

Technical Specification for R & D Equipments

1

3D Optical Blue Light Scanner

S. No	Items	Specification
1	Make	Bidder to specify
2	Model	Bidder to specify (Please attach the supporting documents like products and accessories catalog)
3	Application	<p>Precise measurements to be carried out independently of environmental lighting conditions.</p> <p>Scanning must produces a high accuracy</p> <p>Improved measurement of complex surface, complete data on complex components with deep pockets /fine edges such as turbine blades, reducing the number of individual scans. It is portable and easy to transport at vendor site</p>
4	Scanning light	Optical Blue LED light based 3D scanning system
5	Acquisition time	Less than 2 seconds
6	Life of LED bulb	Minimum 10,000 hours or above
7	Resolution	Dual Camera system 8 Mpix each
8	System accuracy	<p>To be reported as per VDI for all Measuring / Scanning volumes.</p> <p>The System should be certified that it confirms to the above standard.</p> <p>Sphere spacing error for 500 mm, Field of View should be 30 micrometers or less – Certificate should be produced.</p>
9	Measuring Area range	1 mm x1 mm to1500 mm x 1500 mm job size or better
11	Transport box & casing	Transport box and casing to be supplied.
12	Mounting and Handling system	<p>Mounting and Handling system of Sensor by single person to be supplied.</p> <p>High Quality Studio Stand.</p> <p>10 meter sensor cables & Power supply</p> <p>Clamp sets</p>
13	Guided pointers	The system should be equipped with guided pointers for visualizing the optimum measuring distance.
14	Field of View	The item should be supplied with accessories for FOV of <100 <350 mm (or better). System should be easy and simple to setup with the ability to change only the lenses – if necessary, for adapting for different fields of views (FOV). No manual setting of focus either at projector or camera.

15	Operating conditions	The instrument should be capable of operating at 10 to 35 deg C and Relative humidity 55% or less with no condensation.
16	Consumables	10 Sheets of targets and 20 bottles of Spray to be supplied.
17	UPS	UPS should support up-to one hour of operation time of scanner.
18	Scanning Software	Capable of free form digitizing software for reverse engineering, data filtering, scanning with variable density points etc.
		· Automatic and Manual scanning and Processing
		· Calibration Accuracy Check Display
		· Motion /Vibration display
		· Quality / Accuracy Check of scans display
		Should have the ability to merge scanned data automatically without manual intervention
19	Software for 3D Surface Generation & Inspection	Multiple Alignment to CAD
		Editing - Polygon creation / editing
		· Feature extraction -Feature extraction
		· Datum creation -Should facilitate datum creation
		· 3D analysis - Tolerance and deviation Computations
		· 2D analysis - Tolerance and deviation Computations for sections and surfaces
		· Report- Should be capable of Report generation and Graphics feedback
		· Inspection features - Should be able to measure and report all GD&T Parameters
20	Laptop	A laptop for Fixed/portable requirements with the following specifications minimum - with interface cables for connecting Scanner to Peripherals / Laptop to be supplied.
		· CPU - 64 Bit Intel i7 CPU or better
		· Display- 19" or better
		· RAM-32GB RAM or better
		· NVIDIA - NVIDIA Quadro 4000M with 4GB GDDR5
		· DVD - RW
		· OS requirement - Windows 7 or better
		· Mouse - Cordless Optical
· Network Card - 1 GBPS		
21	Software License	All software should be PTB certified and perpetual License. Supply of software updates and also periodicals from the machine manufacturer till the warranty period.

23	Technical updates	Availability of information on technical update such as updated software, case studies, feedback from other customers etc. for effective utilization of the system on a regular basis.
24	Documentation	<ul style="list-style-type: none"> · Operational Manual (User Manual) · Software Instruction Manual · Maintenance and troubleshooting Manual · Training Manual · Installation and Commissioning · Handling of accessories · Software key (for operation, if any) · Software CDs
25	Calibration Plates	<ul style="list-style-type: none"> · Calibration Plate with International STD VDI Certification for all FoV · Periodic calibration of the artefact during and subsequent to expiry of warranty at a periodicity of one year for a period of five years to be indicated.
26	Any other Accessories	Any other Accessories, if available for better utilization - Bidder to specify and quote
27	System	The System shall be catalogued items from a company. All the relevant catalogues shall be enclosed in the technical bid.
28	Scope of supply	Attach list for scope of supply
29	Installation requirements	Bidder to specify , pre-installation requirement
30	Installation & Training	Basic and Advanced training should be provided a minimum 6 days
31	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.
32	Manufacturer's credential	Should have installations of same model worldwide and at least Three similar model sold in Private and Government sectors, Attach OLD PO's for REF

