

**Technical Specifications for R&D, Testing Equipments and Hardware & Software for CIPET
SARP APDDRL Bengaluru**

1	Electrochemical workstation (ECWS)	
S. No	Description	Specification
1	Make	Bidder to specify
2	Model	Bidder to specify
3	ECWS should have capability for measuring (suitable software should be provided)	Electrochemical Impedance Spectroscopy, Solar cell test, Fuel cell test, capacitors Electroanalytical Voltammetry, Pulse Voltammetry, Corrosion measurement & Analysis, Battery / Super capacitor test, Electrodeposition, Electro plating, Biosensing, etc
4	Measuring modes	Impedence, potentiostatic, galvanostatic, pseudo-galvanostatic, rest potential and more
5	Measuring stations	Minimum Four stations having all capabilities in each station
6	Compliance potential range	$\pm 10V$ or higher (24 V atleast in one station)
7	Control voltage	$\pm 10V$ or higher in three or more suitable ranges
8	min potential resolution	1 micro volt
9	minimum CV and LSV scan rate:	0.001mV/s
10	Max. Current	5A
11	Min current Resolution	100 nA
12	Frequency range	10 micro Hz to 1 MHz or higher (5 MHz atleast in one station)
13	AC signal amplitude:	1mV~1000mV or higher
14	Frequency accuracy:	0.01% or better
15	Analog/Digital Converter	16/32 bit
16	PC interface	USB. Windows 10 (original OS is to be supplied)
17	Computer	i7 8GB 21" 1Tb branded workstation as per the requirement of software for equipment
18	Accessories (optional)	Cell system and electrodes I. Ag/AgCl Reference Electrode – 1 No. II. Hg/HgO Reference Electrode – 1 No. III. Hg/Hg sulfate Reference Electrode – 1 No. IV. Saturated Calomel Electrode– 1 No. V. Pt Counter Electrode – 1 No. VI. Pt mesh Counter Electrode – 1 No. VII. Glassy Carbon Working Electrode (2mm) – 4 No. VIII. Compatible Cell kit (with gas purging option) for the above Electrodes. IX. Electrode polishing kit– 1 No. X. Corrosion cell kit XI. Rotating disk electrode XII. Photoelectrochemical cell setup XIII. 8 glass cells with Two Cell top XIV. Sample holder and Cell Stand

19	Installation and commissioning	The vendor should support necessary site preparation for installation. Vendor should carry out installation and commissioning of the machine and its accessories on a turnkey basis
20	Technical support and service	Manufacturer should have established after sales & service network in India. The vendor shall have local service and application office and infrastructure to attend by visit within 48 hours of need. Technical support personnel must have adequate experience in this field. Technical support personnel details should be submitted. Name and address of the authorized service centre/ partner in India along with the certificate of authorization should be attached.
21	Annual Comprehensive Maintenance Contract (ACMC) as optional	Vendor should quote for Annual Comprehensive Maintenance Contract for the whole system and accessories supplied after the completion of performance warranty period. Supplier has to provide service support within 48 hours. Calibration of the machine shall be a part of warranty and ACMC. It shall also be mandatory to perform calibration after every major repair or breakdown.
22	Warranty	2 years

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Server

1	Make	Bidders to Specify
2	Model	Bidders to Specify(Please attach the supporting documents like products and accessories catalog)
3	Processor	2 Intel Xeon E5-2600 v4
		Core: 6 core
		Clock Speed: 1.9 GHz or above
		Cache: 8MB Cache or higher
4	Chipset	Intel C610 series Chipset or better on OEM /Intel motherboard
5	Memory	32GB & upgradable
		2133 MHz or above
		DDR4 or above
6	Graphics card	Nvidia Quadro K4200 Graphics card with dedicated 4GB Graphics
7	Hard Disk	4 Nos 4Tb Enterprise SATA 7.2K RPM
8	HDD bays	3.5" SAS, SATA, nearline SAS,SSD drives with optional flex bay
9	Optical Drive	DVD RW drive / SATA / Internal
10	RAID	RAID 0,1,5 +1GB CACHE
11	Networking	2 x 1GbE LOMs
12	Operating System	Microsoft Windows Server latest version
13	Security & Manageability	Hard Disk, BIOS Password,TPM 2.0,Virus protection for boot sector
14	Monitor	24" standard Monitor
15	Keyboard	OEM make standard Keyboard
16	Mouse	OEM make USB Optical Mouse

17	Form Factor	Minitower / Microtower (With Optimized thermal management, low-noise chassis and silent fans)
18	UPS	1000 VA / 230 V - APS or better
19	Accessories	Bidder to specify any other standard/optional accessories
20	Warranty	3 Years Onsite Warranty

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Biodegradation set up - incubator type

	Make	Bidder to specify
	Model	Bidder to specify
I. BIODEGRADATION SET UP		
1	Type	Rectangular Incubator type
2	Tempertaure Range	Ambient to 80 C
3	Tempearture Accuracy	± 1 C
4	Control panel	Accomodating digital PID temperature controller, safety thermostat, indicating lamps, temperature display and switches
5	Incubator	Double walled, Stainless steel, Powder coated
		Provision for holding 24 nos of glass dessicators
		Capable to maintain the uniform temperature throughout the chamber
6	Composting Glass Vessel	Capacity: 3000 ml - 12 Nos.
		Capacity: 5000 ml - 12 Nos.
7	Mesh Filter	Cylindrica Shaped, Stainless Steel Mesh Filters -24 Nos.
8	Glass Bottles	36 Nos. of glass bottles with 5000 ml capacity with air tight cork fitting
9	Multi Storage Rack	Rack with wheel for accomodating 36 Nos. of 5000 ml capacity glass jars and flow meter attachment
10	FLOW Meters for Incubator	Min 24 Nos. with spare of 24Nos
11	Silicone Hose	300 meters
12	Air compressor	2 HP, Oil free, Robust and Light duty:
13	Set up should be in compliance with standards	ASTM D 5338, IS/ISO 14855 (Part 1), and ASTM D 5988
II. AUTO TITRATOR		
1	Auto titrator	Microprocessor controlled titration unit capable to carryout potentiometric titration Measuring parameters: pH (0 - 14), Potential (0 - 2 mV), Temperature (0 - 100 C), Electrical Conductivity (0 - 20 S/m)
		Titration measuring method: Automatic end point detection, pH adjustment and measurement.
		Interfaces: Dual RS-232 / USB port for attachmentents to PC, Printer, autosampler, balance.
		Minimum 4 burretes to be connected for measurements simultaneously
		Appropriate dosing units to be provided for automatic sampling for titration
2	Automatic Burette	Volume: 1, 5, 10, 20 and 50 ml
		Resolution: 1/1000 of burette volume or better

		Dropping volume: 50 ml - 0.0025 ml 20 ml: 0.001 ml 10 ml: 0.0005 ml 5 ml: 0.00025 ml 1 ml: 0.00001 ml
3	Data Acquisition	Data should be continuously recorded and export and import in CSV / Excel formats
4	Accessories	All other accessories required for automatic titration starting from autosampling till end point determination has to be provided as standard items.
		Any other accessories for better performance of the titrator can be quoted as optional accessories
III. KJELDHAL APPARATUS		
1	Construction	The outer body should be made of Stainless Steel 304 and powder coated
2	Flasks	25 mL, 50 mL, 100 mL
3	Temperature controller	Capable of heating upto 500 C
4	No. of recess	06 Nos.
5	Accessories	Any other accessories required for determining the organic nitrogen content
5	Installation and commissioning	The vendor should support necessary site preparation for installation. Vendor should carry out installation and commissioning of the machine and its accessories on a turnkey basis
6	Technical support and service	Manufacturer should have established after sales & service network in India. The vendor shall have local service and application office and infrastructure to attend by visit within 48 hours of need. Technical support personnel must have adequate experience in this field. Technical support personnel details should be submitted. Name and address of the authorized service centre/ partner in India along with the certificate of authorization should be attached.
7	Annual Comprehensive Maintenance Contract (ACMC) as optional	Vendor should quote for Annual Comprehensive Maintenance Contract for the whole system and accessories supplied after the completion of performance warranty period. Supplier has to provide service support within 48 hours. Calibration of the machine shall be a part of warranty and ACMC. It shall also be mandatory to perform calibration after every major repair or breakdown.

4 **Universal Testing Machine (UTM) with Environmental Chamber**

	Make	Bidder to specify
	Model	Bidder to specify
1	Control System	Microprocessor controlled
2	Maximum Load Capacity	100 kN
2	Cross head Travel distance range	0.01 mm to 500 mm or higher
3	Horizontal daylight	Min. 400mm
4.3	Accuracy for Cross head speed	± 0.01 mm/min

5	Load cells	100 N, 1 kN, 10 kN & 100 kN
6	Load cell Accuracy	≤ 0.5 %
7	Grips & Fixtures	<p>Pneumatic and Mechanical</p> <p>Tensile (suitable for plastics, rubber, film and fibre) compression, flexural, and shear fixtures.</p> <p>All fixtures should be suitable for low temperature testing and can be accommodated in to environmental chamber</p> <p>Rigid plastics (self lock winch grip, opening up to 12mm), plastic/composite rod (upto 12 mm dia) woven sacks (50mm width), rubber, fibre/filament.</p>
8	Machine should Conform to standards	<p>Tensile: ASTM D 638, ASTM D 882, and ISO 527</p> <p>Flexural: ASTM D 790 and ISO - 178</p> <p>Compression: ASTM D 695</p> <p>Shear: ASTM D 732</p>
9	Extensometer	Advanced Video Camera Extensometer -Non Contact type linear and lateral Strain guage
10	Data Acquisition Rate:	24-bit resolution card with data acquisition rate of minimum 500 Hz simultaneously on load, extension, and strain channels.
11	Data Sampling Rate:	400kHz or better
12	Safety lock provisions	Limiting switch for cross head travel should be provided
13	Software	<p>(a) Software attached & data storage for sample test methods</p> <p>(b) Software should automates data acquisition, machine control, analysis, and reporting for a wide range of test requirements.</p> <p>(c) In addition, data compilation and provision for stress relaxation and creep shall be provided as per relevant ASTM Standards</p> <p>(d) Window's based graphical user interface.</p>
14	Essential Accessories	
14.1	Computer System	Computer with suitable configuration to support the software and colour bottled inkjet printers should be provided
14.2	Environmental Chamber	Environmental Conditioning Chamber temp. range : - 100° C to 300° C. Accessories related to cooling and heating should be provided
14.3	Any other accessories required	Bidder should quote and supply any other accessories effective and better utilization of machine.
15	Calibration certificate	Calibration certificate for load cells and extensometer traceable to National / International Standards should be provided
16	Scope of supply	Bidder should submit complete scope of supply (Machine, standard acessories, Optional Acessories etc with make model) in the technical bid without price. Bidder should supply complete start up package including material necessary to prove the machine and provide training.

17	Terms & Conditions	The bidder must have supplied machines at other Institutes in the past (a satisfactory performance certificate from those users may be solicited if needed). Bidder should submit complete contact details.
		Manufacturer of the supplied equipment must be ISO Certified
		Authorization Letter from OEM
		List of clients in last five years to be provided.
		Manufacture/Supplier should have sizable installations of same model worldwide and at least Fives in India.
18	INSTALLATION, COMMISSIONING AND TRAINING	
18.1	Installation and commissioning requirements	Bidder should state the space required and condition of floor and any other requirements for installation of the machine and equipments. State clearly the specifications of electrical requirement. Vendor should carry out installation and commissioning of the machine and its accessories on a turnkey basis.
18.2	Training and documentation	Minimum of 5 days training for five persons which includes basic & advanced level training. Training content and plan to be submitted. Training faculty must have adequate experience in this field.
		The vendor should supply the necessary manuals such as
		· Software instruction
		· Maintenance and trouble manual
		· Training
		· Installation and Commissioning
		· Handling of accessories
		· Software key (if any)
		· Software CDs
18.4	Technical support and service	Manufacturer should have established after sales & service network in India. The vendor shall have local service and application office and infrastructure to attend by visit within 48 hours of need. Technical support personnel must have adequate experience in this field. Technical support personnel details should be submitted. Name and address of the authorized service centre/ partner in India along with the certificate of authorization should be attached.

5 MICROPROCESSOR CONTROLLED AUTOMATIC INJECTION MOULDING MACHINE

Make & MODEL :		
1	Clamping Tonnage	60-80 Tons
2	Screw Diameter	20-40 mm
3	Maximum Daylight	700 mm and above
4	opening Stroke	300 mm and above
5	Distance Between Tie Bar	400 x 350 mm and higher
6	Platen Size	550x500 mm or higher
7	Mould height (Min x Max)	150 – 500 mm
8	Ejector Stroke	Min. 70 mm and above (Multi Stage & Multi Point)

9	Shot volume (Polystyrene)	90 gms and above
10	Injection Pressure	1600 kgf/cm ² and above Multi- Stage
11	Injection Rate	200 cc/sec and above
12	Injection Speed	160 mm/sec and above
13	Hydraulic Multiple core pulling unit	Please specify and quote
14	Screw speed	Multi Stage please specify
15	Motor	Please quote for servo motor drive type
16	Total connected load	Please specify
17	Multi stage Air Ejection - Upto 5 Stage	Please specify and quote
18	Interface for Gas Assisted Injection	Please specify and quote
19	Robot Interface	Please specify and quote
20	Hot Runner Interface	Please specify and quote
21	Hydraulic Multiple core pulling attachment	Please specify and quote
22	Water inlet/ out let manifold for Mould cooling	Please specify and quote
23	Bimetallic screw barrel	Please specify and quote
24	Computer connectivity	Please specify and quote
25	Essential Accessories	<p>Bidder to specify and quote the accessories essential for effective utilization of machine such as</p> <ul style="list-style-type: none"> • Thermocouples (for Nozzle & barrel) • Heaters • Nozzle for Nylon/LCP • Multipoint ejector rod • Limit switches • Set of seal kits, etc.
26	Optional accessories	<p>Bidder to specify and quote the optional accessories available for effective and better utilization of machine such as</p> <ul style="list-style-type: none"> • Chiller Unit • MTC unit • NRV set • Water inlet / out let manifold for mould cooling • Bimetallic screw barrel • Interface for Gas Assisted Injection • Hot Runner Interface • Hopper drier with loader etc.
27	Any other accessories if available/required	Necessary/Optional accessories and spares, if required for running the machine with multiple capabilities, bidder to specify with details and quote.
28	Installation requirements	State space required and condition of floor and any other requirement for installation of the machine/ equipment.
29	Installation & Training	<p>Minimum of 5 days training for three candidates at machine manufactures site.</p> <p>Also on site training (Basic & Advanced level) including providing two sets of operating and maintenance manuals and other reference manuals for getting quality output and longer trouble free life of machine.</p> <p>Basic & Advanced level training schedule and plan to be submitted.</p>
30	Manufacturer's credential	Should have sizable installations of same model worldwide and at least two same or similar model in India.

