comparison of questioned fired bullet with a test bullet
- Gun Shot Residue (GSR) Analysis
- Trajectory Measurements
- Reconstruction of a firing incident in Homicide/Suicide cases
- Identification of Firearm (Factory made/country-made weapons) and parts thereof.
- Serviceability/working condition of firearms/ammunition.
- Identification of ammunition.

The Major/ Minor equipment facilities required for such types of examination are:

S No	Major equipment	Application /Uses	Proposed Specifications
1	Comparison of Microscope	For comparison of test and suspect bullet/cartridge	Annexure-14
2	SEM-EDXA	For morphological and elemental profiles of samples such as fibres, paint, GSR, Bullet etc.	Annexure-15
3	Ballistics Data Measurement System	For measurement of velocity and trajectory parameters	Annexure-16
4	X-ray Fluorescence Spectrophotometer	For characterisation of samples	Annexure-17
5	X-ray Diffractometer	For analysis of crystalline samples	Annexure-18

6	Atomic Absorption Spectrometer	For determination of inorganic elements in the sample	Annexure-19
7	Inductively coupled Plasma-Atomic Emission Spectrometer (ICP-AES)	For determination of inorganic elements in the sample	Annexure-20

Minor equipment	
Bullet recovery Box	Hot Oven
Self-Protection firing system.	Furnace for 2000^{o}C
Wet lab for a chemical test.	Density Gradient Tubes of 6mm dia
Stereo Microscope.	Lighting board as a background for observation of gradient tubes
Analytical Balance	Glassware in various sizes
Fire-arm mounting device.	Hot plates
Tool Box/Workshop Tools	Multi-meter
Chemical/Reagents/Glassware	Sieving machine
Viscometer	Sieves in different numbers
Sonometer	Burettes 25 and 50 ml
Polarising Microscope	Pipettes
Binocular Microscope	pH meter
Balance for weighing up to 100Kg	Tensile Testing Machine
Refractive Meter more than 1.7 RI	Mohes hardness digital testing tool
Weighing Balance	Tensile strength measuring equipment
Automated Ra-Top sieve shaker	High-end work station
Densitometer	Digital micrometre
Digital Vernier callipers	Digital dial callipers
Digital Tong tester	Digital tape
Digital SLR camera	Laser-based measuring tool (for measurement of area/volume/distance)
Boroscope	Ultrasonic cleaner
Magneto-Optical device for the restoration of erased numbers	Electrostatic Dust Print Lifter

Note: The materials and accessories required for spot tests/chemical tests are given in General Laboratory requirements –**Appendix – B**

4. FORENSIC ELECTRONICS

4.1. Digital/Cyber Forensics/Computer Forensics

This branch deals with the examination of digital material such as computers, Hard Discs, CDs, pen drives, DVDs, mobile phone etc. confiscated by investigating agencies during the investigation. As electronic media is fast changing, it is very much essential for any forensic laboratory to be equipped with the latest art of Hardware and software required for seized samples.

Types of Examination/Tests: -

- To recover the original data from the confiscated device for further analysis.
- Write protection of data.
- Imaging of digital evidence
- Hash value verification

The Major/Minor H/w & S/w required for analysis of digital evidence is: -

S No	Major equipment	Application /Uses	Proposed Specifications
1.	Hardware imaging Device • Write Blockers Kit • Tableau duplicator • Falcon	Hardware for cyber Forensics	Annexure-21
2	Software for Forensic previewing, Imaging and Analysis of Digital Media (Encase software)	Software for cyber Forensics and Disk forensics	Annexure-22
3	Software for Forensic Previewing, Image mounting password cracking and Forensic analysis of digital media (Forensic Tool Kit6)		
4	Forensic Tool Kit for Incident Response of Digital Crimes (VPER Kit)		
5	Portable Image Device for Incident Response		
6	Forensic Triage Tool kit		
7	Digital Forensic tool Kit for the analysis of various internet artifacts (Magnet IEF)		
8	Forensic software for the analysis of MAC System		
10	Software based tool for the logical level analysis of GSm/CDMA Mobile phones (UFED Link Analysis	For analysis of mobile phones of various types	Annexure-23
11	Hardware tool kit for physical/logical level analysis of GSM/CDMA Mobile phones/SIM Cards (UFED Touch-2)		

12	Mobile Phone Forensic tool kit for logical analysis of Chinese Mobile Phones(*UFED Chinex)		
13	Digital Forensic Tool Kit for the physical imaging and analysis of SIM Card Memory (Paraben)		
14	Password Cracking tool for Decrypting the passwords protected files		Annexure-24
15	High configuration Server and Workstations	For backup and analysis	Annexure-25

Minor equipment	
Licensed Microsoft office and window software	Computer systems
Safe Bag	UPS
Cyber Check Suite	Mac OS examiner
Autopsy	DVR Examiner
Other software for utilisation of acquisition of data	CCTV Footage Acquisition Analysis(AMPED Five)

4.2 Audio and video analysis

This branch deals with the examination of Audio and video clips generated by using various media and required for investigation purposes. It involves Data recovery, write protection, imaging and hash verification for which high-end hardware and software is required.

Types of Examination/Tests: -

- To recover the original data from the confiscated device for further analysis.
- To compare the questioned Audio clip with Authenticated Audio clip
- Voice Analysis / speaker identification & authentication
- Analysis of Video clips/ CCTV clips and identify morphing
- Authentication of audio & video clips
- Identification of Source camera – Comparisons of a questioned digital photograph with digital photographs obtained from the questioned camera

S No	Major equipment	Application /Uses	Proposed Specifications
1.	**Software** 1.Gold Wave 2.Multi speech 3.Audio Authentication and Enhancement **Hardware** 1. Analog to Digital converter	Hardware and software for Audio Analysis	Annexure-26
2	**Software** **1.** Video Authentication and Enhancement 2.Video Editing **Hardware**	Hardware and software for video Analysis	Annexure-27

	1. High configuration Server and Workstation.		
3.	Facial Recognition Software (3D)	For facial recognition/CCTV footage analysis	Annexure-28
4	Image Analyser Software	Identification of Source camera by comparison and examination of sensor noise pattern in the questioned digital image and test shots	Annexure-29

Minor equipment	
Licensed Microsoft office and window soft wares	Computer systems
Microphones	UPS
Headphones	cables
Pinnacle software	DVR Examiner

Note: The materials and accessories required for setting up of cyber laboratory are given in General Laboratory requirements –**Appendix – C**

5. FORENSIC QUESTIONED DOCUMENT EXAMINATION

The division carries out the analysis of questioned documents which involves cases of handwriting comparison, Signature comparison, forgery of documents, ink analysis etc.

Types of Examination/Tests: -

- Comparison of questioned Handwriting with Authenticated Handwriting
- Comparison of questioned Signatures with Authenticated Signatures
- Determination of addition/alteration/forgery.
- Ink Analysis
- Paper analysis
- Determination of sequence of stokes
- Deciphering of obliterated writing
- Deciphering of indented writings.

The Major/ Minor equipment facilities required for such types of examination are:

S No	Major equipment	Application /Uses	Proposed Specifications
1	Multispectral Imaging system (VSC)	For examination of documents	Annexure-30
2	High-resolution spectral comparator (HRSC)	For examination of documents to determine overwriting/obliteration and sequence of stokes and ink analysis	Annexure-31
3	High-End Computers with server	For backup of stored documents	Annexure-32

Minor equipment	
High-end camera for photography of Documents	Stereo Microscope
ESDA For deciphering indented writings	Reprovit Unit for photography with SLR camera and storage facility
Hand Magnifiers with/without a light source of varying capacity: x3, x6, x8, x10	Examination Table with Transmitted Light box
U V LIGHT Source (wavelength-256nm,265nm, 313nm).	Anglepoise lamp

6. FORENSIC INVESTIGATION

6.1 Forensic Psychology Division

This is related to the investigation and involves the extraction of truth from accused/ suspect by use of scientific tools and methods.

Types of Examination/Tests: -

- To extract the truth from the suspect/accused by the scientific manner
- To determine the changes in voice when suspect/accused is lying and concealing information.

The equipment required to kick start the Psychology Division are;

S No	Major equipment	Application /Uses	Proposed Specifications
1	Polygraph	For Lie detection	Annexure-33
2	Layered voice analyser	To determine the changes in voice under various conditions	Annexure-34
3	High-End Computer with server	For storing data	Annexure-32

6.2 Crime Scene investigation

Majority of the times Forensic Scientists have to visit Scene of occurrences particularly in Explosion cases, Cases of Arson and Burglary and accidents for collection of relevant physical evidence. The List of minor equipment required to search the scene of occurrence is given in **Appendix-D**.

SPECIFICATIONS

Gas Chromatograph (GC)

General Specifications: -

S No.	Specifications	
1.	GC	Automatic microprocessor controlled with self- diagnostic facilities
2.	OVEN TEMPERATURE	Ambient to 450 O C or higher with an incremental rate of 50 O C/minute or more with at least 6 or more ramp and fast cool down of less than 10 minutes from 450 O C to 50 O C.
3.	Injector temperature	400O C or more
4.	Injector	Two injection ports split/ split less (one for capillary and one for packed column-mounted simultaneously
5.	Flow controller for carrier and carrier and detector	Automatic digital flow and a pressure controller/EPC/EFC/IEC must be available
6.	Carrier gas	The system should have the facility to use helium and hydrogen as the carrier gas in the GC system.
7.	Safety features	Auto leak detection of carrier gas and automatic shutdown of GC in case of the leak
8.	GC system should have a gas saver mode	
9.	Detector	Flame Ionization Detector-02 Nos The system should have two nos of detectors (FID) mounted simultaneously. FID-Temp Max-4000 C or more Dynamic range 107 Minimum detection limit:2pgC/s
10.	Validation system	Total validation should be quoted for system and software IQ, OQ or PQ
11.	Column	DB-1 MS or its equivalent 30 mX 0.32 mm(I.D) x0.25 micrometer film thickness- one number DB-5 MS or equivalent 30 m X0.25 mm(1.D)x0.25 micrometer film thickness-one number. 3o/o SE -30 , OV-17 , Porapak g (1 each)
12.	Software (with License)	Should be windows based operating system with validation facility. The offered software should be suitable for the quoted model GC along with performance validation. The facility, multi component analysis, multilevel calibration, baseline correction, methods of analysis, time programming, plotting, graphical representation of the chromatograph and storing of data
13.	Data station	The principal should supply the branded (DELL/HP/IBM etc) computer system along with the licence of an operating system with 21" branded LED monitor along with laserjet printer.
14.	All spare parts and accessories for the installation of the full system should be provided along with one set of a tool kit.	
15.	Spares and consumables-supplier/manufacturer should quote and supply essential spares and consumables including septa (mention item wise) for two years month operation of the quoted system.	
16.	General conditions	
	I. The manufacturer and or supplier will provide a 2-year warranty from the date of installation of the full GC system along with the supplied computer, printer and other accessories for self-sustaining of the entire system.	
	II. Comprehensive and non-comprehensive AMC rate must be quoted for 5 years from the post-warranty date. AMC includes Preventive maintenance- 4 visits per year every quarter and breakdown visit as & when required.	

	III.	The manufacturer/supplier should certify that they will provide all the spares and consumables at least seven years from the date of installation of the system.
	IV.	Training- The supplier should provide on-site operational/ application training for laboratory scientists for at least 5 working days.

Annexure 2

UV-Visible Spectrophotometer

General Specifications:-

1.	Optical System	Double beam
2.	Wave-length range	190 nm to 1100 nm
3.	Spectral bandwidth	0.2-3.0 nm or better
4.	Wavelength accuracy	± 0.1 nm in u.v. region or better. ± 0.3 nm in visible region or better.
5.	Measuring modes	Absorbance mode, % Transmission mode
6.	Light source	Pre-aligned Tungsten & Deuterium lamps
7.	Detector	High ending Photodiodes
8.	Operation mode	Stand-alone and PC control
9.	User-friendly UV-Vis Software (with license)	The latest version of validated Windows-based UV-Vis software with all licensed software to control and operate all functions of the offered system with data acquisition facility along with performance validation of the system.
10.	Data Station	The latest version of branded PC like DELL/HP/COMPAQ/ LENOVO/IBM makes along with the licence of the original system with 21" LED monitor and laserjet printer.
11.	UPS	2 KVA or more with one hour back up with a full load of reputed brand Such as Numeric/APC/Tata Libert
12.	Spares & consumables	Supplier/manufacturer should quote and supply essential spares and consumables (mention item wise) for two years smooth operation of the quoted system.
13.	**General condition/Optional**	
	a) The manufacturer and or supplier should provide a 2-year warranty from the date of installation of the full system along with the supplier computer, printer, UPS and other accessories for self-sustaining of the entire system.	
	b) Comprehensive and non-comprehensive AMC rate must be quoted for 7 years from the post-warranty date (Non-comprehensive for first 2 years and comprehensive for next 5 yrs) payable on year to year basis, Preventive maintenance-4 visit as and when required.	
	c) The manufacturer/supplier should certify that they will provide all the spares and consumables at least for 10 years from the date of installation of the system. The supplier should also certify that they will upgrade the software free of cost whenever such an upgrade occurs.	
	d) The firm should supply tool kit, hard and soft copies of operation manual, and other relevant literature along with a certificate of the license of the library, software and other items wherever applicable.	

Gas Chromatography-Mass Spectrometer

General Specifications: -

S. No	For Gas Chromatography	
1	GC	fully automated microprocessor controlled with extensive self-diagnostic facilities and with Auto sampler
2	Auto sampler	The system should have auto sampler to adjust at least 100 vials Injection cycle time should be less than 8 sec in specified conditions. The Auto sampler has to support a wide range of injection volumes. Auto sampler should be controlled by system software.
3	Oven Temperature	450 ^{0}C with 6 or more ramps facility settable from 0.1 ^{0}C to 50 ^{0}C/min or more
4	Injector-temperature	Up to 400 ^{0}C in 1^{0}C increment or more
5	Injector	spilt and spilt less injector for capillary column
6	Flow controller for carrier	automatic digital flow and pressure controller /EPC
7	Safety features	auto leak detection of carrier gas & automatic shut down of GC in case of a leak
8	GC system should have a gas saver mode	
9	Software	Windows-based
10	Validation	GC and software should have a validation facility
11	Column	DB-5 MS/ HP 5 MS, 15 m X 0.25 mm x 0.25 micrometre one no.
12	ISO 9001 certification and GLP compliance	

Mass Spectrometer		
1	Mass 22pprox.22-	quadruple with pre-filter
2	Ionization source-	electron ionization (EI) and chemical ionization (CI) (Positive and negative) equipped with advance non-vacuum breaking cleaning facility
3	Mass range-	10-1000 amu or more
4	Electron energy/ ionization voltage-	adjustable electron energy up to 150 eV or more
5	Tune facility -	should have auto & manual tune facility
6	Scan rate	variable up to 5600 amu/ sec or more
7	Vacuum pump capacity	200 lit/ sec or more air-cooled turbo molecular pump

8	Sensitivity/ detection limit	1 pgstd OFN scanning from 50- 300 u at m/z 272 with Helium as carrier gas should produce S/N 400: 1 or more in EI mode and equivalent with any other compound 10 pgstd BZP should produce S/N 10:1 or 100 pgstd BZP scanning from 80 to 230 amu in m/z 183 in methane gas should produce S/N 125:1 in PCI mode or better and equivalent with any other compound 1 pgstd OFN should produce S/N 1000:1 or 2 ul injection of 100 fgstd OFN should produce S/N 300:1 in NCI mode or better and equivalent with any other Compound at m/z at 272 amu
9	Calibration facility	should have built calibration facility with internal calibrating material with NIST/ ASTM or equivalent traceability
10	scanning facility	simultaneous scanning in SIM and full scan (TIC) mode
11	Detector	Dynode/photomultiplier
12	Interface temperature	ambient to 325 ^{0}C or more
13	Source temperature	up to 350 ^{0}C or more
14	mass library	NIST Mass spectral library, pflegermaurer weber library, wiley, pesticide
15	User-friendly mass software	should be windows based with validation facility
General Condition		
• 2-year warranty of the full system including computer, printer, UPS etc should be provided		
• Software- suitable for GC along with kinetic software, performance validation software, multi-component analysis software		
• consisting of windows based software with features such as multilevel calibration, baseline correction, all methods of analysis, time programming, plotting and graphical representation of chromatography • software should be able to control the GC-MS system and date acquisition • the latest configuration of the computer with 2nd gen intel core I 3-2120 (3.30ghz 1333, 3 MB, 2C), genuine windows (R) 7 Home basic SP1 64 bit, 4 GB3 DDR3 SD RAM (1600 Mhz), 3.5 " 1 TB 7200 RPM SATA Hard drive (1 X 500 GB), DVD Combo drive, 21 " colour monitor (TFT), optical mouse, keyboard, HP desk jet/ inkjet colour printer • d. the original equipment supplier/manufacturer should supply the total computer data station preloaded in the factory		
• Comprehensive and non- comprehensive AMC rate must be quoted for 5 years from the post-warranty period • AMC condition (for both comprehensive and non-comprehensive) • Preventive maintenance- 4 visit per year every quarter • breakdown visit – as & when required • A tool kit must be provided free of cost • The total validation package for system and software must be quoted		
• ISO 9001 certification and GLP compliance.		
• Training- on-site training for 5 scientists should be provided for at least 10 days of operational training and 5 days of application training.		