2

3D printer - High Temperature Materials

S. No	Items	Specification
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

		<p>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.</p> <p>Software allow the user to add various jobs to a queue for sequencing and job management</p> <p>Software should have ability to pre-program pauses on any layer of the generated slice file to add metal inserts, change color of filament.</p> <p>Software and its support/updates/upgrades should be from OEM/manufacturer of the offered machine.</p>
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	<p>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.</p> <p>Manufacturer of the supplied equipment must be ISO Certified</p> <p>Authorization Letter from OEM</p> <p>List of clients in last five years to be provided.</p> <p>Manufacturer/Supplier should have sizable installations of same model worldwide and at least Fives in India.</p>
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>

	APPLICABLE STANDARD	NA
<u>TECHNICAL SPECIFICATION FOR AIR COMPRESSOR</u>		
Parameters		Details
Type		Tank mounted Rotary Screw Type
Features	An independent Rotary Screw Type Air Compressor (Total Air Solution type) with integrated refrigeration type air dryer unit capable of continuously supplying compressed air to the machine with having	
	a) Receiver Tank (conforming to ASME Norms) fitted with Safety Valves, automatic moisture trap valve in the reservoir tank, pressure gauge. Automatic start/Stop as per the reservoir tank requirement.	
	b) Centrifugal cooling fan & Pressure Relief Valve,	
	c) Automatic Pressure Switch,	
	d) Dry type air intake filter	
	e) Oil Sight Glass	
	f) Blow down Valve,	
	g) Non Return Valve,	
	h) Pilot valve	
	i) Thermal Valve	
Working Pressure	10 bar or equivalent	
Tank Capacity	Minimum 150 Ltr	
Free Air delivery	40 CFM or better	
Air Quality	Discharge air quality should meet the requirement specified in ISO 8573-1: 2001 Type 2.2.1.	
Receiver Air tank capacity:	<ul style="list-style-type: none"> Compressor should be designed for continuous duty and fitted with standard cylinder and Low wear stainless steel Valve Maximum noise level of compressor should be 70 dB (A) or equivalent at normal load condition, at one meter away from the machine 	
Integrated Refrigeration Type Air Dryer	<ul style="list-style-type: none"> Compressor Unit should have an integrated Air-cooled Refrigeration type Air Dryer with Moisture Trap (with automatic and manual drain), suitable for above mentioned applications. 	
Pre Filter	A suitable and efficient Pre Filter for Compressor Unit as per the requirement mentioned above for oil & other foreign particles removal from air.	
Other Accessories required	<ul style="list-style-type: none"> Accessories required for Operation & Maintenance to be provided with the equipment 	

Other Accessories required	<ul style="list-style-type: none"> The quantity should be self-sufficient for the operation of two years.
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"> Anti Vibration Mountings should be provided on the compressor frame for vibration isolation-01 set Machine should come with all other essential accessories & spares required for installation, commissioning & Operation.

5 Atomic force microscopy (AFM) with scanning tunneling microscopy (STM)

S. No	Items	Specification
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
Specifications for Atomic Force Microscopy (AFM) with motorized		
5	Scanning Features	<p><u>Scanning Features:</u> The system should have Sample Scanning techniques and should capable of operating in tapping mode, contact mode and non-contact mode.</p> <ul style="list-style-type: none"> Scanner: A single scanner must be used for both high and low resolution scan
6	Requirement for System Performance	<ul style="list-style-type: none"> The system should achieve high resolution on graphite and mica with scanner 100 μm XY XY Linearity mean error: ≤ 0.1% or better
7	Scanner	<ul style="list-style-type: none"> AFM scan head with Flexure-based electromagnetically/ Piezoactuated XY-scanner; Piezo-based Z-actuator; Optical Z-position sensor; Closed loop Z-control
		<ul style="list-style-type: none"> Scan range in XY: 100 μm
		<ul style="list-style-type: none"> Scan range in Z: 10 μm
		<ul style="list-style-type: none"> Drive resolution in XY 1 nm or Better under both open and close loop and high voltage Drive resolution in Z: 0.5 nm or Better under both open and close loop and high voltage
		<ul style="list-style-type: none"> Static Force Dynamic Force