31	References	Tenderer shall give complete contact details of existing customers having such supply in India.
32	Safety requirements	The machine or set of machines supplied to meet objective shall be able to operate without any risk or hazard without any additional protection, provision, training or guarding devices and meet current international standard.
33	Availability of spares and consumables	Tender shall include list of all essential spares and consumables to be provided with replacement time prescribed for each such item and its availability within reasonable time period. In case if any such item is likely to be out of availability within service period of machine, such item shall be included in initial supply.
34	Price list of spares and consumables	Price list of each material with minimum quantity, build plates, spares and consumables are to be quoted.
35	Technical support and service	Availability of technical support in the area of application and service both within the country. The tenderer shall have local service and application office and infrastructure to attend by visit within 48 hours of need.
36	Scope of supply	Tenderer will supply complete start up package necessary to prove the machine and provide training. List for scope of supply to be submitted.
37	Warranty	2 years

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High Pressure Air Compressor

	Technology	Reciprocating
	Stage	Multistage
	Motor power	Minimum 20 HP
	Motor make	Crompton Greaves or Seimens or Kirloskar
	Free Air delivery	40 cfm or higher
	Dryer & Filters	Air drier with Pre and Post filters
	Piston displacement	50 cfm
	Maximum Working Pressure	400 Psi
	Tank Capacity	Minimum 500 Ltrs
	Pump Type	Oil free pump
	Power source	3 Phase AC
	Noise level	< 70 decibels (db)
	Safety features	Should be available for Machine and Operator with valves, gauges, trip switch, over load relay switch, Auto on/off features, emergency stop, etc
	Essential Accessories	Hose (50 Mtrs),
		Blow Gun – 1, Chuck – 1,
		Handheld pressure gauge – 1, plugs
	Warranty	2 Years

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High Torque Overhead Mechanical Stirrer

	Technology	Microprocessor Control Technology
	Motor	Brushless DC Motor (Min.140 W)
	Display	LED Screen display for rpm,time and torque
	Speed Adjustment	Should be precise

	Speed Transmission	Through switch
	Chuck for	1 to 10 mm shaft
	Speed range (rpm)	50 – 1250
	Maximum Torque	700 Ncm or higher
	Safety	Overload and Motor protection
	Stirring Capacity	100 ltrs (of water)
	Shaft diameter (mm)	2,5,10 (three shafts)
	Shaft type	Hollow
	Stirrer blades	minimum 3 configuration
	Power supply	Single Phase 230 VAC

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GC-MS with Pyrolyzer and Headspace

	Model / Make	Remarks and Amendments needed
	Applications	Separation and identification of solids/liquids/gaseous and their mixtures that includes unknown samples, polymers, pesticides, organic compounds, pharmaceutical ingredient etc.
	General Technical	
	Gas Chromatograph system	Instrument detection limit should be ≤ 4 fg OFN for Statistically derived at 99 % confidence level from the area precision of 8 sequential
	Ionization mode	Electron Impact (EI)
	Detector	Flame Ionization Detector (FID) should be provided which can be coupled with the Gas chromatographic system.
	Data acquisition /operating system	System should be capable of supporting three inlets and three detector ports simultaneously; should have electronic pneumatic/pressure controls for all the gases and should have Chromatography Data system which is based on Microsoft Windows operating system for instrument control, data acquisition, data analysis, quantization, automation & customization with online and offline sessions provided.
	Provision	The system should have post-column backflush capabilities using Advanced flow technology to eliminate long bake-out times for highly retained (or high-boiling) contaminants.
	Column Oven	
	Columns	Provision to install at least two column
	Operating temperature	450°C or more
	Temperature set point resolution	0.1°C or better
	Maximum temp ramp rate	120 °C /min or more
	Cooling rate	From 450 °C to 50 °C: within 4 minutes or better
	Temperature programming	Should have minimum 15 ramps & 16 Plateaus
	Head Space Analyzer	
	Injection system	Loop based or syringe based system
	Sample	Should be able to handle all type of VOC
	Incubation Temperature	35°C to 200°C or more
	Head space vial	Vial capacity 20 or more and upgradable to 70 or more vial capacity
	Pyrolyzer	
	Make and model	Bidder to specify

	Type	Multi-shot pyrolyzer compatible with GC-MS
	Temperature range	Upto 1000 deg.C or better
	Furnace cooling rate	Temperature to go down from 800 deg.C to 50 deg.C within 10 min.
	Sample to be analyzed	Solid and viscous liquid
	Control	Should be provide with controll software
	Injection port	
	Injection port	1. Split/Splitless injection port with electronic pressure control (EPC)/ programmable pneumatic control (PPC) /advanced flow control (AFC) with fast GC capability
		<ul style="list-style-type: none"> • Programmable vaporizer injector and programmable up to 8 ramps (or better); Heating rate 500 deg.C/min. or better • PTV inlet configured with liquid N₂/ PELTIER cooling & Air should have maximum temperature of 400deg.C and support sub-ambient temperature setting upto -3deg.C using Cryo gas.
		Possible to use capillary columns of 100µm to 530µm columns
		Digital display of gas flow, temperature etc.
		Manufacture's software controlled (AFC/EFC/APC/EPC controlled).
	Pressure range	100 psi or better
	Maximum temperature	400 °C or more
	Heating zones	Should have independently heated zones
	Auto Injector-liquid	An automatic injector device having a capacity to hold at least 15 vials capacity and should be field upgradabale to 150 vial capacity
	GC Detector Specifications (FID)	
	FID detector	Having an MDL:<1.5pgc/s or better
	Linear dynamic range	10 ⁷ or better
	Carrier gas head pressure setting	Should be more than 950kPa
	Mass range	m/z up to 1000 unit or better
	Mass Analyzer	Should have inert/metallic quadrupole massfilter with pre-filter or equivalent technology
	Mass axis stability	Should be ±0.10 amu over 48 hrs
	Scan speed	up to 10,000 u/sec or more
	Ion source temp	upto 350 °C or better and it should be programmable.
		It should be cable less source for easy cleaning and maintenance.
		Additional a pair of filament should be provided.
	Ionization mode	EI
	Filament	Dual and automatic switching
	The sensitivity of system should be a followed and demonstrated at site	EI MRM S/N: 1 µL of 100 fg/µL of OFN produces > 15,000:1 RMS for the transition of m/z 272 & 222 using 30m x 0.25mm x 0.25µm
	Turbo Molecular Pump (TMP)	300L/sec or better capacity
	Resolution	Selectable, 0.7 to 2.5 Daltons,
	WorkStation Instrument Control Software	GC and MS system should be combined with the same workstation for simultaneous settings and programming.
		Should have Auto tune (to optimize MS parameters automatically) feature
		A user friendly automatic data collection and analysis system compatible with Microsoft Windows OS and Microsoft Office suite applications
		Library search through Retention Index function should be provided as standard in the software

	Sample preparation	Qucheers Kit: 2 No.
	Spectral Library	Latest mass spectral library (NIST) to be supplied in CD (licensed) for polymers including rubbers, additives, pesticide, insecticide, etc.
	Accessories	Branded latest suitable PC compatible with GC-MS system having HDD Graphics display, 20"LCD/LED Monitor alongwith a good quality printer (should specify the PC and printer model).
		UPS: 10 KVA UPS with at least 60 min back up is needed.
		High quality He, H ₂ , N ₂ , Argon & Zero Air gas cylinders alongwith compatible regulators, gas purification panel for the above mentioned four gases, and required tubings should be provided.
		Syringes for manual and autosampler injection (minimum pack of 10 each), Filaments (minimum 2 no.), capillary column (minimum 1 no., desired 2 no.).
		Mechanical accessories (tool-kit etc) and consumable spares (Vials, Septa, Ferrules etc.) for the operation and maintenance of the instrument should be provided to meet our needs for at least 1 year.
	Other terms and conditions	Installation Qualification (IQ) and Operational Qualification (OQ) should be performed at the time of installation and commissioning.
		The system must be factory tested and a certificate should be provided
		The entire system should be installed by the company professionals at oursite. A thorough technical training (minimum 3 days) in analyzing and troubleshooting should be given by the technical professionals
		A list of references in India, where similar systems have been installed, must be provided and this will be taken very seriously while making the decision. Your post sales service feedback will certainly be a deciding factor
		Complete set of manuals on operation, maintenance of the system in hardcopy as well as soft copy should be provided in English.
	warranty	2 years

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FUEL CELL TEST SYSTEM AND HARDWARE

1	Make	Bidder to specify
	Model	Bidder to specify
2	System	A fuel cell test system suitable for both direct methanol fuel cell (DMFC) and proton exchange membrane fuel cell (PEMFC)
		Impedance analyzer (in-built) for electrochemical impedance spectroscopy and high frequency resistance. System should be able to measure all parameters including proton conductivity.
		Anode and cathode backpressure controller - standards

		PEMFC must be able to operate upto 180 °C with proper humidification control.
3	Fuel cells hardwares	<p>DMFC: Single cell with active area 5 cm²; and 3-cell stack with active area 25 cm². for each cell.</p> <p>PEMFC: Single cell with active area 5 cm²; and 3-cell stack with active area 25 cm². for each cell.</p>
4	Cell features	<p>Thermocouple</p> <p>Nitrogen purge – for anode and cathode separately</p> <p>Current collectors</p> <p>Inbuilt Heater</p> <p>Thermal Chamber/jacket/heater for high temperature PEMFC cell.</p> <p>Cell should have all necessary provision for control of humidity, temperature, reactant inlet and outlet, Nitrogen gas purging; etc.</p>
5	Operating temperature range	<p>DMFC: 35 to 90 °C or more</p> <p>PEMFC: 35 to 180 °C</p>
6	Electronic load	<p>Max current range: 100A</p> <p>Max voltage : 20V</p> <p>Power: 125 W or more</p>
7	Flow controllers	<p>For anode, MFC (Hydrogen): flow range: 0-2000 SCCM or more</p> <p>For cathode, MFC (Oxygen gas and Air): flow range: 0-5000 SCCM or more</p> <p>For DMFC operation appropriate good quality peristaltic pump should be inbuilt with the system. Flow rate 0.1 ml/min to 60 ml/min</p>
8	Humidification system	<p>Humidification system for hydrogen and air with accurate control for operation of the cell at various humidity and temperatures. Anode & Cathode humidifiers with automatic water fill. Humidity and temperature curve to be provided for verification.</p> <p>Humidification room temperature to 95 °C or more for both DMFC and PEMFC.</p> <p>Optional Bypass of humidifier by computer controlled valve</p>
9	Proton conductivity cells	<p>The conductive cell with appropriate humidity chamber or any other advanced system which can measure the conductivity within fuel cell fixture of the bare membrane. Standard four-point-probe cell to measure the in-plane conductivity of various bare membranes (without MEA). Conductivity measurement should be performed in various environments of varying relative humidity (25-100%) and temperature (room temperature to 95 °C or better); leading to a more accurate assessment of membrane conductivity and resistance.</p> <p>Fuel cell system should have appropriate software for measurement of proton conductivity of various membranes</p>

		Membrane Conductivity Cell/probe and system must have all the required hardware, connectors and adaptors for complete conductivity analysis demonstration at varying condition.
10	Safety features:	Interlocks with external safety alarm
		Safety features to include PLC controlled, alarm, nitrogen purge and emergency stop, and hydrogen leak detector.
		High-temperature alarm on each temperature controller
11	Computer	i7 8GB 21" 1Tb branded computer as per the requirement of software for fuel cell system
12	Softwares	Suitable softwares with licence to be included to perform all the fuel cell related analysis in the tender specifications
		Analysis: Open circuit voltage, Current scan, Voltage scan, Potential EIS, Constant load discharge, Constant voltage discharge, and AC Impedance measurement, Half cell potential etc.
		Optional Bypass of humidifier by computer controlled valve
		Preheater to avoid condensation, set temp thru software.
		Software must be user friendly for easy customisation and should be upgradable for life time.
		System should run continuously without any monitoring for durability test at least for 100 hr or more
		Interfacing between system and PC should have fast response with easy data monitoring and aquisition.
		System should provide with digital monitoring and controlling system for temperature, reactant flow rate, cell temperature, humidification, back pressure, stack monitoring, voltage, current, real time cell resistance, half cell voltage, individual cell potential etc.
13	Spares and accessories	Gaskets for anode and cathode for both PEMFC (high temperature) and DMFC (each 0.5 m ²)
		Carbon cloth and carbon paper (30cm X 30cm - 2 No each)
		Catalysts for both anode (Pt/Ru/C 40/40/20%, 10g) and cathode (Pt/C 40/60%; 10g); and Nafion inomer solution (5% in aliphatic alcohol/water; 500 ml) for electrode preparation)
		Digital Multimeter and other tool kit (electrical and mechanical) should be provided.
		Nafion 117 membrane 30cm X 30cm – 2 No.
		Air spray gun (with ultrafine nozzle) for electrodes preparation
		MEA with active area 5 cm ² and 25 cm ² for both PEMFC and DMFC respectively - 5 No. for each.
		Filled in Hydrogen, Oxygen, Air, and Nitrogen gas cylinder for system.