Fourier Transform Infrared Spectrometer (FT-IR)

General Specifications:-

S No.	Specification	
1.	Optics	All optics should be self-aligned for easy replacement by the user. Suitable high stability interferometer with a minimum 5 years warranty.
2.	Spectral range	Spectral range 375-7500 cm-1
3.	Spectral resolution	0.5 cm-1 or better (Non-apodized)
4.	Signal to noise ration	30000:1 or more PP for 1 min. Scan
5.	Fast scan	Minimum 30 spectra/sec or more @16cm-1
6.	Detector	DLaTGS /DTGS in KBr windows
7.	Source	A mid-IR source with a 5-year warranty should be provided. The white light source should be provided. The white light source should be provided.
8.	Beam splitter	KBr beam splitter or suitable beam splitter to cover the spectral range.
9.	Wave number accuracy	0.02 cm-1 or better.
10.	KBr pellet press-hydraulic pellet press capable of making KBr/NaI pellets with controlled pressure	
11.	The system should have the facility for liquid sample analysis (micro-level) using ZnSe and CaF2 microcell.	
12.	The firm should offer micro ATR analytical facility.	
13.	Should offer Auto validation facility with the NIST/A5TN traceable validation kit.	
14.	Software	The latest version of windows based IR software with the licence to control all functions of the offered FT-IR system like the facility for self-diagnostic, software-controlled auto tuning, auto alignment, auto component recognition and auto-optimization data collection, data processing, live data display, spectral quality check, spectral search from the commercial library, creation of the user-generated library, automatic atmospheric correction, spectral interpretation, GLP compliance, QC.
15.	FTIR Library	i. Georgian crime library ii. ii. Canadian Forensic Library
16.	Spares/Consumables	The manufacturer/supplier should certify that they will provide all the spares and consumables at least seven years from the date of installation of the system.

17.	The firm should offer FTIR Installation kit, validation kit, spares parts for smooth running the system with necessary certification wherever applicable.	
18.	Data station	The latest version of branded PC like DELL/HP/COMPAQ/LENOVO/IBM etc. Along with the licence of the original operating system and preloaded software with 21" LED monitor and laserjet printer.
19.	Two-year warranty of the full system should be provided.	
20	The system/manufacturer should be ISO/GLP/GMP/CE complied.	
21.	On-site operation and application training should be provided for 05 days for scientists.	
22.	Comprehensive and non-comprehensive AMC rate must be quoted for 05 years from the post-warranty date. AMC condition includes Preventive maintenance-4 visits per year every quarter and breakdown visit as & when required.	
23.	The firm should supply tool kit, hard and soft copies of operation manual and other relevant literature software and other items wherever possible.	

Annexure 5

High- Performance Liquid Chromatograph

General Specifications:-

SNo.	Technical specification
1.	**PUMP**
	High-pressure Binary gradient pump- 02 Nos or Quaternary gradient pump 01 unit
	Flow rate 0.01ml/min or lower to 2.00 mI/min or higher
	Flow rate accuracy with +/-1% or less
	Flow rate precision RSD less than 0.3 % or better
	Pressure 6000 psi or better
	Degassing unit(Inbuilt / separate)
2.	**INJECTOR**
	Rheodyne type injector or it's equivalent and loops 5 microlitres, 10 microlitres & 20 microlitres with 4 numbers of HPLC syringe (2 nos. of 10 microlitre syringe, 2 nos. of 20 microlitre syringe)
3.	**DETECTOR**
	Detector-Photodiode array detector- 1 no
	Wavelength range 190-700 nm or higher
	Wavelength accuracy +/-1nm or better
	Spectral resolution -1.2 nm or better
	Absorption range/ Linearity up to 2.0 AUFS or better
	Photodiode 512 or 1024 numbers
4.	**COLUMN**
	The column having the stationery phase C18 or its equivalent-2 Nos, Column having the stationery phase C8 or its equivalent-1 Nos or any other column suitable for analysis of Narcotic drugs and psychotropic substances (NDPS). The quoted columns should be capable of 26 approx.26g NDPS substances with suitable guard column or any other mechanism adopted to reduce the column contamination.
5.	**SOFTWARE**
	The firm should offer the latest version of windows based licensed software for total control of the offered HPLC system having data acquisition facility along with performance validation, peak purity determination, quantitative analysis, calibration and method development etc. The firm should quote a licensed operating system.
6.	**DATA STATION**
	The principal should supply the required branded (DELL/HP/IBM etc) computer system along with licenced operating system with 21" LED monitor and laserjet printer. The original equipment supplier/manufacturer should supply the computer data station preloaded in the factory.
7.	**GENERAL CONDITION**
	The manufacturer and or supplier will provide a 2-year warranty from the date of installation of the full HPLC system along with the supplied computer, printer and other accessories for self-sustaining of the entire system.
	Comprehensive and non-comprehensive AMC rate must be quoted for 5 years from the post-warranty date payable in half-yearly post servicing period.
	Preventive maintenance- 4 visit per year every quarter and breakdown visit as & when required. The supplier should also certify that trained service engineers should be available to attend the emergency within 48 hours.
	The manufacturer/ supplier should certify that they will provide all the spares and consumables at least for 7 years from the date of installation of the system. The supplier should also certify that they will upgrade the software free of cost whenever such an upgrade occurs.
	The firm should supply tool kit, hard and softcopies of operation manual, and other relevant literature, software and other items where ever applicable.
	Training-on site operational and application training for user scientists should be provided for at least 5 days.

Ultra-High- Performance Liquid Chromatograph

General Specifications:-

S No.	Technical specification
1.	**SYSTEM**
	UHPLC System must support the pressure of 700 bar (10,000 psi) or better
2.	**PUMP**
	The pressure of 700 bar (10,000 psi) to support <2um particle-sized column.
	Flow range of 0.001/min to 10 mL/min.
	The Pump should be low-pressure Quaternary Pump with serial dual piston mechanism of pumping.
	The pump has a mixing volume as low as 400µL
	The pulsation must be below 0.1% or 0.2 Mpa (whichever is greater)
	The pump must have independent compressibility irrespective of mobile phase composition.
	Flow accuracy - ± 0.1%or better
	Flow precision- below 0.05% RSD or 0.01 min SD (whichever is greater) or better
	Gradient accuracy - ± 0.5% of full scale or better
	Gradient precision – below 0.15% SD or better
	The pump must have built-in safety features like Leak detection and safe leak handling, excess pressure monitoring.
3.	**AUTOSAMPLER**
	The Sampler should support the pressure of 700 bar (10,000 psi) or better
	Sample Compartment Temperature Range must be from 4–40°C
	pH Range of the system must be from 1-12 including components like Loop, Injector Valve and injection wetted parts. Injection range: 0.01–100 µL, min. step = 0.01 µL
	Carryover of the Auto sampler must be <0.0004% with a Caffeine solution.
	The sample capacity with 1.5ml vials is 216 numbers of vials.
	Injection cycle time should be less than 8 sec in specified conditions.
	The Auto sampler has to support injection volumes range from 0.01–100 µL. With options to upgrade injection volume range up to 1mL with multi-draw option.
	Injection volume accuracy typically ±0.5% or better
	The injection precision must be typically below <0.25% area RSD or better.
	The injection accuracy must be typically ± 1% (injection volume 10 µL and water)
	The minimum sample volume in vial or well plate required for injection can be as small as 2 µL
4.	**THERMOSTATTED COLUMN COMPARTMENT**
	The column compartment must provide Dual Thermostatting Modes; Still air for highest efficiency at UHPLC conditions and forced air for easiest method transfer.
	Column compartment must have a temperature range from 5°C to85°C. or better
	The column compartment must support columns with 300 mm length
5.	**MULTI WAVELENGTH PDA DETECTOR**
	The wavelength range of the detector must range from 190 to 800 nm
	The drift of the detector must be below 1mAU/hat 254 nm or better
	No of Photodiodes must be 1024 for better spectral resolutions 0.6nm spectral Bandwidth or better
	The detector must provide a data collection rate of up to 125 Hz or more with spectra acquisition.
	The detector must be able to record 8 channels simultaneously.
	Linearity : <5% at 2.2 AU (typically <5% at 2.7 AU) or better

	Standard analytical flow cell should be of 10mm path length capable of performing self-illumination.
	The detector must have an internal wavelength calibration using the D-alpha line of the deuterium lamp
6.	**FLUORESCENCE DETECTOR**
	Two monochromators with concave holographic gratings and elliptic mirrors
	The light source must be Xenon lamp with tunable pulse frequency
	Wavelength Range for Ex: 200-630nm for Ex: 265-650 nm.
	Data Collection Rate must be 100Hz for single-channel acquisition.
	Single Spectrum Scans or FL Field Acquisitions: Excitation, emission or synchronous mode.
	Spectral Bandwidth of the detector should be (FWHM) Excitation: 20 nm; Emission: 20 nm.
	Sensitivity Raman Criteria must be S/N: >2100 or better
	Flow Cell Thermostatting 15 °C above ambient to 50 °C
	Wavelength repeatability:±0.2nm or better
7.	**COLUMN-**
	Suitable C30, 5µm, ANALYTICAL 4.6 x 250mm column or better with guard column -1Set. Suitable C18,5um 4.6×250mm analytical column or better with guard column -1Set Suitable C8,5 um 4.6×250mm analytical column or better with guard column-1set. The quoted columns should be capable of 28 approx.28g NDPS substances with suitable guard column or any other mechanism adopted to reduce the column contamination.
8.	**SOFTWARE**
	License version of Chromatography data system software. The software should be a strictly validated/original licensed copy software with the specific part number mentioned in the offer [No Pirated version of the software will be allowed and if found the offer will be strictly rejected]. It should be 21CFR Part 11 compliance. The software should have integrated database Software should be capable of performing gradient optimization programming 1-9 gradient programming (linear, step, convex, concave) etc. Audit trial should automatically monitor users' action and records a modification history.
9.	**DATA STATION-**
	The principal should supply the required branded (DELL/HP/IBM etc) computer system along with a licensed operating system with a 21" LED monitor and laserjet printer. The original equipment supplier/manufacturer should supply the computer data station preloaded in the factory.
10.	**GENERAL CONDITION**-
	i. The manufacturer and or supplier will provide a 2-year warranty from the date of installation of the full UHPLC system along with the supplied computer, printer and other accessories for self- sustaining of the entire system.
	ii. Comprehensive and non-comprehensive AMC rate must be quoted for 5 years from the post-warranty date payable in half-yearly post servicing period.
	iii. Preventive maintenance- 4 visit per year every quarter and breakdown visit as & when required. The supplier should also certify that trained service engineers be available to attend the emergency within 48 hours.
	iv. The manufacturer/ supplier should certify that they will provide all the spares and consumables at least for 7 years from the date of installation of the system. The supplier should also certify that they will upgrade the software free of cost whenever such upgradation occurs
	v. The firm should supply tool kit, hard and softcopies of operation manual, and other relevant literature, software and other items where ever applicable.
	vi. Training-on site operational and application training for user scientists should be provided for at least 5 days.

Annexure-7

Gas Chromatograph (GC) with Head-Space

General Specifications:-

SNo	Specifications	
1.	GC	The GC must feature an external color touch screen and should be capable of installing multiple detectors & injectors on the basis of the requirement (User-replaceable within two minutes without the need of service engineer). It should be possible to control the system completely through a data station consisting of a computer and GC software and upgradable to Single Quad MS, Triple Quad MS/MS in future
2.	Oven Temperature	Large Column Oven with a temperature range from 40° C above Ambient to 450° C, Temperature Accuracy: ±1%, Heat-up time from 50°C to 450°C within 4 minutes. Cool-down time from 450°C to 50°C in less than 4 minutes. The maximum heating rate of 125°C/min. A number of Ramps /plateaus: 25/26 or More.
3.	Injector temperature	400° C orbetter
4.	Injector – split/spitless -Two Nos with an adaptor to mount both capillary & Packed Columns	The injector should be capable to operate with a capillary, wide bore and packed columns. The injector needs to permit large volume splitless injection (up to 50 microliters) without requiring pressure pulse to quantitatively recover the whole sample, and without any further hardware requirement. The injector to allow timed closure/opening of the purge line. Maximum Temperature: 400 °C Split Ratio: up to 12500:1 Pressure Range: 0-1000 kPa (0-145 PSI) Total Flow Setting: Control of split flow in 1 ml/min from 0 to 1:250 ml/min Pressure range: 0–1000 kPa (0–145 psi) • Modes: Constant and programmed pressures and flows with gas saver and septum purge Total flow setting: – Control of split flow in 0.1 ml/min increments;
5.	Flow controller for carrier and carrier and detector	Automatic digital flow and a pressure controller/EPC/EFC/IEC must be available Up to 18 channels of integrated electronic gas control Pressure set points minimum increments: 0.01 kPa-0.001 psi in all ranges
6.	Carrier gas	The system should have the facility to use helium & Nitrogen as a carrier gas in GC system & provision to use Hydrogen as carrier Gas with adequate safety measure of arresting Hydrogen Leak.
7.	Safety features	Auto leak detection of carrier gas and automatic shutdown of GC in case of the leak
8.	GC system should have a gas saver mode	
9.	Detector	FID Detector: 02Nos Sensitivity > 0.03 Coulombs/gC; Linear dynamic range = >107 (± 10%); Max Temperature range: 450 °C
10.	Headspace Auto sampler	12 Vials upgradable to 120-vial capacity with vial loader and 3 removable 40-vial racks, further extendable to 240-vial capacity in future if needed. Vial size – 10 ml, 20 ml and 22 ml headspace vials with:

		Magnetic crimp or screw caps, flat or rounded bottom without any need of Vial adapter Oven capacity: Air ventilated oven with 12-seat electrically driven carousel
11.	Liquid Auto sampler/Injector	Vial Capacity: 8 vials or more & upgradeable to 150 vials or better Vial capacity: 2 ml screw top cap Syringe: 10 µL Injection Parameters: Max. volume: 5 µL, Mini. Volume: 0.01 µL, Increments 0.01 µL steps Syringe Rinsing: Pre and/or Post injection Vials & Caps for 1000 sample analysis
12.	Validation system	Total validation should be quoted for system and software IQ, OQ or PQ
13.	Column	DB-1 MS or its equivalent 30 mX 0.32 mm (I.D) x0.25 micrometer film thickness- one number DB-5 MS or equivalent 30 m X0.25 mm(1.D)x0.25 micrometer film thickness-one number. 3o/o SE -30, OV-17 , Porapak g (1 each) Trace GOLD TG-ALC1 30Mx0.32Mx1.8 µm or Equivalent -1No Trace GOLD TG-ALC2 30Mx0.32Mx1.2 µm or Equivalent -1 No (Pre-column: 5Mx 0.32mm -2 Nos Micro fluidic 3-port connector for leak-proof dual detector connection
14.	Software (with License)	Should be windows-based operating system with validation facility. The offered software should be suitable for the quoted model GC along with performance validation. The facility, multi-component analysis, multilevel calibration, baseline correction, methods of analysis, time programming, plotting, graphical representation of the chromatograph and storing of data
15.	Data station	The principal should supply the branded (DELL/HP/IBM etc) computer system along with the license of the operating system with 21" branded LED monitor along with LaserJet printer.
16.	All spare parts and accessories for the installation of the full system should be provided along with one set of the tool kit. Hydrogen Gas Cylinder with Double Stage Pressure Regulator – 01 set Nitrogen Gas Cylinder with Double Stage Pressure Regulator – 01 set Zero Air Gas Cylinder with Double Stage Pressure Regulator – 01 set Helium Gas Cylinder with Double Stage Pressure Regulator – 01 set Gas Distribution system with Purification Unit for He, H2, N2 & Zero Air Branded Online 6 KVA UPS with Isolation, SMF Batteries, Battery Rack and Battery Interconnecting Cables (Three Phase Input &Single-Phase Output) for 60 min. back-up. Crimper and De-crimper- 1 set	
17.	Spares and consumables-supplier/manufacturer should quote and supply essential spares and consumables including septa (mention item wise) for two years month operation of the quoted system.	
18.	**General conditions** i. The manufacturer and or supplier will provide a 2-year warranty from the date of installation of the full GC system along with the supplied computer, printer and other accessories for self-sustaining of the entire system. ii. Comprehensive AMC rate must be quoted for 5 years' post-warranty date. CMC should include Preventive maintenance- 4 visits per year every quarter and breakdown visit as & when required. iii. The manufacturer/supplier should certify that they will provide all the spares and consumables at least for seven years from the date of installation of the system.	

	iv. Training- The supplier should provide on-site operational/ application training for laboratory scientists for at least 5 working days. v. The firm should supply tool kit, hard and soft copies of operation manual, and other relevant literature, software and other items where ever applicable. vi SPECIAL NOTE: a) All specifications offered Needs to be supported with original literature as well as the same literature needs to be available on the website of the manufacturing company. b) The offer to be made in details with all technical specification, item details with part nos (Only line items will not be accepted). c) All supporting technical literature complying the technical specification needs to be attached along with the order. d) Please give reference of at least three users of GC in FSL laboratories in India with details of the user, email ID & contact nos.

Annexure-8

Accelerated Solvent Extraction System

General Specifications:-

Accelerated Solvent Extraction System complete with pump & fittings which provides operation for a single sample at a time with the following features & ease of uses in preparing/extracting sample.
Unattended extraction of up to 24 samples.
Samples cell sizes to be available: - 1, 5, 10, 22, 34, 66, and 100 ml.
Collection vial sizes: 60 or 250 ml.
Operating pressure: 1500 psi (100 bar).
Automatic rinsing of the system between sample extractions
Solvent saver mode for further reduction in solvent consumption
Scheduling programming for automated method optimization
It should reduce extraction time and solvent consumption by use of elevated temperature and pressure during extraction
The requirement of solvent less than 50 mL so to extract a 20gm sample; reducing total solvent usage
It should extract automatically to provide filtered and ready for direct injection or final cleanup sample of interest.
It should have options for Easy-to-use collection bottles or vials (vials with via tray insert)
It should have convenient multiple-method storage for automatic operation.
It is to come with convenient front panel operation runs methods automatically.
It should have Sensors for temperature, pressure, and solvent and liquid leaks alert the operator to a problem, sound an audible alarm, and shut down the system if necessary.
It should include solvent bottle, snap-ring pliers, power cords, and gas line fittings with the following specifications:
Temperature control:
Up to 200 °C; vertical cell orientation with the flow from top to bottom.
Pump: Fluid delivery pressure: 10 Mpa (1500 psi).
Pump flow: 70 mL/minute. Automatic pressure sensor and pressure relief during heat-up.
Fluid Sensors: IR sensors detect fluid level during the collection of extract
Display and Keyboard: Menu operated. LCD 8 × 45 OR similar character display. Method and schedule editor and storage
Extraction Cells: Seven capacities: 1, 5, 10, 22, 34, 66, and 100 mL cells. Cells feature finger tight cell caps with compression seal for high-pressure closure
N2 cylinder with Suitable high-pressure regulator & tubing.
Automated sample extraction using flow-through technology with pH-hardened pathways
Automatic extract filtration
Easy-to-fill sample cells with the finger- or hand-tight fittings
Easy-to-use collection vials and bottles
Convenient front panel operation with multiple method storage
Sensors for temperature, pressure, and solvent vapours ensure safe operation at all times
Easy method transfers between systems
3KVA UPS with 60 minutes' backup

Ion Chromatograph

General Specifications:-

1.	**PUMP SYSTEM**
a)	Binary/Quaternary pumps-02 units (for gradient flow) or any equivalent system suitable for simultaneous detection of cations & Anions. The system should be suitable for gradient flow.
b)	Flow rate:- 0.01-10ml/min or more.
c)	Reproducibility/Accuracy of flow-<0.1% or better
d)	Flow precision-0.1% or better
e)	Maximum pressure range-not less than 5000 psi
f)	Pump heads and all fluid path should be metal-free (PEEK) or any other good polymer suitable for analysis of anion and cations.)
g)	Online degasser or equivalent facility
h)	Leak sensor facility
2.	**INJECTOR PORT SYSTEM:** Dual Rheodyne injector port (Metal-free, PEEK or any other good polymer) for simultaneous anions and cations analysis. The firm should offer adequate no of injection port for simultaneous anions and cations analysis for the offered system.
3.	**SUPPRESSOR SYSTEM:** a) Chemical suppressor should eliminate background conductivity & increase the signal to noise ratio and with continuous regeneration/automatic regeneration or any equivalent technology delivering the same result. The operation should be automatic and should be able to withstand high backpressure and high loading or any equivalent suppressor system. b) The principal /manufacturer will submit an undertaking to supply the suppressor Kit for 7 years from the date of installation.
4.	**DETECTOR (METAL FREE)**
	Conductivity detector with cell: The firm should offer two (02) nos of detectors for simultaneous anions and cations analysis for the offered system. Conductance range: 0-15000microsemens/cm. or better. Block should be thermostated (lower range-35^{0}C or more), Temperature stability -+ 0.01^0 C Auto zero function should be present and should not control through software. The detector should be suitable to give results up to ppm level or better.
5.	**THE QUOTED SYSTEM**(including column and guard column 2 Nos each type and any other consumables like connectors rings etc.) should be self-sustaining and capable of 33pprox.33g the following anions and cations simultaneously. Anions- Nitrate, Nitrite, Fluoride, Chloride, Sulfate, Bromide, Bromate, Phosphate, Perchlorate, Chlorate, Acetate, Formate Cations- Lithium, Sodium Potassium, Calcium, Ammonium, Barium.
6.	**GENERAL CONDITIONS**
a)	The entire offered system for the simultaneous analysis of cations and anions through a single PC and integrated software. The firm should quote the latest version of the software.
b)	The product should be ISO 9001 certified /CE compliance
c)	Two years warranty of the full system will be provided.
d)	Comprehensive and Non-comprehensive AMC rate must be quoted for 5 years from the post-warranty period. AMC condition includes i. Preventive Maintenance- 4 visits per year every quarter ii. Breakdown visit- As & when required. iii. The total validation package for system and software must be quoted.
7.	**DATA STATION**
a)	Consisting of windows based software with features such as multilevel calibration, baseline correction, all methods of analysis, time programming, plotting and graphical representation of chromatograph.
b)	The software should be able to control the ion chromatography system and data acquisition.
c)	The latest version of branded PC like DELL/HP/COMPAQ/LENOVO/IBM etc. along with the licence of original operating system and preloaded software with 21" LED monitor and laserjet printer.
d)	The original equipment supplier/manufacturer should supply the total computer/data station

	preloaded in the factory.
8.	**TRAINING**– At least 2 weeks of operational and application on-site training must be provided for 5 user scientists.

Annexure-10

Auto DNA Extraction System

General Specifications:-

- Electrical Requirements: 220 V, AC 50 Hz.
- Open system to accommodate validated kits for DNA extraction from forensic samples.
- The system should have the capability to simultaneously process at least 6 samples or more, with a sample tracking facility.
- Built-in system for decontamination.
- Cross contamination-free system and provision for monitoring it.
- Software for data management and instrument operation/analysis.
- Warranty for 2 years from the date of installation and followed by AMC for 3 years.

Annexure -11

PCR Thermal Cycler

General Specifications:-

1. Electrical Connectivity: 220 V, Ac 50Hz.
2. Temperature range 4 ° to 99.9 °C with accuracy +/ or 0.25 °C or better.
3. 96-Well Block for 0.2 mL micro centrifuge reaction tubes or 96 well reaction plate and validated for use with 4-6 dye-based forensic HID kits.
4. Block format with 6 independent temperature zones capable of standard and fast runs.
5. Ramp rate 3 °C/Sec. or better.
6. Programmed methods for hot-start PCR, cycle sequencing, long PCR, touch down PCR etc.
7. Touch screen colour display of temperature profiles & set up parameters.
8. The system should be licensed for PCR.
9. Validated for forensic DNA analysis as per SWGDAM (Scientific Working Group on DNA Analysis Methods) guidelines.
10. Warranty 2 years or more from the date of installation followed by AMC for 3 years.

Annexure -12

Real-Time PCR (RTPCR)

General Specifications: -

- Electrical Connectivity: 220 V, Ac 50Hz.
- 96-Well Block Thermal Cycling System with Computer.
- Five-color OR more detection capability to perform different forensic applications including DNA quantitation, SNP (Single Nucleotide Polymorphisms) genotyping, gene expression analysis and plus/minus assay utilizing Internal Positive Controls.
- The specialized optical configuration that supports a broad range of fluorophore dyes.
- The system should be supplied with licensed software that design probes and primers.
- Sample format 96-well plates and optimized for 20-25 uL. Reactions.
- The system should be validated/certified for the latest forensic human/male DNA testing Quantitation kits.

Software Specifications: -

- User-friendly software plate set up, Multi-plate Data Comparisons, Comparative analysis Ct, Standard Curve, Relative Standard Curve, Allelic Discrimination etc.
- Dye discrimination Multi-component algorithm.
- Built-in features for sample quality assessment (Human male: female ratio inhibition & degradation index). Capability for calculating dilution & reaction set up for HID kits.
- Warranty 2 years or more from the date of installation followed by AMC for 3 years.

Annexure -13

DNA Sequencer / Genetic Analyzer

General Specifications: -

1. Electrical requirements: 220 V, Ac 50Hz.
2. Polymer-based 8 capillaries automated DNA sequencer upgradable to 24 capillaries.
3. 6 dye-based chemistry.
4. CCD Camera.
5. The latest version of validated GeneMapper ID-X software for fragment sizing (Forensic STR (Short Tandem Repeat) based human identification) and sequencing with extensive security, auditing and e-signature capabilities.
6. Genetic Analyzer validated for forensic DNA analysis.
7. Auto sampler plate and facility to use capillaries of different sizes.
8. Matrix Standards.
9. Polymer pouches.
10. Capillaries preferably 36 Cm. size. (2).
11. Anode & Cathode buffers.
12. Deionized Formamide.
13. Forensic STR based kits for HID (Human Identification).
14. Warranty of 2 years from the date of installation and AMC for the subsequent 3 years.

Comparison Microscope

1. The comparison microscope shall be used for examination and comparison of tool marks and firearm signatures present on fired cartridge cases/ bullets/ bullet fragments and other forensic physical exhibits.

2. **Basic Comparison Microscope must have following features/provisions:**

- Mounted on a free-standing working bench/table with motorized Z-movement for height adjustment of suitable range.
- An optical comparison bridge with motorized Z-movement for height adjustment of a suitable range.
- Suitable mechanical stages for the left side and right side preferably with a digital scale or micrometre in X and Y directions. Coarse and fine focus adjustment for the left and right specimen stages with independent controls.
- Mechanical and/or motorized coaxial drives for X/Y with a range of movement of the stages of X-50mm/Y-50mm or more and synchronized movement of stages in the X-direction.
- Suitable stage attachments with 3600 rotating basic mounts in horizontal plane and+l1800 angle function with scale divisions.
- A tilting binocular viewing tube preferably with variable angle of observation and with eyepieces l0x/22 FOV or better and with a provision of adjustment of inter-pupillary distances of the viewers.
- The image at eyepiece must be upright and non-reverse and must move in the same direction as the stage sample being viewed. The images must be colour neutral from left to the right side.
- The width of the image dividing line between the two sample images must be adjustable by the user and the microscope must have a provision for moving the dividing line for side-by-side comparisons.
- The comparison microscope bridge must offer the following observation modes: side-by-side view, full left or full right view, and superimposed view.
- Provision for simultaneous binocular and video/photo observation/documentation or to allow full light to be viewed on binocular or full light to divert images to a camera.
- Magnification range: from 6x or less to 80x or higher with suitable objectives. Magnified images must be parfocal and paracentric through the magnification range. Microscope optics must be apochromatically corrected.
- Provision for operational panel supporting all the controls of motorized functions of the comparison microscope at one place.
- Suitable chair with adjustable height, seat and backrest'
- Dust cover for complete coverage of comparison microscope'

Illumination system

- An equal and homogeneous illumination of both the samples during examination provided by one single light source and a splitting system to illuminate the two samples placed or mounted on two stages shall be preferred.
- Suitable light sources including cold light illumination and LED light illumination
- The light sources must have all fixtures, holders, spare lamps, fuses, connecting cables, short and long articulated arms for the fibre-optic light guides, or any other item required for the illumination systems installation and working.

Holders and Accessories

- Suitable holders and accessories for holding or clamping and proper mounting of various shapes and sizes of 4mm to 25mm calibre cartridge cases in order to examine the firing pin marks, breech face marks, extractor/ejector marks and chamber marks; and for bullets/ projectiles/

bullet fragments in order to examine rifling/banel marks including suitable bullet/projectile centring devices/holders.