8	Operational Modes	<ul style="list-style-type: none"> · Lateral Force Microscopy · Phase Contrast · Magnetic Force Microscope(MFM) · Electrostatic Force Microscope(EFM) · Piezoresponse Force Microscopy (PFM) · Kelvin Probe Force Microscopy (KPFM) · Force Modulation, · Conductive AFM (C-AFM) · Spreading resistance (conductive), · Multiple Spectroscopy modes, · Lithography and Manipulation modes. · Liquid modes
9	Probes / tips	<ul style="list-style-type: none"> · At least 40 nos of respective tips / probes for Static & Dynamic modes. At least 10 nos of tips for each standard modes asked in the tender must be included for as per applications · List the cantilevers/probes and calibration standards that are supplied with the basic system free of cost. Also provide the additional Probes cost
10	Tip-Sample Viewing system	On-axis Optical Viewing System with video camera
11	Video camera	<p>Camera Focus: Motorized, user-controlled focus for each camera Zoom range: 4-Fold digital zoom in 3 steps Video output: USB 2.0</p> <p>System having top and side view camera are preferred.</p> <p>Top View Type: Color video, Resolution: 2048 x 1536 pixel or better</p> <p>Side View: Type: High-contrast black and white Resolution: 1280 x 1024 pixel or better</p>
12	Control Electronics	<p>The AFM must have state-of-the-art controlled electronics and following inclusions</p> <ul style="list-style-type: none"> · 24 bit digital to analog converters for scan controlling XY and Z · Electronic signal input should be of 24 Bit ADC with at least 4 high speed ADC/DAC channel · Analog signal handling for minimum electronic noise · X/Y/Z-Axis Position Measurement : 3 x 24Bit ADC, 200kHz or Better · Analog signal input bandwidth : DC to 3MHz or Better · Up to 4096x4096 data points or better,24Bit Zoom In 8 acquisition channels · dynamic digital filters

		<ul style="list-style-type: none"> · X/Y Sample slope correction and Over scan
13	System Computer & Software	<ul style="list-style-type: none"> · Latest branded PC with windows operating system and licenced software for the operation of the instrument.
		<ul style="list-style-type: none"> · Software must be a single package for all modes and attachments with no need for additional software programs.
		<ul style="list-style-type: none"> · Software package must include both image acquisition and data processing software in one package with no need for different programs operation.
		<ul style="list-style-type: none"> · 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.
14	Accessories	<ul style="list-style-type: none"> · Active vibration isolation:Highly compact active vibration isolation for the better measurement
		<ul style="list-style-type: none"> · Acoustic Enclosure: Provides acoustic isolation during measurements &also shields against light, electric and air flow disturbances
		<ul style="list-style-type: none"> · Micrometer Translation Stage:Travel range: 13 mm
		<ul style="list-style-type: none"> · XY Position Reproducibility: <10 µm
		<ul style="list-style-type: none"> · Tool set , Standard Sample for Static, Dynamic, MFM etc modes
Specifications for Scanning Tunneling Microscopy (STM)with integrated /separated from AFM system		
15	Scan Range	<ul style="list-style-type: none"> · X & Y: 300 nm × 300 nm or better · Z: 200 nm or better
16	Scan orientation	Horizontal and Vertical
17	Imaging modes	Topographic imaging with sub atomic resolution in
		<ul style="list-style-type: none"> · Constant Current Mode · Constant Height Mode
18	Resolution	xy 5 pm or better z: 20 pm or better
19	Current amplifier	Max 100nA or better
20	Imaging modes	Const. current (topography), Const. Height (Current)
21	Sample approach	Stick-slip motor
22	Sample size	Min 10 mm diameter or better,
		Min 3 mm thickness or better
23	Data points	Imaging: up to 2048×2048 or better
	Electronics	

24	Spectroscopy Modes	1. IV Spectroscopy in point mode, line mode and grid modes
		(i) Numerical dI/ dV& Normalized dI/dV plots
		2. I- Z Spectroscopy
26	Bias Settings	-10V to+ 10V in Step s of 0.3m V or better
27	Slope compensation	Both Hardware and Software horizontal & vertical Slope Compensation
28	Tunneling Current range	+ 5nA to- 5nA in steps of 0.1n A or Better
29	Power supply	90–240 V AC, 50/60 Hz,
30	Software	Image Display: Dual Imaging Window for Scan and Retrace Image Display
		Sample Navigator: Assistant for localized zooming w.r.t. a large area scan
		Analysis Functions: Line (Single line profile) Extraction, Localized Zooming, Roughness Display, Measure length & angles on the images, 2D Fast Fourier, Transformation etc.
		Image Processing Tool:Spatial and Fourier Low-Pass Filtering, Background Subtraction, Histogram Equalization, Zooming, Contrast, Slope Correction etc.
		Calibration:X/Y/Z- Calibration Utility
	Other Accessories:	
31	STM Basic Sample Kit:	Gold on sample support
		Graphite (HOPG) sample on sample support
		Sample support - 4 pcs.
32	Pt/Ir wire	0.25mm dia& 30cm length – 2No
33	Optional Item	1. Small Sample Heater
		Sample holder for heating samples.
		Materials selected for minimal drift
		Temperature range: Room temperature to +120 °C
		Diameter: 60 mm
		2. Temperature Controller.
		Temperature resolution: 0.1 °C
		Additional Temperature Sensor: Thermocouple Type K
		3. Environmental Control Chamber
		Allows measurement under controlled atmosphere (inert, dry, humid).
Transparent hood and base plate with 4 cable feed throughs and 4 festo gas inlets for 6mm tubing compatible with System		
4. Cantilever Holder Liquid and cantilevers suited for experiments in liquids		

34	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
35	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.
36	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.