		System should have all necessary softwares and assesories for full demostation and commissing of fuel cell.
		System should supplied with all the necessary connectors, pressure gaues, tubing and other hardware for connection for H ₂ , O ₂ , Air, N ₂ gases to the fuel cell system.
14	Certificates	Supplier should provide all Calibration certificates and data sheet related to electronic load, humidity, temperature, backpressure and flow controllers system.
15	Installation and commissioning	The vendor should support necessary site preparation for installation. Vendor should carry out installation and commissioning of the machine and its accessories on a turnkey basis
16	Technical support and service	Manufacturer should have established sales & service network in India. The vendor shall have local service and application office and infrastructure to attend by visit within 48 hours of need. Technical support personnel must have adequate experience in this field. Technical support personnel details should be submitted. Name and address of the authorized service centre/ partner in India along with the certificate of authorization should be attached.
17	Warranty	Should provide atleast 2 years warranty for whole system.
18	Annual Comprehensive Maintenance Contract (ACMC) as optional	Vendor should quote for Annual Comprehensive Maintenance Contract for the whole system and accessories supplied after the completion of performance warranty period. Supplier has to provide service support within 48 hours. Calibration of the machine shall be a part of warranty and ACMC. It shall also be mandatory to perform calibration after every major repair or breakdown.

10

FTIR Spectrometer

1	Make/Model	Bidder to specify
2	FTIR spectrometer	<p>In-built Diamond ATR (pure monolithic for the sample analysis pH 1-14)</p> <p>Spectrometer should have motorized, continuously variable aperature, for optional peak shape collection of data</p> <p>Should have the optional rapid scan facility and it should be able to collect 65 or more spectra per sec.</p> <p>Should be upgradable to Vis, Near IR and Far IR range.</p> <p>Should be used for routine R&D analys of solid, liquid and gas. Major materials include polymers, rubbers, pharmaceuticals and any other compounds.</p>
3	Wavelength range	7500 - 350 cm ⁻¹
4	Spectral resolution	0.25 cm ⁻¹ or better (preferebly 0.1 cm ⁻¹)
5	Wavelength precision	0.01 cm ⁻¹ or better
		Must be capable of at 50,000:1 or better (1 min, peak to peak, at

6	Signal to Noise Ratio	4 cm ⁻¹ resolution) in the well proved standard region of 2200-2100 cm ⁻¹
7	Detector system	<p>Long life, highly sensitive temperature stabilized, Deuterated, L-alanine doped triglycine sulfate (DLATGS) detector to function at room temperature and instrument should have facility for MCT detector and should be supplied with mercuric cadmium telluride (MCT) detector (with liquid nitrogen hold time of more than 12 hrs) with temperature stabilization</p> <p>It should support upto three detectors and have the facility to place it permanently in the detector compartment and should be software selectable.</p>
8	Interferometer	<p>Michelson design type with advanced dynamically auto alignment, non-air bearing/air bearing/any other advanced type.</p> <p>Must be capable of supporting an optional Automatic Beamsplitter Exchanger accessory without major modification and it should cover Vis/Near, Mid and Far IR.</p>
9	Light Source	<p>Long-life Ceramic source with hot-spot stabilization. Must be user replaceable.</p> <p>Capable of white light source to be used for near-IR or visible operations, mounted in a similar manner to the infrared source and similarly user-replaceable.</p>
10	Laser	HeNe
11	Beamsplitter	<p>KBr beam splitter with protective coating Al/Au (preferably Gold) (with suitable dehumidifier controller protection)</p> <p>Automatic Beamsplitter Exchange system shall provide location for upto 3 beamsplitters supported by the interferometer.</p> <p>System should allow full spectral range for available beamsplitters to be realized without manual handling of the fragile optical components and without interruption of the purge or sealed and desiccated condition of the spectrometer.</p>
12	Standards	<p>ASTM E1421</p> <p>NIST traceable 1.5 mil polystyrene with certificate</p>
13	Optical system	Single beam
14	Optics	Gold coated
15	Others Features	<p>The spectrometer cover shall be sealed and desiccated and must be equipped with coated KBr sample compartment windows.</p> <p>The instrument must be equipped with the necessary internal plumbing and external connector for optional purge operation.</p> <p>System should have the facility of at least two external output beams and two external source inputs.</p>
16	Compulsory accessories	<p>Latest, HP/IBM/DELL or any other branded PC with 21" screen, latest hardware and software configuration: Processor: 3.2 GHz (or higher) Core i7/Xeon processor Memory: 16 GB (or higher) Internal Drives: 2 TB</p> <p>Hydraulic press, die, KBr pellet holder etc</p> <p>Dessicants kit</p> <p>Magnetic film holder</p> <p>Gas cell (10 cm path length)</p> <p>Suitable Liquid cell (path length 0.1 mm) for aqueous solution and organic liquid</p> <p>Appropriate 5 KVA UPS for 1 hr back-ups</p>

		Laser printer
18	Software	Window based
		Real time reference curve capability; Multitasking: simultaneous measurement and evaluation; Graphic and data export, allow creating methods etc.
		All routine data processing functions like Arithmetic calculations, peak detection, dynamic spectrum subtraction, derivative calculation up to 2nd order, peak area integration, Absorbance to Transmittance conversion, log intensity conversion, data smoothing, peak normalization, interpolation etc.
		Must have as a standard feature advanced data processing capabilities including Single Point and Multi-Point Quantitation software, Atmospheric correction, Multi-linear Regression (Multi-Component analysis) capability, Deconvolution, Film Thickness measurement, Spectral Purity measurement, ATR correction Double Recurrence Analysis, etc.
		Must have as a standard feature advanced data processing capabilities including Single Point and Multi-Point Quantitation software, Atmospheric correction, Multi-linear Regression (Multi-Component analysis) capability, Deconvolution, Film Thickness measurement, Spectral Purity measurement, ATR correction Double Recurrence Analysis, etc.
19	Upgradation capability	Instrument should be upgradable to FT Raman and mapping facility and Built-in Video camera, TGA-IR, GC-IR and FT Microscopy.
20	Spectral library	Latest spectral library of minimum 10,000 including all major polymers and plastics, rubbers, pharmaceuticals and any other materials must be supplied (licenced version).
21	Warranty	Minimum 10 Year full instrument warranty including, interferometer , laser, source etc.
22	Installation & training	Training should be given for staff and students.
		The entire system should be installed by the company professionals at our site. A thorough technical training (minimum 2 days) in analysing and troubleshooting should be given by the technical professionals.
		Complete set of manuals on operation, maintenance of the system in hard copy as well as soft copy should be provided in English.

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Transmission Electron Microscope

1.	Model	Bidder to specify
2.	Make	Bidder to Specify
3.	Electron source	Field Emission Gun (FEG) with High Voltage Supply Unit.
		Probe current should be ≥ 1.5 nA/ 1 nm with beam current ≥ 75 nA. (not varified)
		Fully automatic
		Microscope should have oil free vacuum system

4.	Vacuum system	Turbo Molecular Pump based fully Dry-Vacuum system for the TEM with all required backing pumps, high vacuum pumps and Ultra-High Vacuum Pumps, suitable Pressure Gauges, Compressors and Suitable Air/Water Chillers etc. required for TEM operation.
		FEG gun vacuum should be $<2 \times 10^{-7}$ Pa or better
		TEM column vacuum should be $<2 \times 10^{-6}$ Pa or better
5.	Accelerating Voltage	200 kV or better
		It should work at accelerating voltages upto 200 kV or better in step/continuous variable mode.
6.	Resolution and spot size	TEM mode: Point Resolution should be ≤ 0.25 nm or better
		Lattice resolution should be ≤ 0.14 nm or better
		STEM resolution should be ≤ 0.2 nm or better
		These resolutions should be proved in our system.
7	Analysis Mode	EDS Analysis
		STEM-EDS Mapping (Point/Line /Area Mapping)
		3D tomography
8	Magnification	TEM Magnification 50 \times to 1,000,000 X or better
		STEM Magnification : 150 to 15,00,00,000X or better
9	Imaging mode	• Bright-Field (BF)
		• Dark-Field (DF)
		• High resolution Imaging
		• Selected-area electron diffraction (SAED)
		• Convergent-beam electron diffraction (CBED)
		• High angle annular dark field (HAADF)
		• STEM Imaging
10	Specimen holder	Single tilt holder: $\geq 70^\circ$: 1 No.
		Double tilt holder: $\geq 35^\circ$ (Specimen Tilt Angle $\geq \pm 25^\circ$) : 1 No
		Single tilt Cryo-Holder (temperature down to -170°C): 1 No with necessary liquid nitrogen pumping station and related essential accessories. (For liquid sample)
		Single-tilt multi-specimen holder (for grid size 3 mm).
		Tomography holder: 1 No.
11	Specimen chamber	X, Y movement range : $\geq \pm 1$ mm or better
		Z movement range: $\geq \pm 0.20$ mm
		5 Axis Eucentric Sample Stage or better.
		Drift ≤ 1 nm/minute with a standard holder
		Specimen grid size 3 mm
12	Detectors	STEM should be consisting of BF, DF and HAADF detectors.
		STEM imaging with high angle annular dark field (HAADF) detector with resolution: ≤ 0.2 nm or better
		EDS with SDD detector with total active area 60-80 mm ² or higher.
		All Detectors should be supplied with software for data acquisition and analysis.
		Imaging in Z (atomic number) contrast mode should be possible.

13	EDS: X-ray detector (Optional)	Fully retractable/in-column Silicon Drift Detector for energy analysis of secondary X-rays for carrying quantification of elemental composition with suitable active area
		Detector resolution ≤ 129 eV or better
		Capability to detect elements with atomic number ≥ 5 (i.e. from B onwards) to Uranium
		Appropriate software to quantify the elemental composition in STEM and TEM modes and for elemental mapping.
14	Lens system	Consisting of condenser lens, objective lens, Lorentz Lens, diffraction, intermediate and projection lenses
15	Cooling system	Close circuit, automatic temperature and flow rate controlled water cooled chillers
16	Camera	CMOS camera
		16 Mpixel (Or better) @ 25 (or better) fps with full resolution
		Camera should be suitable for step and variable accelerating voltage upto 200kV or better
		Output images should be compatible with other commercial image analysis software
17	Tomography	
18	Sample preparation tools (OPTIONAL)	Suitable Ultra-microtome with cryo attachment with all necessary accessories
19	Future upgradation	TEM should be upgradable
20	UPS	ONLINE UPS with power backup for at least 1 hour for smooth operation.
21	Consumables	Spares and Accessories: Under comprehensive (including FEG filaments) warranty of 3 years all necessary spares and consumable need to be included in the quote.
22	Equipment software	Full software package for TEM control, data acquisition, analysis and display.
		Software should be capable of image processing, EDS analysis; electron based imaging and selected area electron diffraction analysis.
		Upgradation of the software has to be supplied free of cost.
		Facility for recording specific specimen translation position as reference point in memory
23	Vibration Isolation Platform	Auto leveling, active, anti-Vibration system for chamber and electron column isolation is required.
		Preinstallation site visit for the same.
24	Calibration Standards:	All calibration standards traceable to SI Units for TEM and EDS
		Should provide standard TEM sample calibration accessories including resolution standards, magnification standards
25	Safety devices	Should provide all safety system Against power/water/vacuum failures including automated Field Emission filament Safety device.
		Three No.- one for TEM, one for EDS and one for storage and processing of images separately.
		All control, data acquisition, analysis and diagnostics software loaded and tested on the computer.

26	Computer Hardware	Latest, Branded (HP/IBM/DELL) PC with latest hardware and software configuration, the minimum features being the following: Processor: 3.2 GHz (or higher) Core i7/Xeon processor Memory: 16 GB (or higher) Internal Drives: 2 TB OS: All software used to operate the instrument, acquire and process the data should be based on 64-bit platform such as Win 10 or compatible. Software: All softwares used to operate the instrument, acquire and process the data should be pre-installed.
		32" (or higher) TFT monitors
		CD/DVD reader and writer combo
		All software should be upgradable free of cost.
27	Utility requirements	Suitable Chiller and compressor for the main equipment should be supplied
		Closed circuit automatic temperature and flow-rate controlled chiller
29	Installation, commissioning and training.	Pre-installation requirements such as room size, required power rating, gases (argon, N ₂), AC etc. are to be clearly mentioned.
		Site inspection and qualification must be performed by vendor's authorized representative, well in advance of system delivery.
		Installation, complete interfacing of the system with its subsystems, and commissioning is to be carried out by the vendor's factory-trained engineers, followed by a demonstration of the system's performance to the user's complete satisfaction.
		Warranty: The instrument and accessories should have a minimum of 3 years of Comprehensive Warranty from the date of installation on the complete system, including all the subsystems. The comprehensive Warranty should cover: All parts including accessories and labor and Free maintenance and service with Regular up-gradation of softwares
		Onsite training: Onsite training to the researchers by the company person in two phases. First training for two weeks immediately after commissioning of the equipment and Second training for two weeks after two months of first training.
		Compliance statement to each item of this document to be provided along with the technical bid.