- Holding or mounting surfaces should not alter, erase, add or diminish the firearm signatures on exhibits. Mounting of exhibits should be slip-proof'

5. Digital Imaging Workstation and Software

- C-mount, firewire/USB, high definition digital camera for image capture of at least 5- megapixels image resolution with suitable adapters for optical comparison bridge including licensed software for image capturing; storing, processing, 40pprox.40g, data transfer, calibrated measurement, extended annotations, retrieving the image and report generation as well as image database functions.
- The digital imaging workstation with licensed latest windows 64-bit or better operating system pre-installed, 4GB RAM or more, 1.0T8 SATA HDD storage capacity or more. Licensed office or equivalent word editor software of the latest version must be installed. The workstation must come with a USB keyboard, USB optical mouse, 2GB graphics, DVD Read-Write Devices and a21" or larger high definition LED monitor.
- High-resolution color laser printer to print A4 size plain papers and photographic papers for printing comparison images.

6. Power consumption

AC Power supply of 220t 10% Volts, 50-60Hz

7. Spares and Consumables

The firm must supply spares for a period of at least five (5) years and availability of spares must be ensured a period of at least for ten (10) years after the date of installation. List of spares and consumables with cost must be supplied. The firm must provide for a minimum of two (2) years warranty

8. Installation and Training

The firm must do installation and commissioning of the Comparison Microscope at the user's site and provide on-site operator's training to four end-users. The firm must have to submit a pre-requisite requirement for the installation and commissioning of the comparison microscope at the user's site after inspection'

9. Operating manuals

The firm must supply the standard operating manuals for the various components of the Comparison Microscope.

10. Calibration

Comparison microscope must have the facility of calibration for its various measurements.

SEM-EDXA

General Specifications:

1.	Resolution	At least 1.2nm at 30 kV or 1.5 nm at 15 kV and 3.0 nm at 1 kV)
2.	Magnification	50X to 500,000 X or better
3.	Acceleration Voltage	0.1 to 30 kV (or better)
4.	Chamber	Large chamber with at least 7 accessory ports. Anti-vibration table must be inbuilt.
5.	Probe Current	1 nA to 1µA or better suitable for all applications.
6.	Detectors	a) High sensitive Everhart-Thornley SE detector b) In-Lens SEI detector for high-resolution imaging in High Vacuum at lowkV OR low vacuum/ variable pressure mode. c) IR-CCD camera d) High-resolution state of art backscattered detector(BCD) for using both in high vacuum and variable pressure. e) The detector should have the capability of high sensitivity for low kV analysis. f) Specify built-in automatic/ manual control for contrast and brightness.
7.	Electron Gun	Thermionic emission type – Tungsten source
8.	User Interface	Keyboard, Mouse, Control Panel with multifunction for the control and adjustment of frequently used SEM parameters
9.	Electron Optics	Beam deceleration technology or equivalent for high-resolution imaging at low kV. Ease of operation is desired.
10.	Vacuum System	Fully automated microprocessor-controlled vacuum system a. Suitable vacuum system equipped with ion pumps, turbo-molecular pump & rotary pump. b. Chamber pressure better than 10^{-4} Pa / 4 x 10^{-6}mbar c. Pump downtime should be less than 5min
11.	Digital imaging and processing	It should have the following capabilities: a. Design of the imaging and processing should be optimized for SEM-EDX electron microscopy b. Image Frame Size: Selectable up to pixel density of 4096 x 3536 or better c. Image post-processing d. 4 detector inputs and signal mixing or above, extendable up to 8 detect or inputs **Image Display** a. 22" high-end TFT flat screen or better b. Standard data zone includes magnification, working distance,scale bar and date Custom data zone c. Multiple point-to-point and line width measurement systems freely adjustable for orientation d. Line profile display e. Images can be viewed live, averaged or integrated **Image Storage** a. 1 TB hard disk or better b. Front-panel USB ports. CD/DVD recorder c. Storage of SEM images on the hard disk in standard TIFF, BMP, or JPEG Formats and in 8-bit or 16-bit depth

		d. Operating conditions easily stored and file management through Microsoft® Windows operating system
12.	Essential Accessories	a. Chiller. b. Compressor. c. Interface among SEM EDX/EDS. d. 3 Spare Filaments e. 20 number of single stubs and 10 number of multiple sample holders
13.	Integrated EDX/EDS	
	EDS	Integrated EDX/EDS system a. LN2 Free SDD detector with 30 mm^2 crystal area and 130 eV resolution or better. b. The elements detection range should be from Beryllium (Be) to Uranium(U). c. The EDX/EDS should be capable of selective element mapping, line scan, selected area analysis, quantitative analysis, qualitative analysis, multi point analysis. d. Supplied EDX/EDS server & analysis software should be capable of performing data acquisition, storing and transfer in common Windows-based application format, qualitative & quantitative analysis, line scanning, elemental or dot-mapping (area) including spectrum imaging and phase mapping with specimen drift correction. e. Thin-film analysis software with nanometer-scale resolution in both space and depth capabilities should be quoted.
15.	Warranty, Training and Support	a. Three years of comprehensive warranty b. Necessary on-site training must be provided.

Ballistics Data Management System

General Specifications:

VELOCITY MEASUREMENT SYSTEM

The system should have the provision to measure any velocity in the 'ang' of 10 – 2000 m/s (or more) with an accuracy of up to 0.01%. The system should also have the provision of measuring velocities at a minimum of three points of the trajectory simultaneously so as to evaluate the muzzle velocity, striking velocity and remaining velocity. The non-contact velocity measurement equipment will consist of optical detectors, light sources, multi-channel timer units, workstations and various connectors, cables etc. as described in the subsequent section. The calibration protocol of these measurement systems should also be provided and suitable training is given during the pre-dispatch inspection stage.

1.1: OPTICAL DETECTOR – 06 Nos. (3 sets)

- Projectile calibre: 4mm to 10mm or more
- Projectile Velocity: up to 1500 m/s
- Sensitivity: The optical detectors should be able to work in ambient light and respond to less than 0.1% change in ambient light level.
- Operating temperature: up to 60° C
- Provision of automatic/fixed alignment with the light source
- **Mountable on rails with brake/locking system**
- Apparatus must be sealed against moisture.
- Commissioning, testing and training at a site

1.2: LIGHT SOURCE – 06 Nos.

- Coupled with optical detectors
- Rugged construction
- Power supply: 200 – 260v AC ±10%, 50/60 Hz
- Humidity: up to 95%
- Operating temperature: up to 60°C
- Mountable on rails with brake/locking system
- Commissioning, testing and training at the site

1.3: MULTI-CHANNEL COUNTER – 1Nos.

- Each multi-channel counter will support optical detectors (minimum 3 sets)
- Storage capacity: ≥ 256 velocities or rate of fire measurements
- Rate of fire: 1000 rounds per minute or more
- Operating temperature: up to 60°C
- Humidity: up to 95%.
- Sufficient cable for minimum 100 m installation.

1.4: WORKSTATION (1 Nos.) AND ACCESSORIES

- Workstations comprising of latest and high-end processors along with hardware accessories like high-end graphics, data writers (DVD/CD), wireless keyboards, mouse, external memory devices, Ethernet modules, high-end printers etc. The mainframes should be interconnected.
- OS and other s/w: High-end graphics s/w, Windows (latest), data acquisition s/w, range control, office suites, networking.
- Commissioning and testing at the site.

1.5: UNIVERSAL BREECH SYSTEM AND STANDARD BARRELS (1 EACH)

- One universal receiver for above barrels, recoil rest with barrel support and laser alignment tool.
- Remote firing units and security equipment for the above.
- Cleaning and spares kit.
- Mountable on rails with brake/locking system
- Commissioning, testing and training at the site

1.6: STANDARD BARRELS

- One test barrel (rifled) as per ANSI/SAAMI standard for 5.56x45 mm ammunition.
- One test barrel (rifled) as per ANSI/SAAMI standard for 7.62x51 mm ammunition.
- One test barrel (rifled) as per ANSI/SAAMI standard for 7.62 x 54 mm ammunition.
- One test barrel (rifled) as per ANSI/SAAMI standard for 7.62X39 mm ammunition.
- One test barrel (rifled) as per ANSI/SAAMI standard for 9x19 mm ammunition.
- Cleaning and spares kit

1.7: FIREARM REST TABLE (1 No.)

- For mounting the different calibre firearms and withstanding the jerk caused during firing.
- Height 1200 ±100 mm, Weight less than 500 KG.
- PLC controlled auto trigger system with touch panel.
- Dual vice model for mounting shoulder arms and handguns.
- Barrel mounting vice and butt rest to avoid any recoil during firing.
- Lockable anti-vibration pads to absorb recoil.
- Arrangement for tilting the firearm.
- Caster wheel and toe provision with locking system.
- Cabinet for storage of guns/tools.

1.8: TARGET TABLE (1 No.)

Target table in X, Y, Z and C axis with the remote control system

- Height of table platform 1200mm ±300mm movement.
- Z-axis movement ±300mm
- Stainless steel dial plat with diameter 1000 ±100mm rotating 360 degrees with step movement of 5 degrees each.
- Caster at the base for movement and adjustable mounting foot for firm resting.

1.9: HEAD FORM (2 Nos.)

Head Form (aluminium) for mounting large, medium and small-sized BP helmets as described in NIJ standard.

1.10: TROLLEY (1 No.)

Manually driven hydraulic trolley of 400 kg capacity.

- Fork span wit in the range of 600 ±50mm, Fork length 1150±50mm and height of fork adjustable from min. 90mm to the max. 1500mm.

1.11: BULLET TRAP (1 No.)

- For stopping the bullet with velocity 4500 f/s.
- The size will be 3m × 3m (vertical blinds).
- Commissioning, testing and training at the site.

X-Ray Fluorescence Spectrometer

General Specifications:-

S. No.	Technical Parameter	Specifications
01	H.V. Generator	H V generator should be 3 KW or more, 60 KV (with 1 kW steps), 100 mA (with 1 mA steps), Stability of the Generator should be ± 0.005% (for both kV and mA, against ± 10% input variation) or better.
02	Excitation Source/probe beam	Rhodium (Rh)/ Tungsten (W) anode based X-ray tube (about 4 kW) capable of operating up to 40 kV, suitable for analysis of low Z and high Z elements. Appropriate filters for detection of various elements with a wide difference in atomic numbers.
03	Optics	Optics should be best suitable for analyzing powder and solids samples. The system should have proper dust trap for protection of the optical chamber.
04	Detector	High Resolution & large area Fast Silicon Drift Detector(Fast SDD) with the capability to acquire X-ray data/count rate greater than 100 kcps (kilo counts per second).
05	Operating environment	Temperature: -5 °C to +50 °C or more; Humidity: 10 % to 90 % relative humidity non- condensing.
06	Resolution	<145 eVFWHM @ 5.95 keV Mn K_α line.
07	Elemental Range	F(9) to U (92) OR Mg(12) to U (92)
08	Sample Chamber and Automatic Sample Changer	The system should be offered with at least 12 positions Automatic Sample Changer. Sample chamber should be easily accessible for the user for day to day cleaning purpose.
09	Vacuum Pump	Single vacuum pump with dust trap should be offered
10	Spectrometer Chamber	Should have a system for Thermal stabilization preferably heater system to keep optical chamber temperature steady.
11	Data acquisition	Data acquisition and user-friendly instrument operation and data processing and file storage software and hardware (PC/Monitor/Printer/Licensed software) should be offered.
12	Measurement area	Minimum spot size shall be 5 mm or less
13	Safety provisions for the instrument and operation	X-ray enabling only in the presence of the sample using an IR proximity sensor. Safety provision for X-ray detector. Shock and water-resistant case.
14	Data storage and transfer	Internal memory: 500 GB or better Data transfer : Through USB port for connection to a computer for data transfer. The instrument software should support Microsoft windows 8/10 or higher version of the PC for data transfer and readable through Microsoft-Word/Excel.
15	Operating Environment /Power supply	Line Voltage: 230V±10%, 50/60Hz ± 5% (without any step-up or step-down transformer) with protective RF ground. Appropriate DC power supply cord with an adapter to operate from an AC power source (100-240 VAC,50-60 Hz.) shall be provided.

16	Device/ instrument software	The operating system of the instrument shall be licensed and Microsoft Windows-based software. There should be a backup of all essential software related to OS and application software in the form of the flash drive. Spectrometer software should be compatible with Window 8/10, 64bit, including multipoint background correction, line overlap correction, ratio calculation, calibration curve, qualitative analysis incorporating matrix correction, recalibration program, data storage & retrieval facilities.
17	Application software for composition analysis	Built-in calibration check at the start including standard specimens. Automatic grade identification using a database of standard grade library (≥300 grades) covering various International standards. Standard Library:- It shall include grade library.
18	Training	Hands-on training including details of hardware components, OS, application software, calibration checking, chemical composition analysis of various standard specimens and others, troubleshooting, report generation, data transfer and saving the spectra and composition results to other computers through USB.
19	Certificates/ Manuals	ISO Certificates. Full details of authorized service partner in India for providing after-sales technical support.
20	Consumable Accessories	As per requirements of the instrument, consumables & accessories should be supplied along with equipment for the smooth functioning of the XRF Analyzer.
21	Warranty	3 years
22	System Accessories	Suitable UPS (15 KVA, 30 min back up) to run the system and any other recommended items or support system. Suitable branded computer (1 no) with the printer, Suitable cooling system (water chiller–1 no). Sample holders.

X-Ray Diffractometer

General Specifications:-

I. X-RAYGENERATOR

Power	The maximum continuous output power of 3 KW or higher
Input voltage range	208 – 240 V
Rated Voltage	20-60 KV or better range (in steps of 1 KV).
Rated Current	2-60 mA or better range (in steps of 1 mA).
Stability	• 0.01% per 10% main variations
Cooling	The system should have a requisite cooling system – external chiller/heat exchanger etc. for smooth and stable running.
Control	Fully controlled through Windows-based PC software
Safety Device	Abnormal cooling water, flow rate, water Pressure, Temperature detection, abnormal XG load (overload, line current, abnormal low and high voltage, emergency stop switch, leak breaker), shutter malfunction detection

II. X-RAYTUBE

Insulation	Ceramic
Anode material	i. A Cu anode; The system should also be able to work with other X-ray sources like Mo, Co, Fe, or Cr. ii. A Co anode must also be coated.
Maximum power	2 kW or higher
Focus	The fine focus, long line fine focus with Ni K. Filter. Facility to switch between line and point focus applications without disconnecting cables and utility lines or unscrewing the X-ray tube.
Tube Shield	Electromagnetic shutter interlocked with radiation enclosure

III. GONIOMETER

Geometry	Vertical (keeps sample horizontal and stationary)
Operation mode	Theta – Theta
Scanning mode	θ_D/θ_S independent or coupled
2 theta measurement range	-90 to 165 deg or better range (with the capability of transmission mode)
Scan Speed	Between 0.001 to 1.25 deg/sec or better
Slew speed	9 deg/sec or higher
Min step size	0.0001° or better.
Diameter	The minimum diameter of 480 mm; without major alignment procedure will be preferred.

Data quality guarantee	The manufacturer must submit data quality guarantee certificate from the factory on the angular position (<= 0.01 deg 2theta over the entire angular range) to be carried out on NIST sample. The same NIST sample should be in the scope of supply for evaluation.