6 Biodegradation set up - incubator type

S. No	Items	Specification
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 Provison 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 (Determination of Carbon Dioxide by titration method)	
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	(Determination of Organic Nitrogen Content)	The outer body should be made of Stainless Steel 304 and powder coated

2	Flasks	25 mL, 50 mL, 100 mL
3	Tempertaure 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
6	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
7	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.
8	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.

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

S. No	Items	Specification
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	Flow rate	20 m ³ / h
22	Vacuum Level	10 ⁻³ torr
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 rerquired for the better utilisation of the equipment
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.

8

CNC Milling

S. No	Items	Specification
1	Make	Bidder to specify
2	Model	Bidder to specify
3	Axis Travel	
3.1	X-Axis (mm)	400-450
3.2	Y-Axis (mm)	300-350
3.3	Z-Axis (mm)	250-300
4	Table	
4.1	Length (mm)	600-700
4.2	Width (mm)	300-400
4.3	T-Slot Width (mm)	14-16
4.4	Number of Std T-Slots	3
4.5	CD of T-Slots (mm)	110
5	Feed	
5.1	Rapid Feed (X, Y,Z Axes) (m/min)	30 or better
5.2	Max. Feed (X, Y,Z Axes) (m/min)	20 or better
6	Spindle	
6.1	Rating (kW)	11 or higher
6.2	Max. Speed (rpm)	10000 or higher
6.3	Taper	BT40
7	Accuracy	
7.1	Positioning (µm)	10 or better

7.2	Repeatability (μm)	5 or better
8	Automatic Tool Changer	
8.1	Magazine capacity (Nos)	10 or better
8.2	Tool select by shortest & Random select	Bi-Directional
8.3	Max. tool diameter (mm)	80 or better
9	Control System	
9.1	Controller	Fanuc / Siemens (Latest with complete module)
9.2	Part Program Storage (GB)	Standard to store CAM programs
9.3	Programming Functions with editor	Complete Module
10	Essential Accessories	
10.1	Servo stabilizer	Bidder to specify and quote suitable for the machine
10.2	Ultra Isolation transformer	Bidder to specify and quote suitable for the machine
10.3	Air Compressor with drier and multi dry filter	Bidder to specify and quote suitable for the machine
10.4	Automatic centralized lubrication system	Bidder to specify and quote suitable for the machine
10.5	Touch Probe	Bidder to specify and quote Branded quality(Renishaw / Blum) Touch Probe
10.6	Machine protection	Monitoring vibration during machining to protect machine and spindle failure. User autorisation to the control system and the machine. Safety during power failure and Panel cooler for electrical cabinet. Door interlock for safety
10.7	Industry 4.0 features leads to smart machine	Live status of important component of the machine in operation, internet based remote diagnosis of the machine like fault on the machine
10.8	Operation hardware	Electronic handwheel, Flushing gun for internal cleaning, Coolant tank with chip conveyor

10.9	Tool holding devices	<p>Bidder to specify and quote Set of suitable Cutting Tool holders</p> <p>ER 25 collet chuck -1 No.</p> <p>ER 25 collets Dia 3 to Dia 14 in steps of 1mm - 1 each</p> <p>ER 32 collet chuck - 1 No.</p> <p>ER 32 collets Dia 15 to Dia 19 in steps of 1mm - 1 each</p> <p>ER 40 collet chuck -1 No.</p> <p>ER 40 collets Dia 20 to Dia 25 in steps of 1mm - 1 each</p> <p>ER 25 Tap collets with square drive for M8 and M10 taps- 1 each</p> <p>ER 32 Tap collet with square drive for M12 tap- 1 each</p> <p>Side lock adaptors Dia 16, 20, 25 & 32 -1 each</p> <p>Keyless drill chuck 0-13mm</p> <p>Holder (adapter) for 80 mm Face mill - 1 No</p> <p>Holder (adapter) for 40 mm Face mill - 1 No</p> <p>Holder (adapter) for 50 mm Bull - 1 No</p> <p>Tool locking device-1 No.</p> <p>Pull stud- 30 no's</p>
10.10	Cutting Tools	<p>Bidder to specify and quote Set of Cutting</p> <p>Face mill cutter (with replaceable inserts 20 nos.) - Dia 80 mm</p> <p>Bull nose cutter (with replaceable inserts 20 nos)- Dia 50 mm</p> <p>End Mill cutter (with replaceable inserts 20 nos)- Dia 32 mm</p> <p>Bull nose cutter (with replaceable inserts 20 nos)- Dia 25 mm</p> <p>Endmill cutter (with replaceable inserts 20 nos)- Dia 20 mm</p> <p>Endmill cutter (with replaceable inserts 20 nos)- Dia 16 mm</p> <p>carbide End Mill cutter (each two)- Dia. 3, 4, 5, 6, 8, 10, 12, 16 mm</p> <p>carbide Ball End Mill cutter (each two)- Dia. 3, 4, 5, 6, 8, 10, 12, 16 mm</p> <p>M8, M10, M12 HSS Tap with suitable Carbide Drills - 2 Sets</p> <p>HSS Drills (one set) - Dia. 1 to 20 mm</p> <p>Centre Drill (Carbide & HSS) - each 3 Diff. Sizes</p> <p>Finish boring kit dia 10 to 40- 1 set</p>
10.11	Clamping Kit	<p>Clamp set</p> <p>Precision Hydraulic Vise with jaw opening of 275 mm and clamping force 60 KN - 1 No</p> <p>3 Jaw chuck - 300 mm dia - 1 no..</p>