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THERMOGRAVIMETRIC ANALYSER (TGA)

1	Type	R & D
2	Operating Temperature Range	Ambient to 1000 °C or higher
3	Temperature precision	± 2°C or better
4	Heating rate	0.5 deg C/min to 50 deg C/min or better
5	Cooling Rate	1000 deg C to ambient temprature in less than 30 mins
6	Cooling method	Air cooling OR Forced water cooling
7	Balance	
	measuring capacity	1000 mg or higher

	Measurement Sensitivity	0.1 µg
	Precision	0.02% or better
	Tare	±2 µg reproducibility
	Weighing accuracy	0.02% or better
8	Essential features and accessories	Auto-Dynamic heating rate Accessories to enable upgradation for coupling with FTIR and GCMS Calibration standards for balance and temperature with NABL/NPL traceability calibration certificates Sample pans: 10 Platinum, 50 ceramic, 1000 Al and 100 Cu Double stage SS regulators for Nitrogen and Oxygen gas supply Tubing fittings
9	Control system	Moisture tap and filters for inline gas supply Digital flow controller and gas switching accessory for atleast two or more gases simultanously ability to continuously measure sample weight loss of up to 1.0 gram Single thermocouple design with continuous use of the measured sample temperature to control the furnace so as to minimize thermal lag. Push button automatic loading and unloading of sample pan. Automatic recording of initial sample weight Five points for temperature calibration
10	Software/PC	Latest Branded PC (not assembled) with latest hardware and software configuration, the minimum features being the following: Processor: 3.2 GHz (or higher) Core i7/Xeon processor Memory: 16 GB (or higher) Internal Drives: 2 TB OS: All software used to operate the instrument, acquire and process the data should be based on 64-bit platform such as Win 10 or compatible. Software: All softwares used to operate the instrument, acquire and process the data should be pre-installed. 32" (or higher) TFT monitors CD/DVD reader and writer combo All software should be upgradable free of cost. High sensitivity with minimum buoyance & chimney effects compatible to Windows 10 or higher OS and should have the capabilities to heating rate, temperature setting, etc. Capable of automatic data analysis including starting and end point of weight loss, kinetics of decomposition, DTA, etc.
11	Compliance to Standards	ASTM D6375, ASTM E1868, ASTM E1131
12	Service	AMC for atleast 3 years to be quoted separately
13	Optional accessories	Autosampler for 20 samples or above

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Atomic Force Microscopy (AFM) with STM

1	Make	Bidder to specify
2	Model	Bidder to specify
3	Applications	To study surface morphology of polymers, nanoscale morphological features, phase transitions etc.

4	Instrument type	Latest technologically updated model with motorized stage (XYZ Axis)
5	Scanning Features	The system should have Sample Scanning techniques and should capable of operating in tapping mode, contact mode and non-contact mode.
		A single scanner must used for large and small (nm range) area scanning
		Automated focus, Automatic Laser Alignment and tip approach
6	XY Scanner	Maximum scan range: 50 μm \times 50 μm or more
		Minimum scan range: 200 nm \times 200 nm or lower
		Drive resolution in XY 0.1 nm or Better under both open and close loop and high voltage
7	Z-Scanner	Max. height range: 15 μm or more
		Drive resolution in Z: 0.1 nm or Better under both open and close loop and high voltage
		AFM scan head with Flexure-based electromagnetically/ Piezoactuated XY-scanner; Piezo-based Z-actuator; Optical Z-position sensor; Closed loop Z-control
		Close loop XYZ scanner
8	Operation modes	Liquid sample analysis mode
		Static mode
		Dynamic Force
		Lateral Force Microscopy
		Phase Contrast
		Magnetic Force Microscope (MFM)
		Electrostatic Force Microscope (EFM)
		Piezoresponse Force Microscopy (PFM)
		Kelvin Probe Force Microscopy (KPFM)
		Force Modulation and nano mechanical for quntitative
		Conductive AFM (C-AFM)
		STM with all necessary accessories
		Electrochemical cell (optional)
9	Probes/Tips	Appropriate Probe kit should be provided for all operational modes, with at least 10 tips for each kit.
		Vender must provide tips with diameter of 5 nm or less. All tips should have spring constant suitable for polymer and polymer composite samples.
		Should provide cantilevers/probes and calibration standards that are supplied with the basic system.
		At least 20 nos of additional tips for non-contact and contact mode should be provided
		Mounted tips should be provided
10	Video camera	On-axis Optical Viewing System with video camera with 5MPixel or better

		System having top and side view camera are preferred.
		Objective lens focus 10x or better
11	Control Electronics	<p>The AFM must have state-of-the-art controlled electronics and following inclusions:</p> <p>24 bit or more digital to analog converters for scan controlling XY and Z</p> <p>Electronic signal input should be of 24 Bit ADC with at least 4 high speed ADC/DAC channel</p> <p>Analog signal handling for minimum electronic noise</p> <p>X/Y/Z-Axis Position Measurement : 3 x 24Bit ADC, 200kHz or Better</p> <p>Analog signal input bandwidth : DC to 3MHz or Better</p> <p>Up to 4096x4096 data points or better, 24Bit Zoom In 8 acquisition channels</p> <p>dynamic digital filters</p>
12	System Computer & Software	<p>X/Y Sample slope correction and Over scan</p> <p>Latest branded PC with windows operating system and licenced software for the operation of the instrument.</p> <p>Software must be a single package for all modes and attachments with no need for additional software programs.</p> <p>Software package must include both image acquisition and data processing softwares with multiple licence.</p> <p>Automatic cantilever spring constant calibration. 2D Fast Fourier analysis, Plane-fit, High pass and low pass filters, Zoom in/out, Optional grid on images and curves Color bar completely user definable 2D and 3D height presentation etc.</p> <p>All software should be upgradable for lifetime.</p>
13	Accessories	<ul style="list-style-type: none"> Active vibration isolation: Highly compact active vibration isolation for the better measurement Acoustic Enclosure: Provides acoustic isolation during measurements & also shields against light, electric and air flow disturbances Translation (sample) Stage: Travel range: 15mm x 15mm x 15mm or more <p>Should provide standard reference samples for all operational modes</p>
14	Optional Item	<p>Sample support - 4 pcs.</p> <p>0.25mm dia & 30cm length – 2 No</p> <p>1. Small Sample Heater</p> <p>Sample holder for heating samples.</p> <p>Materials selected for minimal drift Temperature range: Room temperature to +120 °C</p> <p>Diameter: 60 mm</p> <p>2. Temperature Controller.</p> <p>Temperature resolution: 0.1 °C</p> <p>Additional Temperature Sensor: Thermocouple Type K</p> <p>3. Environmental Control Chamber</p>

		Allows measurement under controlled atmosphere (inert, dry, humid).
15	Installation & training	Training should be given for staff and students.
		The entire system should be installed by the company professionals at our site. A thorough technical training (minimum 7 days) in analysing and troubleshooting should be given by the technical professionals.
		Complete set of manuals on operation, maintenance of the system in hard copy as well as soft copy should be provided in English.
		The vendor should support necessary site preparation for installation. Vendor should carry out installation and commissioning of the machine and its accessories on a turnkey basis
16	Technical support and service	Manufacturer should have established after sales & service network in India. The vendor shall have local service and application office and infrastructure to attend by visit within 48 hours of need. Technical support personnel must have adequate experience in this field. Technical support personnel details should be submitted. Name and address of the authorized service centre/ partner in India along with the certificate of authorization should be attached.
17	Annual Comprehensive Maintenance Contract (ACMC) as optional	Vendor should quote for Annual Comprehensive Maintenance Contract for the whole system and accessories supplied after the completion of performance warranty period. Supplier has to provide service support within 48 hours. Calibration of the machine shall be a part of warranty and ACMC. It shall also be mandatory to perform calibration after every major repair or breakdown.
	Warranty	2 years

14 Chemical Vapour Deposition SYSTEM :PLASMA ENHANCED (PECVD) - GRAPHENE AND CNT SYNTHESIS

1	Make	Bidder to specify
2	Model	Bidder to specify
3	Applications	Graphene and CNT Synthesis; Coating on polymer/ceramic/glass/metal substrates
4	Temperature Range	Ambient to 600° C or higher
5	Substrate Size	50 mm dia.
6	Temperature accuracy	±2°C or better in whole range of temperature
7	Temperature Controller	PID
8	Chamber	Horizontal Process Chamber with Ultra high vacuum flange
9	Sample holder size	50 mm dia minimum.
10	Gas Injection Ports	O ₂ gas injection ports
11	Pressure control	Vacuum pump rotary valve with throttle valve
12	Pressure Gauge	Regular Pressure gauge
13	Plasma system	1000V/ 200mA, position adjustable counter electrode

14	RF range	Primary source 10 MHz or above & Secondary Source less than 500 KHz
15	Safety interlock	Safety interlock should be provided for pressure change
16	Loading system	2 or better gas line loading system
17	Standard gas	Acetylene, Ammonia, Nitrogen, Methane, Hydrogen
18	Purge gas	Argon
19	Flow meter	Digital mass flow meter
20	Vacuum pump	Rotary valve type pump
21	Gas flow rate	20 m ³ /h or better
22	Vacuum Level	10 ⁻³ torr or lower
23	Safety Provisions to be provided for	Over heating Air pressure Thermocouple Pump failure
24	CVD should capable of developing the materials	Nanomaterials Vertically Aligned CNT's below 600 °C Si Nanowire Thin Film Solar Cell Amorphous Silicon, micro- Crystalline Silicon, Polysilicon Dielectric Film: SiO ₂ , Si ₃ N ₄ Diamond and Diamond like Carbon thin film II-V Semiconductors (GaN, GaAs, AlGaIn, InP, etc.) II-VI semiconductors (ZnO, ZnS) IV semiconductors-Si, Ge, Strained Si
25	Accessories	Bidder to specify and quote any ther accessories required for the better utilisation of the equipment
	Warranty	2 years
26	Installation and commissioning	The vendor should support necessary site preparation for installation. Vendor should carry out installation and commissioning of the machine and its accessories on a turnkey basis
27	Technical support and service	Manufacturer should have established after sales & service network in India. The vendor shall have local service and application office and infrastructure to attend by visit within 48 hours of need. Technical support personnel must have adequate experience in this field. Technical support personnel details should be submitted. Name and address of the authorized service centre/ partner in India along with the certificate of authorization should be attached.
28	Annual Comprehensive Maintenance Contract (ACMC) as optional	Vendor should quote for Annual Comprehensive Maintenance Contract for the whole system and accessories supplied after the completion of performance warranty period. Supplier has to provide service support within 48 hours. Calibration of the machine shall be a part of warranty and ACMC. It shall also be mandatory to perform calibration after every major repair or breakdown.

1	Make	Bidders to specify
2	Model	Bidders to specify
3	<u>amplifier.</u>	
	Conventional	150 N
	peak	12 mm
	Max. Acceleration	65g
	Table diameter	Ø 50 mm
	Maximum Load	5 Kgs
	Effective mass	0.4- 5 Kgs
	Frequency Range	5Hz – 5 kHz or better
	Excitation output	10-32 mounted stingers
	Max. operating current	≤10 amps
	Armature Coil resistance	2.8 Ω
	Mounting Hole(mm)	bidder to specify
	Power Amplifier	100W/200W
	Cooling	Natural Air cooled option.
	Vibration controller	Suitable for the above shaker
	The controller should have the following specifications	4 channels, built in power source for IEPE with a sampling frequency of upto 54Khz
	Software capabilities:	Swept sine:
		Control Strategy:
		Single Channel.
		Average.
		Maximum.
		Minimum.
		Sweep Definition:
		Number of Sweeps.
		Duration.
		Cycles
		Sweep Direction:
		a) Up only (in multiple sweeps).
		b) Down only (in multiple sweeps).
		Up and Down.
	Other software features	Sine, Random, Sine on Random etc.,
4	<u>Dynamic Signal Analyzer,</u>	
	<u>(i) Hardware specification</u>	
	Portable all-in-one data acquisition system, rugged industrial design	
	Dynamic channels -4	
	Type of input connection- BNC	
	Universal analyser	
	Additional Speed/Trigger channels- 2	
	Output channel - 1	
	Sampling rate >100 Ks/s – 24 sigma delta ADC	
	Resolution – 24 bits(144 DB) input range at 1kHz - ±0.05 DB Temp variability - <0.1 DB / 10 degree C	
	Type of inputs - AC/DC/ICP/TEDS/FLOAT - ± 17.5 mV to ± 10 V	
	Dynamic range > 120 dB	
	Filters: High/Low pass- Stop/pass band – Integrator(Simple/double) – Differentiator – A/C/Z	
	Frequency range - DC – 40kHz - ±10 V range	
	64 X over sampled (upto 6.4 MHz) – resolution: > 160 ns ±10 V range	
	1 Inbuilt force DSP	
	Ac – 100 V to 240 V, DC – 10-28 V	

	Interface -1 Gb/s Ethernet
	Maximum weight - 1.4 Kgs
	<u>(ii) Software specification</u>
	Software features:
	Graphical: Windows Management - Trace Management – Zoom & Translation – Scale management –
	Display: Time series – Narrow band – Profiles – View Meter – 3D
	Data Management:Setups – Load, save and recall workbook withMeasurements – Save selected results and raw data automatically. Projects – Project manager tree –filters
	Project Manager
	Measurements – Save selected results and raw data automatically
	Real time analysis: Gap free recording – 4 ch; 40 kHz.Real time FFT – 4 ch
	Output/Generators: Pure tone – 1 independent fixed sine. Noises – 4 uncorrelated random
	Swept sine – 1 to 6 simultaneous outputs
	Import/Export: Signal import(time series) – OROS wav
	Result import(others)- AE2
	Export – UFF –TXT - SDF
	Report – MS WORD- Excel
	Standard plug-in: Bandwidths – 1 independent bandwidths
	Tracks – Upto 128 tracks
	Modes – Start to time –Start to stop
	Narrow band spectra: 401 lines (for 801, 1601,3201, 6401 lines multiply requested SPU respectively
	20 kHz bandwidth
	0% overlap
	1 channel processing = 1 SPU
	Bandwidths – DC to 20 kHz
	Averaging – Time, spectral
	Weighting window – Hanning- Hamming
	Filters – HP,LP
	Cross functions – Cross spectra
	Others – Adjustable band power tracking
5	<u>Modal Analysis Software (3D visual),</u>
	Basic geometry modelling ,display and revision of test data in time or frequency domain ,overall modal parameter identification of SIMO single frequency point in full frequency range ,Frequency based ODS 3D motion simulation ,3D simulation of modal shapes .
6	<u>Tri-axial Accelerometer with connecting cable,</u>
	Built-in IEPE preamplifier Tri-axial (x,y,z) miniature accelerometer Single 4-pin Connector.
	Measuring Range: $\pm 700g$
	Sensitivity : 10mV/g
	Frequency response, 0.5dB : 1 to 8,000 Hz
	Mounting Resonance Frequency : 40,000Hz
	Resolution 1-10,000Hz : 0.0001 g rms
	Maximum Transverse Sensitivity : $\leq 5\%$
	Non-linearity : < 2%
	Weight : Not more than 1 gram
	Connector : Single 4 pin connector
	Mounting provision : 10-32
	Housing materials : Stainless steel
	Seismic element : ceramic
	Sensing geometry : shear
	Sealing : welded hermetic
	Excitation voltage: 18 to 28 VDC
	Constant Excitation: 2 to 10 , typical 4 mA
	Output impedance : <100

	Output bias voltage : 10 to 14 VDC	
	Noise, 1 to 20,000Hz: <0.002	
	Shock limit , \pm peak : 1000g	
	Temperature range, operating : -40 to +250 °F	
	Transient temperature : 0.01 g/°C	
	Base strain sensitivity : 0.0002 g/ μ e	
7	Accessories	
	Calibration certificate	
	10-32 mounting stud	
	Single 4 pin connector with 5meter length and 3 BNC male connector end.	
8	<u>Fixture with test specimen.</u>	
	and forced vibration setups ,	
	of free and forced vibration.	
9	Any other accessories if available for better utilization	Bidder to specify and quote if any other accessories available /required for smooth running and better utilization of the machine.
10	Scope of supply	Bidder should submit complete scope of supply (Machine, standard accessories, Optional Accessories etc with make model) in the technical bid without price. Bidder should supply complete start up package including material necessary to prove the machine and provide training.
11	Installation requirements	Bidder to specify , pre-installation requirement
12	Installation & Training	Basic and Advanced training should be provided at no extra cost Also the required operation, maintenance and other reference manuals should be provided for getting quality output and longer trouble free life of machine.
13	Technical support and service	Availability of technical support in the area of application and service both within the country. The tenderer shall have local service and application office and infrastructure to attend by visit within 48 hours of need.
14	Manufacturer's credential	Should have sizable installations of same model worldwide and at least two same or similar models in India.