IV. OPTICS

Slit type	- Automatic Computer Controlled & Programmable Variables lit - Alignment-free and tool-free change of optics - Should be used either in the fixed or non-fixed mode
Primary / Incident slit	Motorized slit and parabolic multilayer mirror for changing from Bragg & Brentano focusing optics to parallel multilayer mirror 0.05-7.00 mm or better; 0.01 mm Step or better
Secondary / Receiving slit	Motorized slit and parabolic multilayer mirror for changing from Bragg & Brentano focusing optics to parallel multilayer mirror optics 0.05 – 20.00 mm or better, 0.01 mm Step or better.
Slit specification	Motorized slit and Soller collimator (minimum 2 suitable sizes) along with Anti-scatter slit assembly to reduce air scattering particularly for low angle measurements; for incident beam and detector
Fluorescence suppression	Suitable hardware and software for suppressing secondary fluorescence must be included.
Height limiting slit	Necessary height limiting slits are to be included
Optical system alignment	Complete automatic alignment without manual intervention for the alignment of source height, source angle, mirror optic, crystal optic, slit height, sample surface and detector angle.

V. DETECTOR

Type	- Solid-state high-speed detector with a minimum 150channels / semi conductor strips equipped with diffracted beam monochromator; must be maintenance-free and must work without using any cooling agent or gas. - It should offer good angular resolution and perfect profile shapes with no defective channels/pixels and operable for all kinds of radiations ex. Cu, Co, Cr, Fe & Mn.
Efficiency	>98% for Cr, Co, and Cu radiation
Spatial resolution (pitch)	Minimum 75 micro metre
Capture angle	>2.5° 2Theta angular coverage at 500 mm measurement circle diameter on both X & Y direction and all channels/pixels should remain active for a minimum 5 year from the start of use. In case if any of pixel/channel found dead within this period supplier has to replace with a new detector FREE of cost.
Counts	Minimum 100,000,000 cps or better.
Energy resolution	<680 eV for Cu radiation at 25°C
Fluorescence suppression	Suitable hardware and software for suppressing secondary fluorescence to be offered.

Low Angle Data	Capable to collect high-quality data starting at angles as low as 0.15° 2Theta.

VI. SAMPLE STAGES

Sample stage type	- Computer-controlled rotating sample stage with the ability to control & vary the rotating speed for orientation studies with suitable motors. This stage should facilitate both reflection & transmission measurements with sample horizontal. - Capable to accommodate samples of different thickness with minimum 10 numbers of sample holder (for spinning and non-spinning)
Sample stage for stress, texture and thin-film study	Motorized Chi (-3° to +90° or better) and Phi rotations and Z translations suitable for common thin film, texture or residual stress samples and other samples with load capacity minimum 250 g.
	Optional item: The basic high-resolution thin film attachment should include incident Ge (220) channel-cut monochromator to remove K▪ 2doublet.
For small samples	Silicon zero background sample holders to hold small sample size (150 mg) – flat and cavity type or equivalent, 2 No's each should be supplied which can be used with a rotating sample stage.

VII. SAFETY AND RADIATIONENCLOSURE

- The XRD system must be fully radiation protected as per the international radiation safety norms.
- The offered XRD system must comply with the requirements of the Machinery Directive 2006/42/EC for European Manufacturer or the equivalent norm for non-European Manufacturer.
- Open & Close Door System (with a Pb-contained Acrylic Resin Windows)
- Lead equivalent: 0.5mm Pb equivalent.
- Warning Light: Installed independently on the top of the Radiation Enclosure.

VIII. SOFTWARE

- The PC based software must be capable of both qualitative and semi-quantitative analysis; and easy simulation and automatic refinement / smoothening of measured data.
- The system should have provision for interfacing with computer and data analysis software shouldbecapableofsimultaneousdatacollectionandcarryouttheanalysiswitha minimum of five multi-user protected licenses for independent systems. The software should have a facility for remote operation and diagnostics of the instrument.
- Highly integrated software from XRD manufacturer employing various profile fitting techniques for working on below applications should be offered under options.
- Single Line Fitting up to Whole Powder Pattern Fitting.
- Whole Powder Pattern Decomposition
- Structure determination with features like Fourier series, Charge Flipping etc. and refinement by features like Rietveld method, Two-Step Method, Rigid body, preferred orientation corrections etc.
- The software should work with Fundamental Parameters methods – line profile, shape analysis by fundamental parameters approach (FPA) or equivalent.
- Quantitative phase analysis with various whole pattern methods for amorphous as well as crystalline phases by employing Rietveld, Internal Standard, External Standard, phases with known or unknown structure. Measurement and data collection with variable counting time feature should also be a part of the software.

- The diffraction data may be capable of peak search, k-alpha1 and k-alpha2 separation, integrated intensity calculation, multiple recording of raw data files, measurement condition display and editing, data conversion to ASCII and general text format output as colour-coded diffraction profiles, reflection lists, or as raw data files, or in ASCII/ CSV forms, and exportable to popular platforms like MS Excel. The offered data acquisition software should run on Windows platform format for additional user manipulation.
- The software should be enabled with the latest Rietveld algorithm for standard-less quantitative analysis.
- The manufacturer must offer their licensed software developed by them with certificates along with media and exhaustive operating manual(s). Licenses for all the databases and computational software should be for a minimum of five years with updates. Periodic updates of all software should be provided free of cost for a period of a minimum of five years.
- Latest ICDD Database with Minimum five User 5 years License must be offered.
- The application software package for residual stress and texture (pole figure) and orientation distribution function (ODF) must be included with a suitable application-oriented attachment for residual stress and texture measurement.

Annexure -19

Atomic Absorption Spectrometer

General Specifications:-

S No	Technical Parameter	Specifications
1	Atomizer System	1. The system should have software-controlled automatic vertical and horizontal alignment of the flame burner head for optimum light transmission. 2. The system should come with standard 10 cm titanium burner head for Air-Acetylene flame for better absorbance. 3. The system should have software-controlled flame ignition. 4. A suitable air compressor should be available with the system. 5. The system shall have a possibility for direct solid sample analysis or alternate mechanism for 51 approx.51g solid samples.
2	Light Source/ Lamp support	1. The system should have a minimum 4 to 6 lamp holder including Tungsten, halogen, hollow cathode lamps with long life and emission intensity at ≥3000 °C, or equivalent. 2. The system should have a provision of automatic lamp selection, slit width selection, and wavelength selection. 3. The light source should be effective across many wavelengths and stable over its lifetime. 4. The system should have a built-in power supply for all types of lamps.
3	Sample Introduction System	1. A high sensitivity nebulizer system including impact-based and flow spoiler with corrosion resistant against the acids. 2. Corrosion-resistant spray chamber.
4	Optical system/ Monochromator	1. A true double beam spectrometer system with high light throughput. 2. Monochromator system with diffraction grating ruling density with at least 1800 lines/mm blazed in both the UV and Visible regions. 3. A focal length of minimum 250 mm and a reciprocal linear dispersion of 1.6 nm/mm. 4. Variable slit width between 0.2 to 2.0 nm with automatic slit selection. 5. The system should have the maximum light transmission for the best detection limit with least maintenance and with updated technology like fibre optics for transmission of light. 6. The system should automatically adjust to changes in lamp intensity for stable baselines and compensates for drift multiple times per second. 7. The system should have a fast start-up and exceptional long term stability without recalibration. 8. 4-step bandwidth selection with automatic switching – 0.2, 0.7, 1.3, 2.0
5	Detector	The system should have P.M.T Detector with high quantum efficiency. The system should have operator selectable read time from 0.1 to 120 sec.
6	Wavelength	185 – 900 nm or better.
7	Background Correction system	High-speed continuum source (Deuterium lamp) for Background correction

8	Gas flow system	1. Software controlled flame ignition and automatic changeover of oxidant. 2. Fully software controlled oxidant and fuel gas flow monitoring. 3. All safety interlock built-in and additional features like burner head interlock, nebulizer End cap interlock and drain interlock to be built-in.
9	Sensitivity	> 0.9 absorbance with the precision of <0.5% RSD from 5 second integration for 5 ppm Cu standard for flame operation.
10	Accessories	1. Vapour/Hydride accessory to connect with flame. 2. HCL lamp for suitable elements like Mn, Fe, Ca etc., and high-intensity electrode less discharge lamp for Hg, Se, Pb and As elements. Built-in suitable power supply for these lamps. 3. Individual element standards 1000 ppm. 4. Suitable PC with a colour printer and suitable UPS. 5. Acetylene gas and Argon gas with regulator and purification panel 6. Pyrolytic coated graphite 7. Vapour generator: Continuous flow type for fast determination of hydride and cold vapour formers such as Se, As, Hg, Te, Bi, Sn, Ge at low detection levels 8. Vaporizer to improve detection limits/sensitivity of elements in the test scope. 9. Syringe, Plunger, Sample vials 1.1ml, Sample vials 2ml, Capillary assembly, Cuvettes, T-cell for mercury and arsenic and Gas purifiers. 10. Oil-free Air compressor.
11	Warranty	3 years
12	Voltage stabilizer	15 KVA Voltage stabilizer
13	Power supply	Shall be suitable for operation on 220 V-240V and 50/60 Hz mains power
14	Safety features	The system should include are-circulating water chiller/cooler(below0°Cand>3Lofwater; compatible with 220 V-240 V power requirement) also includes a safety system capable of controlling the cooling water (in terms of heat and pressure), gas pressure, mains power, furnace block and over current.
15	Training	Hands-on training through an authorized representative shall be provided to users at purchaser's site for the safe operation of the Instrument including details of hardware components, OS, application software, calibration checking, analysis of various standard specimens and others, troubleshooting, report generation, data transfer and saving the spectra and composition results to other computers through USB.
16	Certificates/ Manuals	1. ISO Certification. 2. User's manual of the instrument that includes safety instructions during operation and maintenance of the instrument.

Annexure -20

Inductively coupled Plasma Atomic Emission Spectrometer (ICP-AES)

General Specifications:-

1.	PLASMA GENERATOR
a. **RF Generator**	Solid-state generator with less warm-up/Startup time
b. **Frequency**	Crystal controlled40MHz/ 27 MHz with stability better than 0.01%
c. **Power**	Computer adjustable from 800 - 1550 watts for 40MHz/1400-2000wattsorwiderisbetterfor 27 MHz
d. **Controls**	Fully computer-controlled with programmable power, start and shut down of the plasma.
e. **Gas flow controls**	Computer-controlled mass flow controllers for all channels should be available for control of the flow rates of Plasma, Auxiliary, Nebulizer gas
f. **Plasma mount**	Plasma should be vertically mounted & radially viewed
g. **Re-circulating Chiller**	The external chiller with details should be provided for an external need for RF coil cooling,
2.	**OPTICAL SYSTEM**
a. **Wavelength range**	165 to 770 nm
b. **Grating**	Original, ion etched holographic grating/Echelle cross dispersion with ultra-violet fused silica prism
c. **Focal length**	More than 0.5 meters for holographic grating/ More than 0.32 meter for Echelle grating
d. **Entrance slit height**	Maximum to view complete plasma height in one shot
e. **Optical Resolution**	Better than 10 pm up to 320 nm OR (7 pm at 200 nm or better)
f. **UV purge**	Nitrogen/argon purge/gas sealed for 165 to 190 nm.
g. **Stabilization**	The temperature of the optics should be internally regulated to ≤ 2° C
h. **Grating density**	More than 50 lines/mm for Echelle grating/more than 2000 lines/mm for holographic grating.
3.	**DETECTION SYSTEM**
a. **Type**	CID/CCD/PMT
b. **Dynamic range**	Greater than 5 orders of magnitude
c. **Cooling**	If CCD is used it should be cooled internally with multistage Peltier
d. **Range**	Spectral range from 165 to 770 nm OR 167 to 853 nm
e. **Blooming**	The detector shall not be subject to any blooming effect from nearby wavelengths, or excess concentrations.
4.	**SAMPLE INTRODUCTION**
a. **The kit which includes a torch, spray chamber, nebulizer & tubings**	1. Aqueous Kit 2. High Solid Kit 3. HF Kit 4. For Organic Kit
b. **Sample pump**	More than 10 rollers peristaltic pump with 3 or 4 channels. Computer-controlled rinse and flush times, as well as computer-controlled sample flow rate.
5.	**PLASMA TORCH**
a. **Torch type**	Completely demountable and vertical mounted

b. Alignment	It should be possible to remove and replace the torch, spray chamber, nebulizer etc.
c. Viewing height	Maximum plasma should be viewed at once, to minimize interferences.
6.	**COMPUTER SYSTEM AND SOFTWARE**
a. Configuration	The configuration of the computer should be suitable to the unit supplied with a 21 inch full HD monitor. An optical mouse, optical keyboard and laser printer.
b. Software	1. The software must provide preprogrammed conditions for a variety of matrices. 2. The software must provide optimization by the element of sensitivity, speed and precision based on user's input. 3. Database availability and provision in the software for matrices, elements run most often and standards also. 4. The software must allow for both the export of data and import of sample details in a suitable format. 5. Software shall provide a library for maximum emission lines in all orders.
7.	**INSTRUMENT PERFORMANCE**
a. Precision	The in-run precision for a suite of 3 elements Pb, Al, Cd at 1 ppm shall be less than 1.5% Relative Standard Deviation (RSD).
b. Stability	The ICP spectrometer shall be able to demonstrate an RSD of less than 2% for all elements.
c. Precision and stability with dissolved solids	The ®CP must be able to demonstrate running a 20% NaCl solution for more than 4 hours without clogging, and achieve a precision of less than 5% RSD for 5 ppm Pb solution and be able to get a Limit Of Detection (LOD) of less than 10 ppb for Pb using the 20% NaCl blank solution.
d. Radial Detection limits	The instrument shall offer < 10 ppb detection (LOD) at 3 sigma with a RADIAL ICP.
8.	**CONSUMABLES KIT**
a.	**Should contain:** Torch tubes for HF application, High Solid applications and aqueous applications.
b.	Tubing for each of the above applications.
9.	**AUTO SAMPLER AND HYDRIDE GENERATOR**
a.	Random access auto-sampler for unattended analysis, with auto-shutdown at end of batch analysis for samples.
b.	Hydride generator for an increase in sensitivity for hydride forming elements.
10.	**OTHER ACCESSORIES TO BE SUPPLIED**
a.	Suitable fume exhaust system
b.	Swagelok dual-stage regulator.
11.	**WARRANTY -** Three years
12.	**STANDARDS** A set of standard solutions for the system calibration with NIST traceable certificate should be supplied.

13.	**TRAINING** Should be provided after installation. The training should be for a period of one week covering all aspects of the software.
14.	**UPS** Suitable UPS should be provided

Annexure-21

Hardware Based Forensic Imaging Device

General Specifications: -

S.No.	Tool/Facility	Specifications
1.	**Hardware Imaging Device** • **Write Blockers Kit** • **Tableau Duplicator** • **Falcon**	• **WRITE BLOCKERS KIT** The kit should have the blocker devices for the storage media having the interface of SATA, IDE, Firewire USB2, USB3, e-SATA, Micro-SATA, Combine SATA and ZIF, and SAS (Serial Attached SCSI) along with their respective connecting cables. • **TABLEAU DUPLICATOR** Image SATA, USB 3.0, and IDE hard disks natively Image SAS drives with the SAS Expansion Module Standard operations: Disk-to-Disk (clone) duplication Disk-to-File (image) duplication Format, Wipe, Hash (MD5 or SHA-1) HPA/DCO detection and removal Blank Disk Check • **FALCON** 1. Capable to acquire/clone data from one-to-one, two-to-two destinations media. 2. Capable to acquire/clone data at the rate of 5GB/Min. (or more). 3. Capable to acquire/clone data in Drive to Drive, Drive to Uncompressed segmented files and Drive to Compressed segmented files format to support analysis in various forensic analysis tools. 4. Capable to cross copy support to IDE, SATA, eSATA, micro SATA, SCSI, SAS, ZIF and USB interfaces and combine-SATA etc. 5. Capable to authenticate the data with at least two hashing algorithms. 6. Capable to identify and acquire HPA and DCO Areas of the suspect media. 7. Capable to acquire data directly from the live system/content-based image. 8. Capable to boot/Mount the suspect media virtually in a write-protected environment from the preview of live data. 9. Capable to acquire data from suspect RAID (all RAID Configuration) drives. 10. Capable to acquire data over a network. 11. Capable to generate the log of the processes. 12. Capable to search for the keywords in the suspected media. 13. Preloaded operating software.