10.12	Others	Ethernet, USB ports
11	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.
12	Terms & Conditions	Manufacture/Supplier should have sizable installations of same or better model worldwide and at least Five in India which is education institutions centrally funded institution. A Satisfactory Performance certificate from two institutions to be provided for eligibility. Bidder should submit complete contact details
		Equipment should be CE certified
		Authorization Letter from OEM
		List of clients in last five years to be provided.
13	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.
14	INSTALLATION, COMMISSIONING AND TRAINING	
14.1	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.
14.2	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		

14.3	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.
14.4	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

9

Digital Weighing Balance with Density Kit

S. No	Items	Specification
1	Capacity	220 g
2	Accuracy	0.1 mg
3	Display	LCD/VFD
4	Weighing pan diameter	80 - 100 mm
5	Repeatability	0.1 mg
6	Power Supply	230 V AC, 50 Hz
7	Pan Size	8 to 10 cm
8	Weighing units	mg, g
9	Stabilization time	2 sec
10	Stability Filters	Three filters to match weighing environment
11	Output	RS 232 Interfaced
12	Optional Item	Calibration Weights Sets-01 Set consisting 1mg,2mg,5mg,100mg,1gm,5gm,10gm,50 gm,100gm,200gm weights NPT calibration certificate
13	Other Accessories	Density measurement kit with thermometer(Range: Upto 30 Deg,L.C: 0.1 DegC) and sinker of Concave & convex type
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 .

	<ul style="list-style-type: none"> • Required traceable to calibration certificate for the machine
	<ul style="list-style-type: none"> • Machine should come with all other essential accessories & spares required for installation, commissioning & Operation.

10 Dynamic mechanical analyzer (DMA)

S. No	Items	Specification
1	Temperature Range of Furnace	from -150°C to 500 °C or better on both side
2	Temperature Resolution	0.1 °C
3	Heating Rate	0.1 to 20 °C/min or higher
4	Cooling Rate	0.1 to 20 °C/min or higher
5	Cooling system	Automated cooling system should be provided to achieve the specified low temperature
6	Force Range	18 N (Max) and 0.001N (Min)
7	Force Resolution	0.0005N or better
8	Tan δ Range	0.0001 to 10
9	Resolution	1.0 X 10 ⁻⁴
10	Sensitivity	1.0 X 10 ⁻³
11	Sample Deformation modes	Single and dual cantilevers bending modes: 3-point bending mode Tension and compression modes Shear Mode Powder Clamp (Fixtures should be provided to all modes) 1 mm to 1 cm or better
12	Amplitude resolution	10 μ or better
13	Modulus Range	10 ³ to 10 ¹³ Pa
14	Modulus Resolution	0.001 to 300 Hz with minimum of 0.01 Hz increment or better 0.001 to 200 Hz with minimum of 0.01 Hz increment or better.
15	Frequency Range	0.001 to 300 Hz with minimum of 0.01 Hz increment or better
16	Liquid Nitrogen Dewar	Dewar of capacity of 50 ltr or better should be provided in the system
17	Other	<ul style="list-style-type: none"> • Humidity Controller in the chamber • Provision for control flow of N₂ or Air • Calibration Standard Kits should be provided
18	Software	compatible to Windows 10 OS and should have the capabilities to programme stress, strain, amplitude etc.

		compatible to Windows 10 OS and should have the capabilities to programme stress, strain, amplitude , Elastic Modulus (G') versus temperature, frequency, or strain,Viscous Modulus (G'') versus temperature, frequency, or strain,Damping Coefficient (Tan D) versus temperature, frequency, or strain
19	Workstation	Branded Desktop PC (i7, 8 Gb RAM, 1Tb HDD 21 " LCD display,) Inkject colour Printer & Branded UPS
20	Accessories	Biddere to specify and quote any ther accessories rerquired for the better unilisation of the equipment
21	Scope of supply	Bidder should submit complete scope of supply (Machine, standard acessories, Optional Acessories etc with make model) in the technical bid withour price.Bidder should supply complete start up package including material necessary to prove the machine and provide training.
22	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
23	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.
24	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. 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.