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3D printer - High Temperature Materials

1	MACHINE	
1.1	Make	Bidder to specify
1.2	Model	Bidder to specify
1.3	Technology	Solid based production additive manufacturing system based on Material Extrusion technology, capable of producing parts for high temperature and strength application.
1.4	Machine Capability	Should be able to build high strength, high performance and high temperature and medical grade materials. Provision for inclusion of new materials developed by R&D.
1.5	Minimum Build Volume (X, Y, Z)	200 mm x 170 mm x 150 mm (maximum allowable deviation 10%)

1.6	Layer Thickness	Minimum horizontal build layer thickness 0.1 mm or better Greater/lesser than 0.1 mm can be quoted as additional features.
1.7	Part accuracy (in all three directions)	+/- 0.1 mm or better
2	Material Handling	Material handling systems should be part of the Printer with automatic material loading, feeding and storage management system. At any instance of the machine operation during idle or run time, the machine shall indicate the quantity of material available in the spool / cartridge for optimizing the material consumption.
3	Operation and Process	Controlled Chamber temperature
		Material extruding nozzles should have self-cleaning mechanism
		Auto calibration of build platform for coordinates.
		Auto and manual calibration of offset between model and support nozzle.
4	Display Feature	Printing status, Material in cartridge, Temperature of chamber and print head/nozzle etc..
5	Part building	Direct printing on base plate
6	Facility Requirements	Machine compatible of working in office/lab environments setup.
		Noise level of the machine at the lowest level preferably 70 decibels. Relevant documentation/test results to be provided.
7	MATERIAL	
7.1	Model Material	Suitable Materials for medical, aerospace and other high performance engineering application.PEEK, Medical grade PEEK, CFR PEEK, PEI and metals. Medical grade material should be biocompatibility and sterilisation properties and Confirming ISO 10993 or equivalent standard.
8	SOFTWARE	
8.1	Slicing and control	Software should capable to edit the internal structure of each layer and/or group of layers of the CAD model.
		Software should generate customizable build styles
		Software should provide real time part build status, time etc.
		Software should have capability to section large parts which does not fit into the build volume
		Software should be able to create stabilizing structures to support build of thin and tall geometries. And ability to put supporting structures to prevent warpage in case of large flat and bulky parts.
		Software allow the user to add various jobs to a queue for sequencing and job management
		Software should have ability to pre-program pauses on any layer of the generated slice file to add metal inserts, change color of filament.
		Software and its support/updates/upgrades should be from OEM/manufacture of the offered machine.
8.2	License	License must be perpetual
9	Networks Connectivity	10/100 base T connection. Ethernet protocol
10	Workstation Compatibility	Compatible with latest Windows OS
11	Regulatory Compliance	Machine should be Regulatory Compliance - CE / FCC Relevant documentation to be attached.

12	Safety	The machine and all the accessories supplied to meet objective should be able to operate without any risk or hazard, without any additional protection, provision, training or guarding devices and meet current international standards. Operations of machine should be in closed chamber with necessary safety measures. Chamber door must auto lock during part building.
13	Essential Accessories	
13.1	Support removing system	Bidder should specify and quote as per the requirement
13.2	Consumables	Bidder should supply minimum quantities of consumables like build platforms, wiper blade, brush etc., required for 6 months. Also bidder should supply minimum quantity of model material each type 10 Canisters and support material each type 05 Canisters. Minimum two sets of Nozzles for different layer thickness minimum to maximum for all types of materials.
13.3	Compressor	Bidder should supply suitable compressor with dryer and filter units along with the machine, the compressor should have an air storage capacity that support the machine and its accessories for at least 1 hr at the time of power failure.
13.4	De-humidifier	Vendor should supply suitable de-humidifier to maintain room humidity level within suitable range for machine operation.
13.5	Filament Dryer	Bidder to specify and quote suitable system for drying the filament
13.6	Sintering & De-binding station	Bidder to specify and quote suitable system for printing of metal parts
13.7	Online UPS	Vendor should supply suitable UPS with minimum 60 minutes power backup for the machine and essential accessories. Should have built in safety to protect machine from voltage spikes and sudden surges.
13.8	Workstation with accessories	Bidder should supply suitable latest model OEM workstation with complete accessories and UPS for handling large size stl data (128 GB RAM, i7 or higher processor, Hard disk 5TB, 4GB dedicated Graphics card)
13.9	Tool kit	Bidder should supply standard tool kit for startup, removal of parts and cleaning (list to be attached).
13.10	Any other accessories required	Bidder should quote and supply any other accessories for high speed printing, material transport trolleys / carts and spares required for effective and better utilization of machine.
14	Scope of supply	Bidder should submit complete scope of supply (Machine, standard accessories, Optional Accessories etc with make model) in the technical bid without price. Bidder should supply complete start up package including material necessary to prove the machine and provide training.
15	Terms & Conditions	The bidder must have supplied machines at other Institutes in the past (a satisfactory performance certificate from those users may be solicited if needed). Bidder should submit complete contact details.
		Manufacturer of the supplied equipment must be ISO Certified
		Authorization Letter from OEM
		List of clients in last five years to be provided.
		Manufacturer/Supplier should have sizable installations of same model worldwide and at least Fives in India.

16	INSTALLATION, COMMISSIONING AND TRAINING	
16.1	Installation and commissioning requirements	Bidder should state the space required and condition of floor and any other requirements for installation of the machine and equipments. State clearly the specifications of electrical requirement. Vendor should carry out installation and commissioning of the machine and its accessories on a turnkey basis.
16.2	Training and documentation	<p>Minimum of 5 days training for five persons which includes basic & advanced level training. Training content and plan to be submitted. Training faculty must have adequate experience in this field.</p> <p>The vendor should supply the necessary manuals such as</p> <ul style="list-style-type: none"> • Software instruction • Maintenance and trouble manual • Training • Installation and Commissioning • Handling of accessories • Software key (if any) • Software CDs
16.3	Technical support and service	Manufacturer should have established after sales & service network in India. The vendor shall have local service and application office and infrastructure to attend by visit within 48 hours of need. Technical support personnel must have adequate experience in this field. Technical support personnel details should be submitted. Name and address of the authorized service centre/ partner in India along with the certificate of authorization should be attached.

17 AUTOMATIC MELT FLOW INDEX TESTER With PC & Software

Quantity		01No
Make, Model, Series & Sr. No.		To be specified by Bidder for all including PC & other accessories
Reference Standard		ASTM D 1238 (Method A,B,C&D) & ISO 1133
Purpose		For automatic Measurement of Flow behaviour of Polymeric materials as per ASTM & ISO methods
TECHNICAL SPECIFICATION		
1	Temperature Range	Working range 30 to 400°C
2	Temperature Accuracy	± 0.1 °C
3	Timer	Digital timer with a range of 999.9 Sec or better, accuracy ±0.001 Sec with buzzer indication facility.
4	Temperature Controller	Electrically heated with Microprocessor based PID Digital Temperature Controller
5	General requirement	Corrosion resistant pistons and barrel inert to the test materials confirming to ISO 1133 & ASTM D1238 with dimensional conformity Traceable certificate.
6	Test Weights	Standard Weights/masses (0.325 kg, 1.0 kg, 1.2 kg, 2.16 kg, 3.8 kg, 5 kg, 10 kg, 15 kg & 21.6 kg) with mass conformity Traceable certificates.
7	Die Material	Tungsten Carbide with dimensional conformity Traceable certificate
8	Die Dimension	Confirming to ASTM 1238 & ISO 1133

9	Cutter	Automatic extrudate cutting device.
10	Special Features	<ul style="list-style-type: none"> • High-Precision digital Encoder for automatic measurement of MVR • Auto weight Loader and Lifter for automatic and accurate test mass application • Integrated Load system for material compacting, purging and final expulsion with a controlled and programmable force • High-temperature accuracy and stability • On-board interface for method setting and visualization of results • Fully automatic mass selector system to carry out tests with single weight or multiple weights in increasing, decreasing or free sequence. • Built in timer with buzzer alarm. • Temperature accuracy and stability according to standards on whole working range • Quick release die slide • Corrosion-resistant material for barrel, piston, and dies
11	Software	<ul style="list-style-type: none"> • Software for set up of parameters, automatic control of operations like automatic weight lifter, storage of various test parameters & measurement points & Standard functions like auto calibration , calculation & data collection. • PC control and advanced data analysis. • For Graphs and numerical data for the whole test, Basic statistical analysis of data • Shear Rate, shear stress, and viscosity (flow curve from multi-weight tests), MVR, Intrinsic Viscosity (I.V.) estimated through correlation with MFR data/MVR Data. • Operating console with LCD display
12	Others Accessories	<ul style="list-style-type: none"> • Standard Tool Kit containing cleaning tool for barrel and die, compression tool, die removing tool, die plug, cut-off knife, • Should be supplied with suitable external thermometers suitable to calibrate the barrel temperature at 190°C & 230°C with traceable calibration certificate (188°C to 192°C with readability 0.1°C) & (228°C to 232°C with readability 0.1°C). • Go/No - Go gauge for capillary diameter complete with dimensional conformity traceable certificate – 01 No. each • 01 No. of extra Standard die & 01 No half die as per standard • PC of suitable configuration with necessary software
13	Standard Reference Materials	Standard Reference Materials of low MFI & with NIST traceable certificate as per ASTM 1238 requirements to be supplied.
14	Other Mandatory Items	<ul style="list-style-type: none"> Hard copies of Operational & Service Manual- 01 set Safety gloves & goggles required for day to day activities during operation of Machine-01 set Necessary Hoses & Nipples & pressure controller sytem required to connect the air line & Switches & adaptors for electrical connection-01 set The Machines should come with all other essential accessories & spares (as per ASTM & ISO standards) required for installation, commissioning & operation. Onsite free operational Training

CONTOUR CUTTER

Quantity		01No
Make, Model, Series & Sr. No.		To be specified by Bidder for all including accessories
Reference Standard		ASTM 638, ASTM D790-17, ASTM D5930-17, ASTM D257-14, ASTM D3039-17, ISO 294-1, 294-2, IS -14151 Part-1 Type-2 dumbbell, For Tensile specimen - ISO 527-2-2012, Parts-4 and 5, IS 12701 (Tensile and Flexural specimen), IS 4984-2016, IS 13360 (Part-5 sec 6) rectangular
Purpose		For preparation of test specimens out of thermoplastic (rigid) materials & composite sheets to be used for Testing as per various Standards.
TECHNICAL SPECIFICATION		
1	Table size (LXD)	330 x 375 mm or equivalent
2	XYZ axes stroke	310 x 220 x 160 mm or equivalent.
3	XYZ axes movement resolution	3 µm or better
4	XYZ axes positioning repeatability	0.02 mm or better
5	Fraise head holder movement	Through a step motor and suitable dia.ball, screw without backlash, 5 mm pitch.
6	Max speed (mm/sec)	100
7	Fraise rotation speed (rpm)	8000 to 24000 set manually according to the material type
8	Shield opening safety lock	Timed door lock release.
9	Emergency stop	Red panic button (Mushroom type)
10	Voltage(V)	230
11	PC connection	series RS232
12	Dimensions	600 x 800 x 700mm or equivalent with safety shield closed (L x W x H)
		600 x 850 x 900 mm or equivalent with safety shield open (L x W x H)
13	Other special features	•Vacuum system for dust collection to be included
		•Set of cutter for various type of materials and for different type of finish
		•Speed control
		•Dimension control
14	Personal Computer (PC)	A Personal Computer (PC) of reputed make (bidder need to mention the make & model while quoting) having latest configuration. All software shall be loaded in the hard disk with appropriate partitions. All original CDs/DVDs must be provided.
15	Other Mandatory Items	• Hard copies of Operational & Service Manual- 01 set.
		• All templates as per standards mentioned above with traceable calibration certificates
		• Machine should come with all other essential accessories & spares required for installation, commissioning & operation
		• Onsite free operational Training