Software for previewing, Imaging and analysis of digital Media (Encase software)

General Specifications:-

SNo.	Tool/Facility	Specifications
1.	Software for the Forensic Previewing Imaging and Analysis of Digital Media (Encase Software)	1. Should support preview of suspect media. 2. Should support acquire data from various types of storage media. 3. Should support acquiring data in multisession. 4. Should support various operating systems viz, Windows, Linux, Unix, Sun Solaris, Macintosh, Apple's iOS, Android OS, Blackberry OS, HP's Palm OS, Nokia Symbian, Windows Mobile OS etc., 5. Should support automated processing of evidence with the capability to indexing, auto de-NISTing, file signature analysis, hash analysis, Protected File signature analysis, hash analysis, Protected file analysis, Expand compound files. File parser for Emails (PST, NSF, DBX, EDB, AOL, MBOX), extract internet artifacts, timeline analysis, System Info Parser, IM Parser (AOL, MSN, Yahoo), File Carver, Windows Event Log Parser, Windows Artefact Parser, Unix Login, Linux Syslog Parser, etc. 6. Should support decryption of disks, volumes, folders and file of the suspected media having various types of encryption. 7. Should support custom programmes for processing of data. 8. Should support various file formats for viewing the data. 9. Should support iOS Physical image analysis. 10. Should Support 64 bit systems.
2.	Software for the Forensic Previewing Image Mounting Password Cracking and Forensic Analysis of Digital Media (FTK 6 M/S. Access Data)	1. Should support windows, Apple, UNIX and Linux operation system for analysis of the media. 2. Should support RAM analysis. 3. Should Support PLIST, SQLite database, Apple DMG and DD_DMG disk image and JSON file, etc. 4. Should support Automated processing of evidence with the capability to indexing, auto de-NISTing, Recover files and partitions, detect deleted files, file signature analysis, hash analysis, Recover Folders, Expand compound files, parse Email. Databased, extract internet artefacts, timeline analysis, system Imfo Parser, IM Parser (AOL, MSN, Yahoo), File Carver, Windows Event Log Parser, Windows Artefact Parser, etc. 5. Should support the registry log analysis. 6. Should support auto-detection of password-protected files, decryption of various types of encrypted files. 7. Should support the generation of CSV based reports for timeline analysis. 8. Should support automated explicit image identification by skin tone analysis. 9. Should support automated file indexing and statistical report generation of each file type. 10. Should Support auto carving of files and adding the carved files to the file tree structure.

3.	Forensic Tool Kit for Incident Response of Digital Crimes (VPER Kit)	1. Mobile workstation: • Processor: Intel Core™ i7 (3920XM) • Operating System: Windows 7 Ultimate 64-bit or latest version • Memory: Up to 32GB2 DDR3 SDRAM at 1600Mhz or higher • Chipset: Mobile Intel ® QM77 Express Chipset • Video Card: NVIDIA Quadro K5000M with 4GB GDDR5 dedicated memory • Display: 17.3"FHD(1920x1080), Premier Color technology, IPS, with a view, anti-glare, LED-backlist. • Hard Drive: One TB SATA hard drive. • Optical Drive: DVD-ROM, Slot load DVD+/RW, Blu-ray Disc writer; • Connectivity: Wired: Integrated Intel 82579M/V 10/100/1000 Gigabit Ethernet Bluetooth: Wireless • Should have the facility for hard drive swapping 2. The Kit should have Following tools for search, seizure and analysis of digital evidence. • Hardware Forensic Duplicator • Write-Blocker Kit • Incidence Response Tool for live acquisition of RAM, system Profile, etc. on site. • Digital Evidence Analysis Tool. • Mobile Phone Forensic analysis tool including SIM Cards • Digital HD Video Camera etc.,
4	Portable Imaging Device for Incident Response (Encase Portable M/S Guidance Software)	1. Should have the inbuild blocker device for the source drive. 2. Should support the disks of various interfaces like IDE, SATA, ESATA, FIREWIRE and USB devices. 3. Should have the facility to Disk to Disk duplication with a facility of compression. 4. Should have the facility to Disk to File duplication with e01 and .ex01.' 5. Should compute and verify the hash values with at least two hashing algorithms. 6. Should have the facility to format./wipe/black check the destination drive. 7. Should have the facility to display, print, and save logs. 8. Should have a user-friendly GUI screen. 9. Should have the facility to use the device as a remote write blocker.
5	Forensic Triage Tool Kit	1. Preview and acquire full disk, targeted data, support Image formats of AD1, E01, RAW, or SMART. 2. Acquire data from a live system with an active USB port. 3. Manual mode to search the file system/data prior to collection. 4. Pre-configured options for reporting on collected data. Support to collect data from Chrome Browser History, Default Browsers, Firefox Browser History, Internet Explorer History, Internet Explorer Registry Keys, Typed URLs, Recently Accessed media Player Files, Local Network Connections, Remort Share, IP Addresses, Application Usage History, Installed Software, Program Files Software, Start-up Programs, Clipboard Data, Device Drives, Memory Dump, Processes, Scheduled Tasks, Screenshot, Services, User Accounts, User Groups, Acquire Registry, System Information, Typed Paths, USB Devices, Users, Owner Information, SAM User etc.

6.	Digital Forensic Tool Kit for the Analysis of the Various Internet Artifacts, Browsers (Magnet(IEF) Internet Evidence Finder Magnet Forensic Inc, Canada)	1. Run directly from the USB thumb drive without having to install the software on the target computer. 2. Mount & Serch volume shadow copies on a live system, at the logical or physical level. 3. Save all results directly to the thumb drive. 4. Automatically check for disk encryption including Truecrypt, PGP, Bitlocker and SafeBoot. 5. Built-in live RAM capture. 6. Should be able to collect/ parse/ carve/ recover artefacts left behind live/ offline system when using. • Cloud Artefacts line Dropbox, Carbonite, SkyDrive, Google Docs, Google Drive Flickr Social Networking Pages like Facebook, Twitter, Bebo Chat, Myspace Chat, Google+, Linked In • Webmail Applications like Gmail Email, Yahoo Webmail Email, Hotmail Webmail Email • Instant Messenger Chats like Google Talk Chat Messages, Yahoo Chat Messages, MSN/ Windows Live Messenger Chat Messages, messenger Plus Chat Logs, AOL Instant Messenger (AIM) chat logs, mIRC Chat logs, Skype, ICQ, World of Warcraft, Second Life, Trillian • P2P File sharing Application line Linewire, Frostwire. Props Files, Gigtribe Chat Messages, Ares P2P Search Keywords, Shareaza Search Keywords, eMules. Torrent File Artifacts • Web Browser Activity from Internet Explorer History/Recovery URLs, Firefox History, Google Chrome History, Apple Safari, Opera, Google Maps, Browser Activity-Chrome Incognito/Firefox Private Browsing.
7.	Forensic Software for the Analysis of Mac System (Mac Forensics Lab M/S. Mac Forensics Lab Inc, USA.)	• Analyze Mac OS and dual-boot disk and partition images in multiple formats • Analyze configuration and log files from common OS applications, such as Mail, Safari, iChat and Address Book. • Perform rapid searches using metadata. • Gathers comprehensive machine usage information. • List detailed information about every iPod and iPhone that has been connected to the machine. • Detect VMWare, Virtual Box & Parallels Virtual Machines. • Detect and analyze File Vault-encrypted user directories. • Support dd, EnCase, FTK, AFF, and Apple disk images. • Should run on Microsoft Windows OS as well as Mac OS. • Full support for Mac OS both as an analysis machine and an investigative target. • Analysis of iCloud configuration Data

Annexure-23

Software/Hardware for analysis of various types of mobile phones, SIM cards, Memory cards

1	Software Based Tool Kit for the Logical Level Analysis Of GSM/ CDMA Mobile Phones (Universal Forensic Extraction Device (UFED) Link Analysis)	• Should extract phone basic information and SIM Card data. • Should extract phone book and contact list, Call Logs, caller group information, organizer, notes, SMS messages (live & deleted). Web-browser artifacts, multi-media messages with attachments, e-mail messages with attachments, multi-media files (images, audio & video files), details of installed applications and their data, traffic and sessions log. • Should support timeline analysis, GEO event positioning analysis, skype parsing, SQLite database parsing, list parsing. • Should support iPhone backup analysis, blackberry IPD backup analysis, DMG parsing. • Should Support for parsing the password-protected iPhone backups. • Should support link analysis. • Should support Social Networking data analysis. • OEM Connectors cables.
2.	Hardware Tool Kit For The Physical/ Logical Level Analysis Of GSM/CDMA Mobile Phones & Sim Cards (UFED Touch 2 M/S. Cellebrite)	• Should Support physical and logical analysis of various mobile phones working on the various OS platform. • Should Support physical analysis of password-protected, jailbroken, non-jailbroken, encrypted and non-encrypted iOS devices. • Able to bypass PIN, passcode lock, pattern lock from the mobile equipment. • Support to GPS devices. • Able to extract all data (call logs, phone book, SMS messages, e-mail messages along with attachments, MMS messages along with attachments, calendar, multi-media files, passwords, location information, audio and video files etc.) • Able to perform timeline analysis, image carving, conversation view, SQLite database parsing. • Should support for physical memory dump and file system dump. • Should support for SIM Card reading, extract SIM related info along with user information line phone book, call register, text messages (Active and Deleted) and SIM Card cloning to bypass PIN. • Should support for data authentication by hashing algorithms.
3.	Mobile Phone Forensic Analysis Tool Kit For the Physical Logical Analysis of Chinese Mobile Phones (UFED Chinex M/S. Cellebrite)	• Should support mobile phones working on Chinese chipsets like MTK, INFINEON, SPREADTRUM, etc. • Should support low-level data extraction from.bin files. • Should support the interpretation of low-level data into a readable format. • Should recover deleted phone information. • Should recover/ bypass passwords. • Should extract internet artifacts and GPRS activity.

4.	Digital Forensic Tool Kit for the Physical Imaging and Analysis of SIM Card Memory (Paraben SIM Card Seizure Paraben Corporation, USA)	• Read-Only Access to system and user data held on the SIM card. • Able to handle PIN and PUK. • Present data in an easily readable format. • Authentication by MD5/ SHA hash. • Support for multi-language text messages. • Recover deleted SMS messages.

Password Cracking Tool for Decrypting the Password Protected Files

Password Cracking Tool for Decrypting the Passwords Protected Files (Passware Kit Forensic)	• Recover passwords for various file formats and decrypt encrypted hard disks. • Should support batch file processing. • Able to scan computer and network for password-protected files and decrypt the same. • Acquire memory images of the seized computers. • Able to recover User Login passwords. • Able to run from a USB thumb drive and recover password without installation on a target PC. • Able to reset the password for Local and Domain Windows Administrators instantly. • Able to recover encryption key for hard disks protected with BitLocker, including BitLocker ToGo, TrueCrypt, FileVault2 and PGP volumes. • Able to recover password for Windows user from a memory image or a standalone SAM file, iTunes backups: both iPad and iPhone. • Able to recover passwords from email, websites and network connections from standalone registry files. • Able to extract passwords from encrypted Mac keychain files.

High-end configuration Server and Workstations for backup and analysis

General Specifications:-

Technical Specifications for Localized Server	4U Rack Mounter Server with the following Components: **FILE SERVER:** • Multi-core Neon Processor with 8 cores per processor or better • Total RAM Memory 256GB with the provision of scalability to 512GB • Total File Storage Memory of 200TB by RAID6 configuration in SATA based Secondary Storage Media with provision for future storage expansion. • Support remote acquisition. • Backup support into latest LTO Tapes with backup / archival software. • Cabling with Data Transfer Capability of 10Gbps among file Server and Processing Server and Work Stations. • Latest Microsoft Windows Server Operating System or suitable OS for the management of the File Server. • Sufficient Modular Power Supply • Integrated Dual Modular Battery Backup for uninterrupted Power Supply. • Integrated Modular Cooling System for better heat dispensing. **PROCESSING SERVER:** • Multi-core Xeon Processor with 10 cores per processor or better • Total RAM Memory 512GB with Provision of scalability. • SSD based Processing Storage of 512 GB with the provision of scalability. • Facility to create custom Virtual Desktops with varying configuration by visualization • Support to minim 25 clients with scalability. • Support Sharing of Digital Forensic Tools over LAN • Cabling with Data Transfer Capability of 10 GBPS among File Server and Processing Server and Work Stations. • Latest Microsoft Windows Server Operating System or suitable OS for the management of the Processing Server. • Sufficient Modular Power Supply • Integrated Dual Modular Battery Backup for uninterrupted Power Supply. • Integrated Modular Cooling System for better heat dispensing. • Integrated GPU supporting the processing of data by Digital Forensic Tools and decryption related activities. • Integrated Modular Monitor with Keyboard and mouse provision for the management of the Server via user console management. • The server should have sufficient no. of USB 2/3 ports along with USB C-port. • Fibre-based LAN to support up to 10 Gbps data speed between server locations to workstations. • Minimum of 3000 VA rack-mounted integrated dual power supply via UPS. • Warranty for 03 years with lifetime free servicing.

Generalized specifications for workstation:

1. CPU	Intel ® Xeon ® Processor E-5-2650 v2/v3, 2.6 GHz 20 MB L3 cache or higher
2. Chipset and Mother Board	Intel C 602 or better
3. Memory	08 GB DDR3 1600MHz expandable to 256GB or better
4. Hard Disc Drive	1x1000 GB SATA HDD at 7200 rpm upgradable to 2 HDD or better
5. Storage Controller	SATA Controller RAID Support 0 & 1
6. Key Board	Standard Keyboard
7. Mouse	Optical Scroll Mouse
8. PCI Slot	5 PCI/PCI Express including 2 PCI Express x 16 for Dual Graphics and TESLA Card support
9. Bays	Total bays (2 internal and 2 external)
10. Ports	5 USB 2.0, 2 USB 3.0, rJ-45, audio in, audio out, mic in
11. Cabinet	Mini tower
12. Optical Drive	8 x DVD writer
13. Networking Features	Integrated 10 / 100/ 1000
14. Operating System	Microsoft windows i.1 Professional 64 Bit or higher
15. OS Certifications	Windows and Red Hat or SUSE Linux or Ubuntu Linux
16. Applications	As per list enclosed at Annexure-A OEM Certification for (a) Digital Content (b) Electronic Design automation (EDA_ and (c), Mechanical Computer-aided Design (MCAD) from OEM Manufacturing workstation shall be acceptable.
17. Safety Certification	As per IEC: 60950-1 / IS:13252 with all amendments up to date
18. Power Supply	230V + / - 10% single phase, 50 Hz AC
19. Power Management	ACPI (Advanced Configuration and Power Management Interface)
20. Bundled Software	System Health monitoring tool available with H/w box
21. Security	Integrated panel lock or padlock

Hardware/Software for Audio Analysis

General Specifications:-

1. Forensic Audio Examination Hardware and Software System

Capture of Audio

- Facility for minimum 4 – Channels input or above to collect audio signals simultaneously from various devices.
- Facility for minimum 4 – channels output or above, line and speaker, headphone output.
- Frequency response for both AC and DC mode – 20 Hz – 50,000 Hz.
- Dynamic range should be greater than 90 dB.
- Support the sampling rates 8,000 – 50,000 Hz or better for analysis of higher frequency signals for research and case analysis purpose.
- Inbuilt features for accurate voice signal capture such as the use of low-latency ASIO drivers, high gain pre-amplification and anti-alias filtering.
- The facility of Software Interface card with Audio Stream Input and Output (ASIO} and Multi-Media Extensions (MME}.
- Facility for segregation of Audio from different formats

Noise reduction of Audio

- The facility of Digital Interface card with AES/EBU or S/PDIF connectors and support various audio formats
- Ability to offers signal-to-noise performance typically superior to generic sound cards.
- Facility for Signal Normalization
- Facility for AC coupling to removes low-frequency components.