11

Electrochemical workstation (ECWS)

S. No	Items	Specification
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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 stations	Independently running Four stations or higher
5	Measuring modes	Potentiostatic, galvanostatic, pseudo-galvanostatic, rest potential, ZRA and more
6	Compliance potential range	±10V or higher
7	Control voltage	±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	1 nA
12	Frequency range	10 micro Hz to 5 MHz or higher
13	AC signal amplitude:	1mV~2500mV
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	<p>Cell system and electrodes</p> <p>I. Ag/AgCl Reference Electrode – 1 No.</p> <p>II. Hg/HgO Reference Electrode – 1 No.</p> <p>III. Hg/Hg sulfate Reference Electrode – 1 No.</p> <p>IV. Saturated Calomel Electrode– 1 No.</p> <p>V. Pt Counter Electrode – 1 No.</p> <p>VI. Pt mesh Counter Electrode – 1 No.</p> <p>VII. Glassy Carbon Working Electrode (2mm) – 4 No.</p> <p>VIII. Compatible Cell kit (with gas purging option) for the above Electrodes.</p> <p>IX. Electrode polishing kit– 1 No.</p> <p>X. Corrosion cell kit</p> <p>XI. Alligator clips-10 Nos</p> <p>XII. Rotating disk electrode</p> <p>XIII. Photoelectrochemical cell setup</p> <p>XIV. 8 glass cells with Two Cell top</p> <p>XV. Sample holder and Cell Stand</p>
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	<p>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.</p>
21	Annual Comprehensive Maintenance Contract (ACMC) as optional	<p>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.</p>

S. No	Items	Specification
1	Fuel Cell Test Station	<p>I. Fuel Cell Hardware</p> <ul style="list-style-type: none"> · (1) 25 cm² single cell fuel cell hardware for PEMC (H₂/O₂) and DMFC. · (2) 5 cm² single cell fuel cell hardware for PEMC (H₂/O₂) and DMFC. · Serpentine flow pattern · Attached heaters · Fittings · Current collectors · Gaskets and Banana plugs · Fuel cell stack, easy mounting and demounting of cells. The stack should be delivered in fully assembled condition. Should allow voltages between individual cells to be measured. · Application must include hydrogen/oxygen and hydrogen/air operation; and DMFC system <p>Operating range; 25 to 80 °C or Better for both PEMC and DMFC</p> <p>II. HUMIDIFICATION SYSTEM</p> <p>Humidity bottles are made from type 316 stainless steel. Swagelok fittings for gas inputs and outputs are welded into the bottle. Nafion tubing is coiled in the bottle to provide dew-point humidity level for the gas passing through the tubing. The bottle is insulated and heated using a silicone rubber flex-pad.</p> <ul style="list-style-type: none"> · Dual Bottle System for Anode and Cathode · Output lines heated independently from bottle · Sight glass for visual water level of bottles · Nafion tubing to provide near dew-point humidity level for the gas passing through · Digital mass flow control should be inbuilt with the system for H₂, Air/O₂ · Flow rate of H₂/O₂/Air: 0-500 SCCM (for anode) and 0-5000 SCCM for cathode. · For DMFC operation appropriate good quality peristaltic pump should be inbuilt with the system. · System should be equipped with all necessary tubing and electrical connections.

		<ul style="list-style-type: none"> · System should provide with digital monitoring and controlling system for temperature, flow rate, cell temperature, humidification, back pressure, stack monitoring etc.
		<p>III. Software</p> <ul style="list-style-type: none"> · Open circuit voltage, Current scan, Voltage scan, Potential EIS, Constant load discharge, Constant voltage discharge, VIR-Polarization testing program, VIR-MR-Multiple range VIR, Life time program, Drive Cycle, Set protocol measurement, Run protocol measurement and AC Impedance measurement. · Humidifier bypass through software. · Preheater to avoid condensation, set temp thru software. · Software must be user friendly for easy customisation and should be upgradable for life time. · It should have fast response and data acquisition. · System should run continuously without any monitoring for durability test at least for 500 hr. · Interfacing between system and PC should be GPIB or LAN with very fast response.
		<p>IV. Electronic Load</p> <ul style="list-style-type: none"> · Maximum Load current : 0-100A or more · Maximum load Power : 500 Watts or more · Maximum load current should be able to draw at near zero cell voltage · Maximum Voltage : 0-50V or more · Potential Resolution : 100uV · Low Range Accuracy : 0.1% + 3mV · High Range Accuracy : 0.1% + 8mV
		<p>V. Impedance : Integrated AC-Impedance measurement facility</p>
		<p>I. Interlocks with external safety alarm</p>
2	Safety features:	<p>II. Optional Add-On - Hydrogen detector supplied, wired into the Dew Point Control System. Will shut-down system on alarm.</p>