REFRACTOMETER

Quantity		01No
Make, Model, Series & Sr. No.		To be specified by Bidder for all including accessories
Purpose		Capable to Measure Refractive Index and Abbe number for Solid and Liquid Samples at different wavelengths. The refractive index curve as a function of wavelength to be obtained.
TECHNICAL SPECIFICATION		
1	Refractive index range	1.3 to 1.7
2	Wavelength Range	450 nm to 1100 nm with suitable filters
3	Light Source	LED
4	Display	LCD
5	Interface	RS 232 with PC.
6	Accessories	Suitable attachments for solid, liquid and film samples, Spare lamp, Standard reference material with known refractive index for calibration
7	Other Mandatory Items	While supplying the Machines, the supplier should also provide the following items apart from above: <ul style="list-style-type: none"> • Hard copies of Operational & Service Manual- 01 Set . • Traceable NABL Calibration certificate for the Standard Reference Material. • Machine should come with all other essential accessories & spares required for installation, commissioning & Operation. • Onsite free operational Training

VOLUME & SURFACE RESISTIVITY TESTER

Quantity		01No
Make, Model, Series & Sr. No.		To be specified by Bidder for all including accessories
Reference Standard		ASTM D 257
Purpose		Should be Suitable For Electrical testing of Plastics, Rubbers, Films, FRP Composites.
TECHNICAL SPECIFICATION		
1	Resistance Measurement Range	10^3 to $10^{14} \Omega$ Type of Measurement: Direct-reading from the instrument Ohms Shunted by Insulation Resistance from main electrode to Guarded Electrode
2	Resistance Measurement accuracy	$\pm 0.5\%$ of setting value
3	Test Voltage Range	Programmable test voltage up to 1000V
4	Voltage Accuracy	$\pm (1\% \text{ of setting} + 2V)$ with resolution 250 mV

5	Display type	High-visibility blue LCD Graphical Display, High-Voltage Indicator & Pass/Fail indicator
6	Standard features	Fully programmable via on-screen, Safety interlock, keypad lockout, measurement averaging (1-140 readings), programmable test times, automatic zeroing of test Load.
7	Operating temp. range	Ambient to 50°C
8	Operating humidity range	45% RH to 90% RH
9	Electrode	1) Standard electrodes with guard ring .The electrodes for insulating materials should be of a material that is readily applied, allows intimate contact with the specimen surface, and introduces no appreciable error because of electrode resistance or contamination of the specimen.The electrode material should be corrosion-resistant under the conditions of test. For tests of fabricated specimens such as feed-through bushings, cables, etc.
		2) Broad combination of electrodes support for measuring a wide variety of objects having different size and shape (Circular, Rectangular, Square, Tube, Cable etc.)
10	Calibration Kit	Required calibration kit should be provided along with instrument.
11	Interface	RS-232 interface, I/O port with safety interlock, USB Host Port for Data/Program storage
12	Additional Requirements	Vendors must have sufficient experience in supplying equipment to reputed organizations of Plastic/polymer Industries. Sheets and molded products should be measured just as they are without the need to cut samples.
13	Power Supply (Mains)	220 V AC in single
14	Other Mandatory Items	While supplying the Machines, the supplier should also provide the following items apart from above: <ul style="list-style-type: none"> • Hard copies of Operational & Service Manual- 01 Set . • NIST/NPL Traceable Calibration certificate of equipment • Machine should come with all other essential accessories & spares required for installation, commissioning & Operation. • Onsite free operational Training

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ATOMIC ABSORPTION SPECTROPHOTOMETER WITH FLAME AND GRAPHITE FURNACE

Quantity		01No
Make, Model, Series & Sr. No.		To be specified by Bidder for all including PC & other accessories
Purpose		For detection of various heavy metals as per IS 12235
TECHNICAL SPECIFICATION		
S.No.	Description	Specifications

1	Atomizer System	A compact integrated dual atomizer system with inbuilt flame and furnace atomizers. Changeover from Flame to Furnace mode and vice-versa should be automatic and controlled through the software. Furnace autosampler should be permanently aligned with the system with no manual changeover. The vertical and horizontal alignment (if needed) of the flame burner head in the light beam should be Motorized automatic through the software. Separate 10 cm titanium burner head for Air – Acetylene flame and 5 cm titanium burner head for Nitrous oxide – Acetylene flame should be supplied with the system. Suitable Zeeman Background correction for GF to have higher light throughput. The Furnace Autosampler must be integrated to main Spectrometer with a minimum of 60 sample positions. The system should be equipped with an integrated graphite furnace camera as a standard for easy autosampler tip alignment and real time viewing of the process happening in graphite furnace. The GF system should be supplied with pyrolytically coated graphite tube, integrated platform, rapid furnace heating (up to 3000 °C/s). A good quality air compressor and a recirculating water chiller unit of appropriate capacity for cooling of Graphite Furnace must be quoted by the manufacturer. Auto Sampler for flame should be quoted .
2	Lamps	The system should have a minimum 6 lamp holder with a provision of automatic lamp selection. Built-in power supplies for Coded Hollow Cathode Lamps that are used for the analysis of volatile elements like As, Pb, Hg, Se, etc. (HCL's or other types of specific lamps should be quoted for specific elements if required). Lamps & Standards for elements Aluminum, Antimony, Arsenic, Cadmium, Chromium, Copper, Iron, Lead, Mercury, Molybdenum, Nickel, Selenium, Tin, Titanium and Zinc.
3	Sample Introduction System	A high sensitivity nebulizer system including impact bead with corrosion resistant against the acids like 5% hydrofluoric acid, hydrochloric acid and Nitric Acid. Corrosion resistant spray chamber.
4	Optical System	A double beam spectrometer system with high light throughput optical system with a diffraction grating ruling density of atleast blazed in both UV and Visible regions. Reciprocal linear dispersion 0.5 nm/mm at 200 nm. Optical resolution should be available as 0.1nm for better sensitivity at UV region.
5	Detector	Photomultiplier Tubes (PMT) or Solid State Detector, Wavelength range: 185 – 900 nm
6	Background Correction Methodology	Zeeman Background Correction for the Graphite Furnace with the magnetic field applied along optical path should be available
7	Gas Flows system	Software controlled gas flow and automatic changeover of oxidant flow from air to nitrous oxide when switching to or from air-acetylene to nitrous oxide – acetylene flame.
8	Additional Features	All safety interlocks built-in and additional feature like Burner Head Interlock, Nebulizer/End Cap Interlock, and Drain Interlock to be built-in.
9	Sensitivity	Greater than 0.8 absorbance with the precision of <0.5% RSD from 5 second integrations for 5 ppm Cu standard

3	Capillary Rheometer	Twin bore rheometer for rheological properties - R&D, advanced measurement capabilities under high pressure and high shear rate for plastics, polymer, rubber, composite, compound, recycled materials, ceramics, inks and coating.
4	Mesuring mode	Constant speed
		Constant pressure/ force
5	Piston	Lowest test speed: 0.005 mm/min or lower
		Maximun speed: 1000 mm/min or higher
		Dynamic speed ratio: 2,50,000:1 or better
		Independent load cell on each piston
		Advanced high resolution and accurate speed control system (vendor should furnish details of speed resolution and speed control system in details)
6	Barrel	2 Barrels system: 2x15mm bore diemeter
		Lenth: standard 290 for each barrel
		MOS: Hastelloy or equivalent corrosion resistant metals
		Barrles should be straight, smooth, without any tools mark.
		Barrels must be easily accessible for both feeding of test samples and also for cleaning after the testing.
		Each barrale should have three independet heating zone
		Cleaning device and accessories should be integrated for barrel cleaning at the end of each test.
		Should have inert gas purging unit for moisture and tempearature sensitive materialsr and to minimize sample degradation
7	Force	50 kN or better
		Accuracy :0.4% for whole range
8	Pressure transducer range	Pressure range : 0 to about 2000 Bar
		Accuracy: <0.5%
		Vendor should provide 02 sets of pressure transducers with max. pressure of about 50 bar, 200 bar,1000 bar and 2000 bar with 0.1 bar resolution

9	Temperature range and control system	Ambient to 400 °C or more
		Temperature resolution: 0.1 °C
		Microprocessor based temperature control, heating rate should be in between 0.5 to 5.0 °C
		Should have at least three independent temperature zones
		Temperature accuracy: ± 0.2 °C or better
10	Capillary dies	MOS: Tungsten carbide
		A: (i) Dia: 1 mm, length 10 mm (ii) Dia: 1 mm, length 20 mm (iii) Dia: 1 mm, length 16 (iv) Orifice Dia: 1 mm, length: 0.25 mm; Vendor should also provide Orifice dies for every die diameter for Bagley correction .
		B: (i) Dia: 1 mm, length 16 mm (ii) Dia: 1.5 mm, length 20 mm (iii) Dia: 0.5 mm, length 08 for wall slip
		Vendors should provide other dies as required to operate rheometer from lowest to highest shear rate for measurement of all rheological properties.
11	Rheological properties measurements	Vendor should provide all necessary accessories for following measurement options according to International standards:
		i). PVT
		ii). Dynamic and static laser die swell measurement
		iii). Shark-Skin (Flow instabilities)
		iv). Pressure dependence of viscosity (Measurement of pressure coefficient, wall slip's critical shear rate, Maximum pressure.); and Viscosity measurement
		v). Thermal conductivity (optional)
		vi). Extensional viscosity (Blown film, forms, spinning and coating materials)
		vii). Melt strength measurement (Fiber spinning materials)
		viii). Melt temperature determination
		ix). Melt cutting unit

		x) Constant shear test; extensional test; Die swell; Wall slip analysis; Melt fracture; thermal stability; Low speed degradation; Stress relaxation; Intrinsic melt viscosity; Viscosity dependent on temperature; Fitting equation for viscosity at zero shear rate and relaxation time etc.
12	Standards	<p>ISO 17744 (PVT; Determination of specific volume of plastics as a function of temperature and pressure; measurement under constant pressure or constant temperature));</p> <p>ASTM D3835 (Measurement of melt viscosity, sensitivity or stability with respect to temperature and polymer dwell time; and die swell ratio, shear sensitivity when extruding under constant rate or stress);</p> <p>ASTM D5099 measurement of rheological characteristics of raw rubber</p> <p>DIN 5930 (Thermal conductivity of plastics in the range from -40 to 400 °C; conductivity range 0.08 to 2 W/m.K ; covering thermoplastics, thermosets, rubber and filled and reinforced)</p> <p>ISO 11443 (DIN 54811) (fluidity of plastics melt</p>
13	PC	Rheometer should be integrated with a branded PC, with latest processor (i7 and above), 3.0 GHz or higher, 8 GB RAM, 21" LCD/TFT color monitor, at least 1.0 TB hard disk, CD/DVD writer, 2 serial, 1 parallel port, keyboard, branded scroll mouse and a ethernet port.
14	Softwares modules and features	<p>Vendors should provide licensed softwares with re-installation capability when required, full functionalities for measurement and analysis of following rheological properties :</p> <p>i). PVT</p> <p>ii). Dynamic and static laser die swell measurement</p> <p>iii). Shark-Skin (Flow instabilities)</p> <p>iv). Pressure dependence of viscosity (Measurement of pressure coefficient, wall slip's critical shear rate, Maximum pressure.); and Viscosity measurement with Slit Capillaries</p> <p>v). Thermal conductivity (OPTIONAL)</p> <p>vi). Extensional viscosity (Blown film, forms, spinning and coating materials)</p>

		vii). Melt strength measurement (Fiber spinning materials)
		viii). Melt temperature determination
		Software module should be user-friendly with following capabilities:
		i). All operations such as parameter setting, test start, data acquisition and processing, saving and re-processing controlled through software
		ii). Online and real-time display should be for raw data signal (load/pressure) etc.
		iii). Should have automatic Rabinowitsch/Bagley/Hagenbach corrections and non-Newtonian index calculations with appropriate hardware
		iv). Should be able to export raw data as well as processed data to excel or any other data management system.
		v). Should be able to perform other calculations such as application of viscosity models (Cross, Cogswell or Carreau, etc.) to viscosity data or application of temperature shifts to data using some standard relations.
		vi). Should enable to feed in any shear rates (increasing/ decreasing/ arbitrary) for testing.
		vii). Software must be capable of displaying raw data during experiment
15	Safety features	Protective cover, hood, limit and safety switches and any other required safety provisions must be in place.
16	Scope of supply	Vendors must provide separate complete list of accessories needed as per tender specification. It should include any other optional accessories.
17	Tool Kit	Vendor must provide complete tool kit for maintenance
18	Calibration	Vendor should provide Hand tools for: charging and cleaning barrel, scouring brush, Sample filling funnel, Die nut removal wrench, cleaning capillary dies, Go/No Go gauges, Barrel Bore Calibration kit etc. for easy operation and maintenance of rheometer.

19	Calibration	Vendor should furnish all certificates traceable to international standard for : force calibration, Pressure transducer calibration, temperature calibrations and dies dimension.
20	Documentation:	All Claims made by the vendor with regards to the above specifications should be supported by specification sheets / brochures / data available on company website. No claims with regards to laboratory data will be accepted.
		Complete original operating & service manual hardcopy along with softwares pack
		if any deviation in tender specification, vendor must clearly mention during compliance statement according to their quoted model
21	Warranty	Vendors should provide at least three years warranty of whole rheometer including temperature sensors, pressure transducers etc.
22	Reference materials	Reference Plastic material of Low Viscosity & High Viscosity -01 kg each

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ROTATIONAL RHEOMETER

1	Make	Bidder to specify
2	Model	Bidder to specify
3	Motor technology	Drag Cup Motor/Brushless DC Motor/ EC Motor
4	Operation Mode	Stress control, Shear rate control and direct strain controlled oscillation at demand strain amplitude.
		A pure Sinusoidal Waveform at all times must be ensured irrespective of the strain imposed.
5	Bearing	Air Bearing system to ensure lowest radial drag & highest axial stiffness.
6	Motor torque	The torque motor must have very low inertia $\leq 15 \mu\text{N.m.s}^2$ to allow rapid transient change of strain, speed and measurement at high frequency with minimal correction for instrument inertia. There should be a standard test available in the system to calculate the motor inertia without applying any corrections & should be demonstrated during the tender process.