Audio features extraction, analysis and display

- Facility for waveform, FFT, LPC Spectrograms/spectrums & power spectrum
- Facility for Pitch, formant extraction and Cepstrum analysis
- Facility for energy and power spectrum
- Support the Windows XP or better operating system.
- Statistical analysis and display of features

2. Audio enhancement and authentication Hardware/ software

- Capture Uncompressed/compressed audio data from a variety of sources.
- Capability to support major audio formats
- Audio stabilization.
- Facility for pre processing and enhancement of Audio signal using different filters such as adopting filtering, filter averaging, filter compression and equalization etc.,
- Facility to determine the authenticity of the audio

Hardware/Software for Video Analysis

General Specifications:-

Forensic Image& Video Enhancement and Analysis System

- A computerized system with preloaded software.
- Capture Uncompressed/compressed audio-data from a variety of video sources including CCTV.
- The system should have editing features such as crop, flip, rotate, re-size, deinterlace
- The system should have the capability to extract and compare the frames.
- Pre-processing of the video signal and image clarification.
- Video de-multiplexing and stabilization.
- Process Digital (DVR) or Analog Video Evidence.
- DVR security video-decode digital video (DVR) files from proprietary security systems into the uncompressed video.
- Enhance dark video and poor quality video security and surveillance video.
- De-interlace field recorded forensic video to avoid blurry stills printed from video frame averaging.
- Facility for enhancing image/video by Laplacian filtering, Gaussian, Bilateral, Wiener, Deblocking filters or other suitable filters for forensic applications.
- Support for enhancement/Noise suppression (Signal SNR up to 4dB).
- Variable slow motion speed adjustment to compensate for time-lapsed video.
- The system should be compatible with digital and analogue video, still image and should be scalable with different modules.
- The system should have the facility to analyze with photogrammetric tools and measurement tools.
- Suitable hardware to meet the above requirement.

Annexure-28

Facial recognition Software

General Specifications:-

- Facial Capturing from different media & pre-processing.
- Creation of photo like composites
- Generation of unique alphanumeric code for every composite.
- Three-tone hair colour, side to side hair flip.
- Data Generation of Facial markings: scars, moles, piercing, tattoos.
- Facility for improvement of age progression.
- Detachable hats and headwear facility.
- Ability to export composite as JPEG file and in other image formats
- Side by sideshow I comparison capability.
- Improved zooming and positioning tools.
- Runs on any standard desk or laptop computer.
- Analyze the static Images
- Full or partial face identification.
- Capable to detect and register the numerous characteristic of each face.
- Capable to store, retrieve and compare the facial features from the database and display matching score.

Annexure-29

Image Analyser Software

General Specifications:-

- Should support Windows 10.
- Should support JPEG, BMP, TIFF, PNG, RAW image file formats.
- The software should have the capability of extracting EXIF metadata of the image.
- Capability to of creating camera fingerprint by identifying pixel non-uniformity (PNU) of the images from a set of test shots which were caused by the fixed pattern noise(FPN) and the photo-response non-uniformity noise (PRNU) of the sensor.
- Variable crop size, pixels and location for PNU identification.
- Comparison with a digital image in question and auto-generation of the comparison result.

Multispectral Imaging system (VSC)

General Specifications:-

Comprising	High-Resolution CCD/ digital FireWire Color Camera of 1.3 megapixel and above Camera Spectral Response range 69 approx.. 350 – 1100 nm Hyper Spectrometer
Optics	30" flat screen monitor Magnification up to x170 Field of view 69 approx. 200 x 150 nm
Illumination	Long Wave incident UV at 365 nm Medium Wave incident UV at 312 / 313 nm Short Wave incident UV at 254 nm Long Wave transmitted UV at 365nm Visible & IR Incident High-Intensity Light Visible / Infrared Transmitted Flood Light IR illumination for Anti-Stokes features detection IR Luminescence
Software (SW)	ICAO data reader Hidden Image Decoder Histogram Stretching Case Work Side By Side Comparison Of Live & Stored Image Color Measurement to measure color Coordinates Comparison of spectrum for whole UV, visible & NIR region Split Screen for simultaneous ink analysis on two separate documents Calibration procedure including measuring statistics, image analysis, Processing and reporting P.C operating system Windows X-Y translator Stage, Polari safe viewer for UV
Image Comparison & Transformation	Superimposition of Live and stored image with the adjustable mix, 0 to 100% Variable Speed Image storable between a live and a stored image Left to right image reversal (Horizontal image reversal) Top to bottom image reversal (Vertical image reversal) Grey level reversal (Positive to negative) Image rotation through any angle Contract / Stretch Image processing, Image quality enhancement filters, Multi-layer imaging, IPI decoder, OVI viewer, MRZ decoder
Image Measurements	Distance between two points The area within a user-defined box The radius of a circular feature from three peripheral points The angle between two lines Area of user-defined shape Area of selected features i.e. An alphanumeric character or logo
Data Base	Passport database with a free update for the next 5 years Bank Note database with a free update for the next 5 years
Computer Hardware	Compatible Computer hardware for the high-resolution spectral comparator of the latest version is to be quoted.

Annexure -31

High-resolution Spectral Comparator (HRSC)

General Specifications for High-Resolution-Hyper Spectral Comparator System

1. High-resolution Hyperspectral comparator System with High-Resolution CCD/digital FireWire Color Camera with suitable resolution in Megapixels to have a high-quality image to avoid blurry and pixelated image, Camera Spectral Response range 70 approx.. 400 or less to 1000 rim or more.
2. The System must have UN illumination facility for examination of UV activated features, erasures, substrate, fluorescent and phosphorescent inks with Long Wave incident UV (365nm or more), Long Wave transmitted UV (365nm) light source.
3. The System must have facilities for examination and discrimination of inks, the examination of erasures, obliterations, additions, deletions, security threads, micro printing, overt and covert (Active and Passive features) security features in the Passports, Bank Notes, Travel documents; the system must have Visible & IR incident High-Intensity Light, Visible/Infrared Oblique/side Light, Visible/Infrared transmitted light, Spotlight source.
4. The System must have visible range light source as well as the provision of transmitted and oblique light source for examination of watermarks and other surface features.
5. The System must have Visible/Infrared Co-axial light provision for the examination of retro-reflective security printing features.
6. The System must have facilities for Hyper Spectral Imaging for precise Ink Examination/discrimination and Image integration.
7. The System must have the facility for examination/viewing and recording of OVD/DOVD/Holograms.
8. The System must comprise arrays of visible range filters, low and high bandpass filters suitable for examination of forensic documents.
9. The System must have suitable wide-field IR illumination assembly for viewing/examination/detection of all Anti-Stokes features.
10. The System must have polarized light for verifying birefringence security features.
11. The System must have ICAO data reader and other ICAO compliant features, Hidden Image Decoder, Histogram Stretching.
12. The System must have 'Case Work Management' provision.
13. The System must have the facility of Image Comparisons such as side by side comparison of Live & Stored Image, Superimposition of live & Stored Image, image transformation and Image annotation provision.
14. The System must have Colour Measurement to measure colour Coordinates.
15. The System must have the facility for Comparison of Spectrums for whole UV, Visible & NIR region.
16. The System must have the facility of spectrometry for measurement of absorption, reflectance, transmission and fluorescence spectra.
17. The system must provide Calibration procedure/function.
18. The System must have the provision of full range examination of the document i.e. under various light sources and suitable magnification with an enhanced field of view along with image storage and retrieval facility.
19. The System must have UV polarized light viewer for special UV features with UV safety locks provision.
20. The System must have Variable speed image storable between a live and stored image, Left to right image Reversal (Horizontal mirror reversal), Top to Bottom image reversal (Vertical mirror reversal), Grey level reversal (Positive to negative), Image rotation through any angle, Contract/Stretch.
21. The System must have the facility of Image processing, Image quality enhancement filters, Multi-Layer imaging.
22. The System must have IPI/ICI Decoder, OVI Viewer, Latent Image visualizer, Barcode reader (1D/2D), OCR, Smart card reader, and other formats of Barcodes, MRZ decoder along with suitable filter light source and software.

23. The System must have the facility of Image measurement facility (software) for measuring the distance between two points, Area within a user-defined box, Radius of a circular feature from three peripheral points, Angle between two lines, Area of user-defined shape, Area of selected features i.e. an alphanumeric character or logo.
24. The System must have Passport, Bank Note and other security documents Database with the assurance of regular update.
25. The system must have Software to control and run various functions and applications of the Spectral Comparator during the course of examination as well as handling of the instrument along with the facility for updating in future.
26. The System must have suitable & efficient hardware and software components to cater & address the aforesaid forensic needs and mentioned parameters of analysis as well as must-have working platform/area, sufficient field of view, optical and digital zoom to enable effective & convenient examination of large-sized documents consisting of extensive data to be examined.
27. The System must have a compatible Computer System with latest windows version and with latest color printing facility and a minimum 30" flat widescreen monitor or more.
28. Consumable and Spare Parts/Accessories for five years use of equipment as per the Standard Practice of manufacturer/firm must be provided with the system.
29. Warranty: Three (03) Years.
30. AMC: Supplier shall undertake to enter into AMC of the equipment on payment basis after the warranty period.
31. The facility of service centre should be available in India.
32. Operational training of seven working days should be provided by the manufacturer for two scientists at consignee place. Two days of additional training for two scientists in case of upgradation of Hardware/Software, if any.

High-End Computer with Server

General Specifications:-

Technical Specifications for Localized Server	4U Rack Mounter Server with the following Components:
	• File Server:
	  • Multi-core Neon Processor with 8 cores per processor or better
	  • Total RAM Memory 256GB with the provision of scalability to 512GB
	  • Total File Storage Memory of 200TB by RAID6 configuration in SATA based Secondary Storage Media with provision for future storage expansion.
	  • Support remote acquisition.
	  • Backup support into latest LTO Tapes with backup / archival software.
	  • Cabling with Data Transfer Capability of 10Gbps among file Server and Processing Server and Work Stations.
	  • Latest Microsoft Windows Server Operating System or suitable OS for the management of the File Server.
	  • Sufficient Modular Power Supply
	  • Integrated Dual Modular Battery Backup for uninterrupted Power Supply.
	  • Integrated Modular Cooling System for better heat dispensing.
	• Processing Server:
	  • Multi-core Xeon Processor with 10 cores per processor or better
	  • Total RAM Memory 512GB with Provision of scalability.
	  • SSD based Processing Storage of 512 GB with the provision of scalability.
	  • Facility to create custom Virtual Desktops with varying configuration by visualization
	  • Support to minim 25 clients with scalability.
	  • Support Sharing of Digital Forensic Tools over LAN
	  • Cabling with Data Transfer Capability of 10 GBPS among File Server and Processing Server and Work Stations.
	  • Latest Microsoft Windows Server Operating System or suitable OS for the management of the Processing Server.
	  • Sufficient Modular Power Supply
	  • Integrated Dual Modular Battery Backup for uninterrupted Power Supply.
	  • Integrated Modular Cooling System for better heat dispensing.
	  • Integrated GPU supporting the processing of data by Digital Forensic Tools and decryption related activities.
	  • Integrated Modular Monitor with Keyboard and mouse provision for the management of the Server via user console management.
	  • The server should have sufficient no. of USB 2/3 ports along with USB C-port.
	  • Fibre-based LAN to support up to 10 Gbps data speed between server locations to workstations.
	  • Minimum of 3000 VA rack-mounted integrated dual power supply via UPS.
	  • Warranty for 03 years with lifetime free servicing.

Generalized specifications for workstation:

1. CPU	Intel ® Xeon ® Processor E-5-2650 v2/v3, 2.6 GHz 20 MB L3 cache or higher
2. Chipset and Mother Board	Intel C 602 or better
3. Memory	08 GB DDR3 1600MHz expandable to 256GB or better
4. Hard Disc Drive	1x1000 GB SATA HDD at 7200 rpm upgradable to 2 HDD or better
5. Storage Controller	SATA Controller RAID Support 0 & 1
6. Key Board	Standard Keyboard
7. Mouse	Optical Scroll Mouse
8. PCI Slot	5 PCI/PCI Express including 2 PCI Express x 16 for Dual Graphics and TESLA Card support
9. Bays	Total bays (2 internal and 2 external)
10. Ports	5 USB 2.0, 2 USB 3.0, rJ-45, audio in, audio out, mic in
11. Cabinet	Mini tower
12. Optical Drive	8 x DVD writer
13. Networking Features	Integrated 10 / 100/ 1000
14. Operating System	Microsoft windows i.1 Professional 64 Bit or higher
15. OS Certifications	Windows and Red Hat or SUSE Linux or Ubuntu Linux
16. Applications	As per list enclosed at Annexure-A OEM Certification for (a) Digital Content (b) Electronic Design automation (EDA_ and (c), Mechanical Computer-aided Design (MCAD) from OEM Manufacturing workstation shall be acceptable.
17. Safety Certification	As per IEC: 60950-1 / IS:13252 with all amendments up to date
18. Power Supply	230V + / - 10% single phase, 50 Hz AC
19. Power Management	ACPI (Advanced Configuration and Power Management Interface)
20. Bundled Software	System Health monitoring tool available with H/w box
21. Security	Integrated panel lock or padlock

Annexure -33

Computerized Polygraph System (CPS)

General Specifications:-

A. Computerized Polygraph system should be based on verified, standard data/chart scoring software.

1. The software should have the following applications.
    a. System should have Minimum ten(10)channels
    b. Automatic & Manual scoring options
    c. Event markers and integrated question timing
    d. Customizable question templates
    e. Licensed & dispute-free polygraph software should be provided
    f. Free software upgrades during the warranted period

2. Physiological Responses Monitoring should have minimum below channels:
    a. Two Pneumography (one thoracic & one abdominal)assembly
    b. One Galvanic Skin Response (Electro Dermal Response)sensor
    c. One standard cardio arm cuff & finger cuff with pump bulb Gauge
    d. One Plethysmograph
    e. ActivitySensorsforseat,armandfoottomonitorandtorecordphysicalcounter
    f. Fingerprint Scanner through the USB port.
    g. Digital recording through Webcam
3. Data Acquisition System interface
4. Portable Subject Chair
5. Warrantee of Computerized Polygraph System should be of minimum two(02) years from the date of installation at the place delivered laboratory.
6. Instruction Manual of Computerized Polygraph(Hard and soft copy)

B. Computerized Polygraph System should have the following hardware:

a. Latest/compatible Computer configuration is available at the time of delivery.
b. The desktopsystemshouldhaveapre-loadedgenuineAntivirusandWindowsten,PDF writer.
c. Minimum 17-inchMonitor
d. Inkjet Color Printer

Annexure -34

Layered Voice Analyser

General Specifications:-

Layered Voice Analyzer system should have the following specifications:

Hardware:

- Laptop based system with the following specification:
  a. Intel i5 processor or higher
  b. Windows 10 or higher operation system
  c. 1TB Hard Disc or more
  d.4GB RAM or more
  e. 14" inch or more LED display with a carry case for laptop
- Headphone with noise-cancelling facility
- Microphone with noise cancelling facility
- External audio speaker and audio recorder
- USB phone connector with an inbuilt sound card
- Laser Jet colour printer

Software:

- The software should have the following specification:
- The software should be based on the psychological pattern of detection on voice samples
- Real-time analysis and real-time feedback of the voice input
- Option to analyse the pre-recorded voice data
- Ability to identify and measure emotional activities and deception from the voice data
- The software should have forensic case creation and reporting facility

Licensed and software for dispute free usage of the instrument for an unlimited period

Two-year onsite warranty

Note: Specifications proposed in above annexures may vary as modern technology is very dynamic in nature.