		<p>III. High-temperature alarm on each temperature controller</p> <p>IV. Terminal Box</p> <p>The conductive cell: conventional four-point-probe method to measure the in-plane conductivity of various bare membranes (without MEA) and/or conductivity performance in various environments of <u>varying humidity (25-100%) and temperature (25-100°C)</u>; leading to a more accurate assessment of membrane conductivity and resistance.</p>
3	PEM Conductivity Cell	<p>Technical Specifications:</p> <p>5 cm² Membrane Electrode Assembly with four probe conductivity measurement</p> <p>Gaskets: Silicone (standard) for Normal Operating Temp: 65 to 90°C; and Gasket for high temperature operation upto 180°C</p> <p>Operating Temp: 25 to 80 °C or Better;</p> <p>Membrane Conductivity Cell must have all the hardware's for functioning</p> <p>Bolt Assembly for Low Tightening Force with Uniformed Force Distribution: 5in/lb</p> <p>Flat Gaskets with High Precision Thickness</p> <p>Fuel Cell Grade Graphite Plates</p> <p>Adaptable to Varied Flow Field Plate Design</p> <p>Gold Plated Plate (Current Collector Plate)</p> <p>Thermocouple Insert Hole</p> <p>Voltage Measurement Banana Plug</p> <p>I. Gasket for anode and cathode for both PEM and DMFC (each 1 m²)</p>
4	Spares and accessories	<p>II. Carbon cloth and carbon paper (each 1 m²)</p> <p>III. Catalysts for both anode and cathode for PEM and DMFC (Pt, Pt-Ru, Nafion inomer solution for electrode preparation)</p> <p>IV. Digital Multimeter and other tool kit (electrical and mechanical) should be provided.</p> <p>V. Nafion membrane 10 X 10cm – 3 No.</p> <p>VI. MEA for 5 cm² and 25 cm² hardware for both PEMC and DMFC - 3 for each.</p> <p>VII. System should provide all the necessary connectors, pressure gages, tubing and other hardware for connection for H₂, O₂, Air, N₂ gases to the fuel cell system .</p>

		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
5	Installation and commissioning	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.
6	Technical support and service	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.
7	Annual Comprehensive Maintenance Contract (ACMC) as optional	

13

High resolution-transmission electron microscope (HR-TEM)

S. No	Items	Specification
1.	Model	Bidder to specify
2.	Make	Bidder to Specify
3.	Electron source	<ul style="list-style-type: none"> • With Schottky Field Emission Gun (FEG) including High Voltage Supply Unit. • Probe current should be ≥ 0.5 nA/ 1 nm with beam current ≥ 75 nA.
		<ul style="list-style-type: none"> • Fully automatic • Microscope should have oil free vacuum system

4.	Vacuum system	<ul style="list-style-type: none"> • Turbo Molecular Pump based fully Dry-Vacuum system for the HRTEM 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 HRTEM operation.
		<ul style="list-style-type: none"> • FEG gun vacuum should be $<2 \times 10^{-6}$ Pa or better
		<ul style="list-style-type: none"> • TEM column vacuum should be $<2 \times 10^{-5}$ Pa or better
5.	Accelerating Voltage	<ul style="list-style-type: none"> • ≥ 200 kV
		<ul style="list-style-type: none"> • It should work at accelerating voltages 60kV to 200 kV in step/continuous variable mode.
6.	Resolution and spot size	<ul style="list-style-type: none"> • TEM mode: Point Resolution should be ≤ 0.25 nm or better
		<ul style="list-style-type: none"> • Lattice resolution should be ≤ 0.14 nm or better
		<ul style="list-style-type: none"> • STEM resolution should be ≤ 0.2 nm or better
		<p>These resolutions should be proved in our system.</p>
7	Analysis Mode	<ul style="list-style-type: none"> • EDS Analysis
		<ul style="list-style-type: none"> • STEM-EDS Mapping (Point/Line /Area Mapping)
		<ul style="list-style-type: none"> • 3D tomography
8	Magnification	<ul style="list-style-type: none"> • TEM Magnification Range: 50x to 1,000,000x or better
		<ul style="list-style-type: none"> • STEM Magnification : Range 150x to 20,00,00,000x or better
9	Imaging mode	<ul style="list-style-type: none"> • Bright-Field (BF)
		<ul style="list-style-type: none"> • Dark-Field (DF)
		<ul style="list-style-type: none"> • High resolution Imaging (HRTEM)
		<ul style="list-style-type: none"> • Selected-area electron diffraction (SAED)
		<ul style="list-style-type: none"> • Convergent-beam electron diffraction (CBED)
		<ul style="list-style-type: none"> • High angle annular dark field (HAADF)
		<ul style="list-style-type: none"> • STEM Imaging
10	Specimen holder	<ul style="list-style-type: none"> • X-ray spectroscopy (EDS)
		<ul style="list-style-type: none"> • Single tilt holder: $\geq 70^\circ$: 1 No.
		<ul style="list-style-type: none"> • Double tilt holder: $\geq 35^\circ$ (Specimen Tilt Angle $\geq \pm 25^\circ$) : 1 No
		<ul style="list-style-type: none"> • Single tilt Cryo-Holder (temperature down to -170°C): 1 No with necessary liquid nitrogen pumping station and related essential accessories.
		<ul style="list-style-type: none"> • Single-tilt multi-specimen holder (for grid size 3 mm).