		Torque in Oscillation Testing mode: Min.: ≤ 0.5 nN.m; Max.: ≥ 200 mN.m
		Torque in Rotational Testing mode: Min.: ≤ 1.0 nN.m; Max.: ≥ 200 mN.m
		Torque resolution: Should be 0.1 nN.m or better
7	Frequency	Min.: 1 μ Hz; Max.: ≥ 100 Hz
8	Normal force	Min.: ≤ 0.01 N; Max.: ≥ 50 N
		Normal force resolution: 0.5 mN or better
		Force rebalance transducers (FRT)
9	Angular deflection and Speed measurement	The Angular deflection and Speed measurement should be done with a High Resolution Optical Encoder. This should allow the user following range of:
		i). Angular deflection range: 1 μ rad to ∞ μ rad
		ii). Angular Velocity range from 1 nrad/s to ≥ 300 rad/s
		iii). Angular deflection Resolution: ≤ 12 nrad
		iv). Maximum Speed: 3000 rpm
10	Raw data	All raw data measured by the instrument like harmonic distortion, phase angle etc should be available in the software. Software for measurement of Normal Force & Velocity Profiles for Tack & Squeeze experiments should be available in the software. Influence of instrument inertia and rotor compliance on test results. Raw data for rotational step experiments etc.
11	Gap Control (Standard)	Automatic Gap Compensation
12	Temperature control	Suitable electric heating device for temperature ranging from -20 $^{\circ}$ C to 400 $^{\circ}$ C for parallel plates and cone/plate measuring geometries.
		Independent top and bottom plates temperature control for parallel plates and cone/plate measuring geometries.
		Temperature ramp:

		Heating rate : 40 °C/Min or higher
		Cooling rate: 30 °C /Min or higher
		Automatic Recognition of Temperature Control Modules and Special Accessories.
		Cup & Bob geometries with Peltier temperature module – temperature range from -20 °C to 200 °C.
		Easily connect geometries & Cartridge environmental controllers: Plug & Play; Auto configuration.
		The temperature control unit should be able to accommodate plate-plate, cone & plate systems & other geometry of mentioned below.
13	Measurement type	Rotational, Oscillatory, Tack/Squeeze & Transient
14	Mesuring Geometries	The following geometries with Temperature control should be offered for rheological properties measurement of solid polymers and melts, soft polymers, rubber , composites, paste, liquid, emulsions, solution, oil, resin, etc.
		i). Parallel plates (MOS: SS)
		Plates Dia.: 8mm, 25mm, 40mm, 50mm - 01 pair for Each for lower and upper plate
		ii). Cone and plate (SS)
		Cone: 1°/8mm diameter or similar - 01 No.
		Cone: 2°/20mm diameter or similar - 01 No.
		Cone: 1°/40 mm diameter or similar - 01 No.
		iii). Cup & Bob
		Cup and bob sizes C14 (DIN), C25 (DIN) and wide diameter C34. Hard anodized aluminium material, SS 316, Designed for optimized thermal properties and mechanical alignment. Quick-connect engagement mechanism and auto-recognition and configuration.
		Measurement geometries (parallel plate and cone & plate) must have appropriate solvent trap system where it is applicable.
		Vendors should provide Lower measuring plates with the same diameter as the upper plate or cone geometry to assure correct sample filling.

		Temperature modules and measuring geometries with easily couplings are able to automatically recognized.
		iv). Disposable fixtures for curing study (25 mm dia. Aluminium): 100 No.
15	Other features of rheometer	<p>The Rheometer should have the easy Fit concept of connecting tools without any threading or special fixtures. The Rheometer should have capability of wirelessly identify the connected tools. The Tools should be supported with Automatic Locking system to allow ease of Sample loading & trimming.</p> <p>Inertial correction for all geometries; Inertia calibration; Gap validation; Air bearing friction correction</p>
16	Rheology software and PC	<p>Vendors should provide licenced softwares (with multiple re-installation capabilities and future upgradability free of cost when it required) with full functionalities for measurement and analysis of following rheological properties. The software should be pre-programmed for all types of materials and testing protocols for all type of Rheology variables to obtain data profiles like</p> <p>i). Viscosity Curve as a function of Time, Temperature, Shear Rate and Shear stress</p> <p>ii). Complex Viscosity as a function of Time, Temperature, Frequency, Strain and stress</p> <p>iii). Shear Stress as a function of Shear Strain to identify the LVER (Linear Visco-Elastic Region) of the Sample</p> <p>iv). Elastic (G'), Loss (G''), Complex Modulus (G^*), Tan δ as a function of Time, Temperature, Frequency, Strain and Stress in Shear mode</p> <p>v). Elastic (E'), Loss (E''), Complex Modulus (E^*), Tan δ as a function of Time, Temperature, Frequency, Strain and Stress in Linear mode</p> <p>vi). Creep Compliance as a function of Time at different Temperatures in Single or Multiple Creep Zones.</p> <p>vii). Transient Measurements: creep/creep recovery measurement; Stress relaxation measurement</p>

		viii). Large Amplitude Oscillatory Measurement : Time-temperature superposition for generating master curve analysis
		ix). Tack and Squeeze flow measurement
		Software package re-installation (in case required) and software updations during the warranty period, in case any, need to be provided to us free of charges.
		The system should be offered with suitable & branded windows operating system based PC workstation.
		Raw data: All raw data measured by the instrument like raw phase angle, harmonic distortion, phase angle etc should be available in the software. Software for measurement of Normal Force & Velocity Profiles for Tack & Squeeze experiments should be available in the software. Influence of instrument inertia and rotor compliance on test results. Raw data for rotational step experiments
17	Air pressure requirement	Vendor should provide suitable air filtration system only along with necessary pressure regulators to be fitted with available centralised air piping system.
18	Scope of supply	Vendors must provide separate complete list of items as per tender documents. It should include any other optional accessories.
19	Tool Kit	Vendor must provide complete tool kit with hand tools for maintainance and operation of rheometer
20	Documentation:	All Claims made by the vendor with regards to the above specifications should be supported by specification sheets / brochures / data available on company website. No claims with regards to laboratory data will be accepted.
		Complete original operating & service manual hard copy along with softwares pack
		if any deviation in tender specification, vendor must clearly mention during compliance statemnt according to their quoted model.
21	Calibration	Vendors should provide at least thre years warranty of rheometer

22	Warranty	Vendor must furnish all calibration certificates with NIST tracability for motor (torque). Temperature cabration for electric and peltier heating elements.
23	Reference Materials	PDMS, Low and high viscosity oil should be provided

24

Abrasion Tester

	NAME	Abrasion Tester
	QUANTITY	1
	Make, Model, Series & Sr. No.	To be specified by Bidder for all including accessories
	TYPES OF TESTS TO BE PERFORMED	To determine the Abrasion Resistance of Plastics and allied materials as per various Standards.
	APPLICABLE STANDARD	ASTM D1044, ASTM D 4060, ASTM D3389
	<u>TECHNICAL SPECIFICATION</u>	
	PARAMETERS	DETAILS
	Equipment platform	A horizontal turntable platform; comprised of a rubber pad, clamp plate, and nut to secure the specimen to the turntable.
	Motor	A motor capable of rotating the turntable platform at a speed of either 72 ± 2 r/min for 110v/60Hz or 60 ± 2 r/min for 230v/50Hz.
	Weights	1) A pair of pivoted arms, to which the abrasive wheels and auxiliary masses may be attached; loads of 250, 500, or 1000 g on each wheel may be obtained by use of these changeable masses. Counterweight attachments of 125 or 175 g should be available to reduce the load against the specimen, and can be used with or without the auxiliary masses.
		2) Without auxiliary masses or counterweights, each arm will apply a load against the specimen of 250 g per wheel (exclusive of the mass of the wheel itself).
	Abrasive Wheels	1) Resilient Calibrase wheels No. CS-17, CS-10, H-18, H-22, CS-10F as required as per the standard.
		2) The wheels shall be 12.7 ± 0.3 mm thick and have an external diameter of 51.9 ± 0.5 mm.
		3) Abrading Wheel material should be Mild to Medium action, Resilient Binder, Aluminum oxide or silicon carbide particles.
	vacuum suction system	A vacuum suction system and vacuum pick-up nozzle to remove debris and abrasive particles from the specimen surface during testing. The height of the vacuum pickup nozzle & nozzle opening shall be adjustable as per the standard requirements. The vacuum system shall operate when testing commences.
	Cycle counter	99999 cycles (Maximum) with digital display
	Display & Control Panel	Compact, durable design of control panel, digital display for the LED readouts and input key pad for operation. Control panel should contain usefull information like ,Cycle selector key, Vacuum level key, Cycles completed key etc.

	Calibration Kit	Required calibration kit should be provided along with instrument. Procedures in the kit should allow the user to verify: Wheel Alignment and Tracking, Wheel Bearings Condition, Vacuum Suction Force, Turntable Platform Position, Turntable Speed & Load.
	Resurfacing Medium	Diamond wheel refacer
	Sample cutter	To prepare specimens (for soft / hard material) as per the standard with a center hole.
		Specimen Size: Ø 100 mm, center hole: Ø 8 mm
	Additional Requirements	Vendors must have sufficient experience in supplying equipment to reputed Polymer/Plastic testing Lab of Govt/PSU organizations/Petro-Chemical industries.
	Testing	Should be Suitable For Plastics, Rubbers, FRP Composites & Coating.
	Power Supply (Mains)	Single phase.
	Other Mandatory Items	While supplying the Machines, the supplier should also provide the following items apart from above:
		• Quiet cabinet to reduce sound level to be supplied .
		• Hard copies of Operational & Service Manual- 01 Set .
		• Calibration certificate of equipment to NIST/international standards.
		• Onsite free operational Training
		• Machine should come with all other essential accessories & spares required for installation, commissioning & Operation .

25

Colour Spectrophotometer

NAME		Colour Spectrophotometer
QUANTITY		1
Make, Model, Series & Sr. No.		To be specified by Bidder for all including accessories
PURPOSES		To measure Colour , Yellowness Index as per various Indian and International standards.
APPLICABLE STANDARD		ASTM D1925, ASTM E313, ASTM D2244, ASTM E308, ASTM E1164, DIN 5033, JIS Z 8722, ISO 7724/1, CIE 15: 2004
MEASUREMENT PRINCIPLE		Dual beam spectrophotometer.
TECHNICAL SPECIFICATION		
SL. No	PARAMETERS	DETAILS
6	Light Source	Pulsed Xenon lamp filtered to approximate D65
7	Viewing Aperture	Large area view : 1.75 in. illuminated, 50 mm measured
		Small area view : 1.75in, 1.00in, 0.50in, 0.25in & 0.13 in illuminated
		2in., 1.20in, 0.70in, 0.40in, 0.20in, measured
8	Lens switching for LAV/SAV	Automatic
9	Spectral Range	400-700 nm
10	Resolution	<3nm
11	Effective Band width	10 nm equivalent triangular
12	Photometric range	0 - 150%
13	Photometric Resolution	0.003%
14	Light Source	Pulsed Xenon lamp, Filtered to approximate D65 daylight

15	Lamp life	1 billion flashes or better
16	Automatic UV Control	420nm cutoff filter for UV Control & UV Exclusion
17	Measurement Time	< 3 seconds; (except 3mm area<10sec.)
		For white tile: $\Delta E^* < 0.09$ for 44mm (1.75 inch)
18	Calorimetric repeatability	For Blue denim tile: $\Delta E^* < 0.07$ for 44mm (1.75 inch)
19	Inter instrument agreement	$\Delta E^* < 0.15$ (Avg) for 44mm (1.75 in.) $\Delta E^* < 0.36$ (Max.) for 44 mm (1.75 in.) CIE Lab (max.)
20	Equipment to be supplied with all essential Accessories such as:	Calibrated white UV Fluorescent Standard with NIST Traceable certificate of calibration -01 no Sample Cup Opaque Cover-01 no Glass Sample Cup(2.5in)-04 nos Port insert, 2.5in Glass sample cup holder-01 no Sample Clamp Assembly-01 no Other parts like cable, adopter, power cord etc Black Calibration light Trap Green Check Tile Suitable advanced software & manual
21	Color matching software to measure: L, a, b, Δxyz	Suitable advanced software inbuilt with instrument
22	Other Mandatory Accessories:	While supplying the Machine, the supplier should also provide the following items apart from above: <ul style="list-style-type: none"> Branded PC (if required for operation) of best configuration with necessary software including software for colour matching & colour printer suitable for the instrument operation. Basic tool Kit-01 set Hard copies of Operational & Service Manual- 01 set The Machines should come with all other essential accessories & spares (as per ASTM & ISO standards) required Onsite free operational Training

26

Microprocessor based HDT/VSP Apparatus

1	Make	Bidder to specify
2	Model	Bidder to specify (Please attach the supporting documents like product & accessories catalogue)
3	Test Standards	HDT test as per ISO 75 & ASTM D648 and equivalents VSP test as per ISO 306 & ASTM D1525 and equivalents
4	Temperature range	From ambient to 300 °C or more.
5	Resolution	0.1°C
6	Accuracy	$\pm 0.1^\circ\text{C}$
7	No of stations	Min 03 Stations.
8	Special Features	The equipment should be automatic microprocessor-based . To be supplied with dedicated Software for test parameters management, data storage and analysis. Automatic lift at the beginning and end of tests Suitable application and removal of the weights on the test stations Automatic cooling cycle at end of test. All operations, test cycle and alarms are electronically controlled by a microprocessor via a keyboard with an LED graphic display
9	Material of construction	Inner bath: S.S Outer-M.S with good finish.