GENERAL LABORATORY CONSUMABLES AND INFRASTRUCTURE REQUIREMENTS

Appendix A

General Laboratory Accessories

- Refrigerator (explosion-proof)
- Oven
- Fume hood (for handling toxic and flammable chemicals)
- Biohazard hood (for handling bio hazardous materials)
- Hot plates or heating mantles
- Ultrasonic bath
- Mortars and pestles
- Spot test plates
- Test tube stands
- Test tubes and corks (or screw-cap test tubes)
- Supports (rectangular base with clamps, and ring support with clamps)
- Tubing (regular and thick-walled for vacuum)
- Magnetic stirrer and stirring bars
- Timer/clock
- Silicone grease
- Bunsen burner (with suitable gas supply—can be portable butane/LPG)
- pH indicator paper, 0-14
- Swab boxes
- Paper towels
- Sealing Wax

Glassware

- Beakers, assorted from 5 to 1000 ml
- Erlenmeyer flasks, assorted from 10 to 2000 ml
- Test tubes, length 130 mm, diameter 25 mm
- Desiccators with the disc, vacuum, safety, with screw thread connection stopcock in the lid,
- top ID 250 mm
- Desiccant
- Glass tubing
- Glass rods
- Dispensing flasks fitted with eye-droppers
- Glass stoppers, assorted
- Reagent flasks
- Pasteur pipettes
- Teats for Pasteur pipettes
- Reagent labels

Volumetric measurements

- Graduated cylinders, assorted from 5 to 1000 ml
- Graduated pipettes, assorted from 1 to 10ml
- Volumetric pipettes, assorted from 1 to 25 ml
- Volumetric flasks, assorted from 5 to 1000 ml

Weight measurements

- Analytical balance, 0.1 mg resolution with internal calibration
- Top-pan balance, 0.01g resolution
- Calibration weights
- Weighing dishes (e.g. disposable plastic boats)

Solution preparation

- Beakers, assorted from 10 to 1000 ml
- Conical flasks, assorted from 50 to 2000 ml
- Graduated cylinders, assorted from 5 to 1000 ml
- Electric hot plate/magnetic stirrer unit
- Magnetic stirrer bars (assorted)

Extraction and separation

- Mechanical shaker
- Centrifuge
- Rotary beater
- Soxhlet apparatus
- Thimbles
- Separator funnels 50, 100 and 200 ml
- Funnels for gravity filtration, diameter 40-60 mm
- Buchner funnels for vacuum filtration, diameter 65-85 mm
- Suction rubber adaptor set
- Centrifuge tubes
- Filter paper, assorted from 7 to 12.5 cm
- Large sheet of filter paper and Bench rolls

Distillation and evaporation

- Rotary evaporator
- Water distillation apparatus for the distillation of tap water including a storage container
- Diagonal condenser including a receiving and an evaporating/rotating flask (vol. 1L)
- Round bottom flasks, assorted from 50 to 1000 ml
- Supports for round bottom flask
- Laboratory jacks
- Water bath
- Clamps
- Vortex
- Vacuum pump
- Recirculation chiller
- Disposable face masks in addition to lab coats
- Bio-waste containers
- Sharps disposal containers
- Appropriate buffers for extraction technique
- Cleaning and decontamination reagents such as appropriate preparations of
- bleach and alcohol

For Thin Layer Chromatography

- Glass or aluminium silica gel coated plates (20x20, 20x10, 20x5 cm), with and
- without a fluorescent indicator.
- Developing tanks
- TLC spray box (a cardboard box can be used)
- Atomizers with rubber bellows for spray reagents
- Air blower (to dry plates after sample application or after development)
- The ultraviolet lamp (254 and 366 nm)
- Desiccators for TLC plate storage
- Solvents
- Spray reagents (colour reagents/iodine vapours)
- Glass micro capillary tubes, 2 µl
- Filter paper (for development chamber saturation)
- Multipurpose spotting guide, 20x20 cm
- Reference standards (known compounds)
- TLC plate heater

If no commercial silica gel plates are available

- Spreading table with levelling device
- TLC plate coater/Applicator
- Drying and/or storage rack for 20x20, 20x10 and 20x5 cm TLC plates (temperature
- range 40-250°C)
- Glass plates 20x20, 20x10, 20x5 cm (79 approx.. 4mm thickness)
- Silica gel with and without fluorescent indicator

For Equipment

- Special gases facilities (gas cylinders with regulators, valves, molecular sieves tubes)
- Data processing facilities
- Crimp sealer
- Decapper
- Stainless steel tweezers
- Wrenches
- Vial racks
- Glass vials
- High purity (5.0) gases (H2 , N2, Helium, aitr)
- Derivatization reagents (e.g., MSTFA, BSTFA, TMCS)—optional
- Hot plate/heat block or water bath to warm-up vials.
- Capillary column cutter
- Reference/standard substances and test mixtures
- De-ionized water
- Specific reagents for buffers and mobile phases
- Syringes, 1-3 ml (for sample filtration)
- Syringes filters with the adequate membranes (e.g. 30mm diameter, membrane
    - PTFE, porosity 0.45 µm.
- KBr die (e.g., 13 mm diameter)—for use in halide disc method
- Micro KBr die (e.g., 1.5-3 mm diameter)—for use in halide disc method
- Sample holder
- Demountable cell mounts
- Agate mortar (e.g., 35 mm diameter) and pestle –
- Teflon spacers
- Stoppers
- Paper rings (e.g., for 13 mm die)—for use in halide disc method
- Syringe, 2 ml—for use in Nujol mull method
- Nujol—for use in Nujol mull method
- KBr powder—for use in halide disc method
- Liquid nitrogen

For general physical measurements (including photography)

- Computer, including CD burner and office application software
- Scanner
- Printer
- LAN with Internet access
- High-End SLR camera.
- Photographic software e.g. Adobe Photoshop®
- Rulers (1 metre)
- Tape measure with larger-scale increments for higher visibility in photographs e.g.
- 2-metre x 25mm mini measuring tape – Pocket Style
- Assorted size reference scales (both solid plastic and adhesive disposable)
- Elasticised "hi-visibility" builders string or similar
- Strapping tape or other re-enforced adhesive tape
- Bulletproof equipment such as vests, Helmets, goggles etc.
- Scientific calculator
- Zero base-line protractor

- Spare camera batteries
- Range of lenses (normal, wide-angle and macro)
- Lens brush and lens tissue
- Image storage cards (e.g. compact flashcards)
- Photographic tripod stand
- Light meter
- Flashlight (and batteries)
- Copy stand, with supports for evidential material
- Filters
- Spare camera batteries and/or charger
- Rechargeable hand-held forensic light source with UV and IR capability (with
    - associated coloured and polarized photographic filters and goggles)
- Software for analysis of bloodstain pattern.
- Hand-held metal detector
- Dental stone and plaster of Paris for shoe and tyre prints,
- Bucket, bowls and/or plastic bags for mixing
- Wooden spatula
- Wire or wooden splints for support, or casting forms
- Silicone casting material for tool marks and indented fingerprints [tube]

For DNA Analysis

- Portable autoclave
- Dissecting microscope
- Surgical Instrument set
- Autopsy saw
- Pipette sets of different measurements.
- Hot plate stirrer
- Microwave
- Drying cabinet

Appendix-C

For Digital Forensics

- Laboratory forensic workstation with the monitor, output devices (CD/DVD) and connections (i.e., USB, Firewire, SATA) configured with the operating system (i.e., Windows or Linux) and user-based software applications (i.e., Office, anti-virus); special configuration considerations include a high-end processor, a significant amount of random access memory(RAM), high-quality video and audio components, DVD and CD drives, multiple peripheral connection capabilities for IDE, SCSI, SATA, USB, Firewire, and networks.
- Laptop or portable forensic workstation with similar configuration and capabilities to those of the laboratory forensic workstation
- Uninterruptible power supply (UPS) for backup power
- Isolation transformer (power/voltage regulation) for PC workstations and audio/video equipment
- Networking equipment
- Internet connectivity for updating software and research
- General use printer
- Digital camera
- Cables and connectors
- Power surge protectors/extension cords of various lengths
- Hard drives
- Compact flash cards (various sizes and volumes)
- Small computer instrument toolkit
- Anti-static wrist band
- RF shielding equipment for mobile telephone examinations
- High-resolution monitors
- Professional quality player of various media formats and DVD recorders.
- High-quality video cables appropriate to the equipment in the lab: analogue video cables, digital video cables
- Image printers
- Colour calibration equipment for monitors and printers

Appendix D

List Of Minor Equipment/Tools Required For Searching Scene of Occurrence

i. For Protection and safety

- Disposable latex or plastic examination gloves
- Disposable coveralls/Aprons
- Hair caps
- Shoe covers
- List of hazardous chemicals signs
- Heavy gloves
- Crime scene barrier tape
- Disposable face masks (dust and anti-putrefaction masks)
- First aid kit

ii. Detection

- Magnifier
- Rechargeable flashlight/torch/hand-held light source
- Rechargeable hand-held forensic light source (basic)
- Goggles

iii. Collection of Physical Evidence

- Clear adhesive tape
- Disposable spatulas
- Scissors
- Scalpels
- Disposable plastic tweezers
- Scalpel replacement blades
- Screw-cap test tubes
- Individually wrapped sterile cotton swabs
- Disposable plastic pipettes

iv. For Packaging

- Cardboard boxes
- Metal unlined cans for collection of arson evidence
- Bindle material/weighing paper
- Plastic bags
- Paper bags (small, medium, large)
- Slide boxes (for teeth, projectiles etc.)
- Envelopes (various sizes)
- Body bags
- Containers for sharp objects (e.g. knives, syringes)
- Evidence tags/labels
- Tamper-proof evidence tape

v. For Documentation (including photography)

- Rulers (30 cm)

- Reference scales (L-shaped)
- Tape measure
- Writing pad
- Clipboard
- Writing and marking pens, pencils, metal scribe, chalk, marking paint
- Paper towel
- Stapler and staples
- Compact camera
- spare batteries, lens brush, lens tissue, image storage cards, filters), memory
- card
- Compass
- Photographic tripod stand with water-level
- Camera flash (and batteries)
- Magnet
- Compass
- GPS Locator
- Stationery items such as pens, markers, sketch pens, different papers, Chart Papers etc

vi. Tool kit

Hammers, saw, screwdrivers, wrench, pliers, knife, shovels, sifters, rake, bolt cutters, power drill, electrical extension cords, wire cutters, hacksaw, socket wrench set, rope, assorted sized of wood chisels, axe, cotton work gloves etc.

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डॉ. एस. के. जैन
निदेशक–सह–मुख्य न्यायालयिक वैज्ञानिक

Dr. S.K. Jain, M.Sc Ph.D
Director-cum-Chief Forensic Scientist

सत्यमेव जयते

न्यायालयिक विज्ञान सेवा निदेशालय,
गृह मंत्रालय, भारत सरकार
ब्लॉक–9, तल नं. 8 , केन्द्रीय कार्यालय परिसर
लोधी रोड, नई दिल्ली–110 003

Directorate of Forensic Science Services,
Ministry of Home Affairs, Govt. of India
Block No. 9, 8th Floor, C.G.O. Complex
Lodhi Road, New Delhi-110 003 (India)
Tel. : 011-24362676 Fax : 011-24362819
E-mail : cfs-dfss@nic.in

Ref No. 37/19/2020/DFSS

Dated: June 5, 2020

Dear Madam/ Sir,

It has been observed since long that most Forensic Science Laboratories have their analytical procedures of writing SoPs and validate methods for analysis of various types of scientific evidences. All labs should have rigorous protocols for administrative and technical reviews as well as major/minor equipment availability but there is no consensus or uniformity across the agencies.

Keeping the above in view, the Directorate of Forensic Science Services, Ministry of Home Affairs, Govt. of India, intends to evolve a uniform protocol of major/minor equipments for all the Central/State FSLs with regard to up gradation of existing divisions as well as establishment of new divisions. To give embodiment to this idea, a committee of the following Senior Experts/scientists of various Central/State FSLs is constituted for submission of their valuable inputs on this issue latest by 30.06.2020 for finalization of protocol document:-

1. Dr. Sukhminder Kaur, Director, CFSL, Pune
2. Dr. Arun Sharma, Director, SFSL, HP
3. Sh. Sangchungnuga, Director, FSL, Mizoram
4. Dr. Deepa Verma, Director, FSL, Delhi
5. Dr. S Sangvi, Jt.Director, DFSS, Gandhi Nagar, Gujarat
6. Dr. I Haque, Deputy Director & Sc. D, CFSL, Chandigarh
7. Sh.M.Krishna, AD & Sc. C, CFSL, Hyderabad
8. Sh.R.Suresh, Dy. Director & Sc. D, CFSL Guwahati
9. Dr.P.V.Jiju, AD & Sc. C, CFSL, Pune
10. Sh. Ramakrishna, AD & Sc. C, CFSL, Hyderabad
11. Dr. Rajeev Jain, Sc-B(Toxi), CFSL, Chandigarh

To facilitate the above Committee, a draft protocol document, prepared by CFSLs under DFSS is enclosed herewith for suggestions/feedback. You are requested to please given your comments/inputs in track mode and submit the same to this Directorate by Email : cfs-dfss@nic.in and cfsl-chd@nic.in

Yours faithfully,

5/6/2020

(Dr S K Jain)
Director-cum-Chief Forensic Scientist

To:
1. All the members of the Committee
2. Director: CFSL: Chandigarh, Assam, Pune & Hyderabad with a request to allow the experts to provide their inputs on the issue.
3. Director: DFSS, Gandhi Nagar, Gujarat with a request to allow the experts to provide their inputs on the issue.

(Dr S K Jain)
Director-cum-Chief Forensic Scientist

DIRECTORATE OF FORENSIC SCIENCE SERVICES
Ministry of Home Affairs, Government of India,
Lodhi Road, New Delhi-110003.

Tel: **011-24362676**(O), **24362819**(F)
E-mail: cfs-dfss@nic.in
website: dfs.nic.in