10	Cooling System	Suitable cooling system to cool the oil temp for running next operation fastly.
11	Displacement Range	0- 10mm with resolution of 0.01mm measured via LVDT transducers
12	Power	230 Volts, 50Hz, single phase.
13	Weights	For Vicat: 1 kg and 5 kg. For HDT: Set of modular binary test weights ranging from 5grams to 4000g or more as per standard.
14	Other Mandatory Items	While supplying the Machines, the supplier should also provide the following items apart from above: <ul style="list-style-type: none"> • Hard copies of Operational & Service Manual- 01 Set . • NIST/NPL Traceable Calibration certificate for the applicable parts of equipment like Weights ,Indentors geometry, Temperature controllers & dial gauge • Machine should come with all other essential accessories & spares required for installation, commissioning & Operation including silicon oil.

27

IMPACT TESTING MACHINE WITH NOTCH CUTTER ALONG WITH LOW TEMPERATURE CRYOGENIC CHAMBER

Make		Bidder to specify
Model		Bidder to specify
The impact tester should confirm to the Standards: ASTM D 256 & ASTM D 6110, ISO 180 & ISO 179		
1	Pendulum Impact Energy Range	0-25 Joules
2	Least Count of Indication	0.01 Joules
3	Release Angle of Pendulum	150°
4	Striking velocity range of Pendulum	2.5 – 3.8 m/s.
5	Hammers	Individual Hammers for Izod Impact Tests –2.75 J, 5.5 J, 11.0 J (According to ASTM D 256, ISO 180 Individual Hammers for Charpy Impact Tests – 1.0 J, 2.7 J, 5.4 J (ASTM D 6110 & ISO 179)
6	Vice	Hard chrome plated vice for Izod & Charpy test.
7	Notch cutting device	<ul style="list-style-type: none"> • Digital Notch depth measuring device (0 to 12 mm, L.C 0.001mm) • Suitable for notching plastics specimens for Izod & Charpy impact tests as per ASTM & ISO specification. The machine shall have gradual feed control mechanism with micrometer & standard notching tool. • Motor driven, attached with constant profile tungsten carbide knife, "V" notch (45°), Type A, Type B and Type C Comply to ASTM D 256 • Knife Speed Regulator • Digital tool with zeroing having accuracy of 0.01mm division for measurement of notch depth.

8	Special Features	Microprocessor Controlled equipment with possibility to modify and create test parameters according to standard and store templates, Possibility to save data and export selected data with customized format, Real time display of impact energy, resilience, pendulum angle, impact speed and statistical analysis
9	Cryogenic Chamber	Cryogenic chamber (Range : -40 °C to Ambient, Accuracy $\pm 1.0^{\circ}\text{C}$ or better, Resolution: 0.1°C) of suitable capacity to accommodate minimum 15 nos of specimens for Charpy / Izod impact test at one time.
10	Standard Accessories	Manual Izod & Charpy vice & Suitable accessories for aligning of un notched specimen according to ASTM D 256 & ASTM D 6110, ISO 180 & ISO 179 Device for Inspection & verification of Notch as per ASTM D 256 .
11	Motorised Notch Cutter & Sample Mounting accessories	Suitable for notching plastics specimens for Izod & Charpy impact tests as per ASTM D 256, ASTM D 6110 and ISO 180, ISO 179
12	Power	230V, 50Hz, Single phase
13	Other Mandatory Items	While supplying the Machines, the supplier should also provide the following items apart from above: <ul style="list-style-type: none"> • Suitable PC with Printer • Hard copies of Operational & Service Manual- 01 Set . • NIST/NPL Traceable Calibration certificate for cutting knife geometry, cryogenic chamber and hammer • Adaptor for both Izod & Charpy test as per ASTM & ISO. • Machine should come with all other essential accessories & spares required for installation, commissioning & Operation.

28

LIMITING OXYGEN INDEX TESTER (LOI)

	Make	Bidder to specify
	Model	Bidder to specify
	APPLICABLE STANDARD	ASTM D2863, ISO 4589-1, ASTM E-2931, IS-13501 and as per UL specifications.
	Digital Read out for oxygen concentration	$\pm 0.1\%$
	Test temperature	Room Temperature
		Paramagnetic Oxygen Cell for assessing accurate oxygen (< 0.1%) levels.
		Compact unit for efficient use inside a laboratory hood, with ventilation.
		Automatic flow control for oxygen level adjustment by turning one single valve.
		Quick loading of test specimen into test chimney measuring 450 mm x 75 mm or equivalent as per Standard.

		Digital display of oxygen percentage in atmosphere during test (no calculations needed).
	Features	Digital display of temperature of gas mixture entering the test chimney.
		Sample holders for both rigid and flexible samples to be supplied.
		Shortened gas path for rapid response
		<ul style="list-style-type: none"> Test apparatus includes glass beaded mixing chamber, specimen support, and heat resistant glass column.
		<ul style="list-style-type: none"> Uniform combustion atmosphere.
		<ul style="list-style-type: none"> Dual inlet gas pressure gauges. 0-100 psi
		<ul style="list-style-type: none"> Ignition wand with variable gas control valve.
		<ul style="list-style-type: none"> Suitable Smoke density measurement system with chart recorder.
	Additional Requirements	Ventilation hood compatible with the instrument to be supplied
		Transparent radiant heated test column.
		Air pump to conserve oxygen and nitrogen supply during standby period
	Should be Suitable For	Testing of Polymers, Rubbers, Fibres, Films, FRP products and allied products
	Other Mandatory Items	While supplying the Machines, the supplier should also provide the following items apart from above:
		<ul style="list-style-type: none"> Hard copies of Operational & Service Manual- 01 Set .
		<ul style="list-style-type: none"> Required filled gas Cylinders(Nitrogen and Oxygen) with best qualitySS Regulator.
		<ul style="list-style-type: none"> Calibration Certificate of supplied gas and flow meters.
		<ul style="list-style-type: none"> Machine should come with all other essential accessories & spares required for installation, commissioning & Operation.

29

Name of software : CATIA

Sl. No.	Description	Minimum No. of Licenses
1	Academic version (R2019x) CATIA 3D experience software with CATIA DESIGN/STYLING, ENGINEERING & SYSTEMS ENGINEERING modules for training purpose.	5

GENERAL TERMS & CONDITIONS

- The above Software should be supplied with Latest versions
- The quote shall be supplied with reference to the module
- The Software should be supplied in DVD / CD media for latest windows OS
- The license must be perpetual
- Warranty & AMC : Bidder should specify the warranty period from the date of acceptance of installation and training .Also submit quote for AMC as option separately.
- The Installation and training will be the responsibility of the supplier

- g) During the above period of maintenance, any upgrades released will be supplied free of cost
- h) Training : 7- Days Training shall be provided at the site after installation

30

Name of software : CREO

Sl. No.	Description	Minimum No. of Licenses
1	CREO Parametric 3D Modeling Software (academic version) with complete modules for training purpose.	20

GENERAL TERMS & CONDITIONS

- a) The above Software should be supplied with latest versions
- b) The quote shall be supplied with reference to the module
- c) The Software should be supplied in DVD / CD media for latest windows OS
- d) The license must be perpetual
- e) Warranty & AMC : Bidder should specify the warranty period from the date of acceptance of installation and training .Also submit quote for AMC as option separately.
- f) The Installation and training will be the responsibility of the supplier
- g) During the above period of maintenance, any upgrades released will be supplied free of cost
- h) Training : 7- Days Training shall be provided at the site after installation

31

Name of software : ANSYS

Sl. No.	Description	Minimum No. of Licenses
1	Latest Academic version ANSYS software with 3D Design, CFD-CFX Structure-LS DYNA bundle for training purpose.	5

GENERAL TERMS & CONDITIONS

- a) The above Software should be supplied with latest versions
- b) The quote shall be supplied with reference to the module
- c) The Software should be supplied in DVD / CD media for latest windows OS
- d) The license must be perpetual
- e) Warranty & AMC : Bidder should specify the warranty period from the date of acceptance of installation and training .Also submit quote for AMC as option separately.
- f) The Installation and training will be the responsibility of the supplier
- g) During the above period of maintenance, any upgrades released will be supplied free of cost
- h) Training : 7- Days Training shall be provided at the site after installation

32

Name of software : Hyperworks

Sl. No.	Description	Minimum No. of Licenses
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1	Latest Academic version Hyperworks software (all modules) for training purpose.	5
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GENERAL TERMS & CONDITIONS

- a) The above Software should be supplied with latest versions
- b) The quote shall be supplied with reference to the module
- c) The Software should be supplied in DVD / CD media for latest windows OS
- d) The license must be perpetual
- e) Warranty & AMC : Bidder should specify the warranty period from the date of acceptance of installation and training .Also submit quote for AMC as option separately.
- f) The Installation and training will be the responsibility of the supplier
- g) During the above period of maintenance, any upgrades released will be supplied free of cost
- h) Training : 7- Days Training shall be provided at the site after installation

33

Name of software : ABACUS

Sl. No.	Description	Minimum No. of Licenses
1	ABACUS 2019 (Academic version) software with complete modules for training purpose.	5

GENERAL TERMS & CONDITIONS

- a) The above Software should be supplied with latest versions
- b) The quote shall be supplied with reference to the module
- c) The Software should be supplied in DVD / CD media for latest windows OS
- d) The license must be perpetual
- e) Warranty & AMC : Bidder should specify the warranty period from the date of acceptance of installation and training .Also submit quote for AMC as option separately.
- f) The Installation and training will be the responsibility of the supplier
- g) During the above period of maintenance, any upgrades released will be supplied free of cost
- h) Training : 7- Days Training shall be provided at the site after installation

34

Name of software : MSC Software

Sl. No.	Description	Minimum No. of Licenses
1	Latest Academic version MSC software with Structures and Motion bundle for training purpose.	5

GENERAL TERMS & CONDITIONS

- a) The above Software should be supplied with latest versions
- b) The quote shall be supplied with reference to the module
- c) The Software should be supplied in DVD / CD media for latest windows OS
- d) The license must be perpetual

- e) Warranty & AMC : Bidder should specify the warranty period from the date of acceptance of installation and training .Also submit quote for AMC as option separately.
- f) The Installation and training will be the responsibility of the supplier
- g) During the above period of maintenance, any upgrades released will be supplied free of cost
- h) Training : 7- Days Training shall be provided at the site after installation

35

CNC Milling with Simulator - Education Model

Sl. No.	Description	Specification
1	Make	Bidder to specify
2	Model	Bidder to specify
3	Axis Travel	
3.1	X-Axis (mm)	400-425
3.2	Y-Axis (mm)	300-325
3.3	Z-Axis (mm)	250-300
4	Feed	
4.1	Rapid Feed (X, Y,Z Axes) (mm/min)	25000 or higher
4.2	Max. Cutting Feed (X, Y,Z Axes) (mm/min)	15000 or higher
5	Spindle	
5.1	Rating (KW)	5 or better
5.2	Spindle Speed (rpm)	20-8000 or higher (continuously variable)
5.3	Taper	BT40
6	Accuracy	
6.1	Positioning (μm)	10 or better
6.2	Repeatability (μm)	10 or better
7	Control System	
7.1	Controller	Fanuc / Siemens /or equivalent OEM (Latest with complete module)
7.2	Part Program Storage (GB)	Capable to store large CAM programs for continuous running
7.3	Programming Functions with editor	Complete online and offline Module
8	Essential Accessories	
8.1	Voltage stabilizer	Bidder to specify and quote suitable for the machine
8.2	Ultra Isolation transformer	Bidder to specify and quote suitable for the machine
8.3	Compressor	Bidder to specify and quote suitable for the machine
8.4	Automatic centralized lubrication system	Bidder to specify and quote suitable for the machine
8.5	Touch Probe	Bidder to specify and quote Branded quality Touch Probe
8.6	Tool holding devices	Bidder to specify and quote Set of Cutting Tools Holder for 50 mm Face mill - 1 No Collect Holder - 5 Nos Set of Collects - 3 to 25 mm Drill Chuck - 2 Nos Pull stud- 20 nos

8.7	Cutting Tools	Bidder to specify and quote Set of Cutting Tools Face mill cutter(with replaceable inserts) - Dia 50 mm Bull nose cutter (with replaceable inserts)- Dia 25 mm Bull nose cutter (with replaceable inserts)- Dia 16 mm carbide End Mill cutter (each one)- Dia. 3, 4, 5, 6, 8, 10 mm carbide Ball End Mill cutter (each one)- Dia. 3, 4, 5, 6, 8, 10 mm HSS Drills (one set) - Dia. 1 to 20 mm Centre Drill- 3 Diff. Sizes
8.8	Clamping Kit	Bidder to specify and quote Set of clamping kits
8.9	Others	Ethernet, USB ports, RS-232C
8.10	Simulator	CNC programming and operation simulator - 5 Nos
9	Any other accessories if available for better utilization	Bidder to specify and quote if any other accessories available /required for smooth running and better utilization of the machine.
10	Scope of supply	Bidder should submit complete scope of supply (Machine, standard accessories, Optional Accessories etc with make model) in the technical bid without price. Bidder should supply complete start up package necessary to prove the machine and provide training.
11	Installation requirements	Bidder to specify , pre-installation requirement
12	Installation & Training	Basic and Advanced training should be provided. Also the required operation, maintenance and other reference manuals should be provided for getting quality output and longer trouble free life of machine.
13	Technical support and service	Availability of technical support in the area of application and service both within the country. The tenderer shall have local service and application office and infrastructure to attend by visit within 48 hours of need.
14	Manufacturer's/ Supplier credential	Should have sizable installations of same model worldwide and at least five same model in India.
15	Warranty and guarantee	The machine shall be guaranteed for at least Two years for replacement and service against any design, manufacturing and workmanship defects.

36

3-matic software for Light Weight Structure

Sl. No.	Description	No. of Licenses
1	Latest Academic Research version 3-matic software for Light Weight Structure experience software with complete modules.	5

GENERAL TERMS & CONDITIONS

- The above Software should be supplied with latest versions
- The quote shall be supplied with reference to the module
- The Software should be supplied in DVD / CD media for latest windows OS
- The license must be perpetual
- The Installation and training will be the responsibility of the supplier

- f) During the above period of maintenance, any upgrades released will be supplied free of cost
- g) Training : 7- Days Training shall be provided at the site after installation