		<ul style="list-style-type: none"> • Tomography holder: 1 No.
11	Specimen chamber	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 • Transmitted Electron detector, Scintillator and PMT (Photomultiplier tube) for TEM, HRTEM imaging. • EDS with SDD detector with total active area 100 mm² or higher size. • 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	<ul style="list-style-type: none"> • Fully retractable Silicon Drift Detector for energy analysis of secondary X-rays for carrying quantification of elemental composition with active area of $\geq 30 \times 100$ mm² • Detector resolution ≤ 129 eV • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • CMOS camera • 16 Mpixel (Or better) @ 25 (or better) fps with full resolution • Camera should be suitable for 60 -200kV • Output images should be compatible with other commercial image analysis software
17	Tomography	3-D reconstruction kit including necessary software
18	Sample preparation tools	Suitable Ultra-microtome with cryo attachment with all necessary accessories (optional)
19	Future upgradation	TEM should be upgradable

20	UPS	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Full software package for HRTEM control, data acquisition, analysis and display.
		<ul style="list-style-type: none"> • Software should be capable of image processing, EDS analysis; electron based imaging and selected area electron diffraction analysis.
		<ul style="list-style-type: none"> • Upgradation of the software has to be supplied free of cost.
		<ul style="list-style-type: none"> • Facility for recording specific specimen translation position as reference point in memory
23	Vibration Isolation Platform	<ul style="list-style-type: none"> • Auto leveling, active, anti-Vibration system for chamber and electron column isolation is required.
		<ul style="list-style-type: none"> • Preinstallation site visit for the same.
24	Calibration Standards:	<ul style="list-style-type: none"> • All calibration standards traceable to SI Units for HRTEM and EDS
		<ul style="list-style-type: none"> • 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.
26	Computer Hardware	<ul style="list-style-type: none"> • Three No.- one for TEM, one for EDS and one for storage and processing of images separately.
		<ul style="list-style-type: none"> • All control, data acquisition, analysis and diagnostics software loaded and tested on the computer.
		<ul style="list-style-type: none"> • 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.
		<ul style="list-style-type: none"> • 32" (or higher) TFT monitors
		<ul style="list-style-type: none"> • CD/DVD reader and writer combo

		<ul style="list-style-type: none"> All software should be upgradable free of cost.
27	Utility requirements	<ul style="list-style-type: none"> Suitable Chiller and compressor for the main equipment should be supplied Closed circuit automatic temperature and flow-rate controlled chiller
28	Plasma Cleaner	<ul style="list-style-type: none"> To effectively remove organic contamination from specimen and specimen holder, the system should have a low energy glow discharge ion source creating hydrogen and oxygen radicals. Should be compatible with the supplied system. An additional mass flow controller (MFC) should support three independent process gases (Argon, Hydrogen, Oxygen) for accurate gas control and long term plasma stability.
29	Installation, commissioning and training.	<ul style="list-style-type: none"> Pre-installation requirements such as room size, required power rating, gases (argon, N₂), 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.

S. No	Items	Specification
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1	Max. stirring capacity	5 Liters
2	Speed rotation range	50-2000 rpm or more
3	Speed rotation control	Step less speed control
4	Chuck range	3 to 16 mm or more
5	Blades	Set of multiple Electro-polished stainless steel 316L
6	Control Display	LCD
7	Other Features	Wide range of stirring shafts High durability to chemicals Ability to mix high viscosity liquids Overload protection

15

High Temperature Air Oven

S. No	Items	Specification
1	Temperature Range	Ambient to 300°C maximum
2	Construction	Double walled outer body of SS 304 grade and Inner SS 316 grade
3	Temperature Accuracy	· $\pm 2^\circ\text{C}$ or better · Uniform temperarute through the chamber · It should rech max .temperature 300°C within 10 min.
4	Controls	PID Controller
5	Temp Display	LED Display
6	Sensor	PT-100 or equivalent
7	Timer	Digital Pre-Set Timer 999 Hrs
8	Dimension	Minimum 600 x 600 x 600 mm
9	Heating Element	Nichrome wire / Kanthal A1
10	Safety device	· Over temperature protection · Electric leakage breaker · Temperature safety as per DIN 12880 Class 3.1
11	Exterior Chamber	MS powder coated
12	Interior Chamber	316 stainless steel
13	Insulation	Inner & Outer wall filled with thermal insulation material
14	Doors	Solid doors with silicone rubber gasket & lock
15	Shelves	Min of 3 Stainless steelperforated shelves (Removable)spaced equi-distant from each other Provision for height adjustment for tray.
16	Air Circulation	Forced air circulation
17	Other Features	· High efficient air circulation from top to bottom should be provided with fan.

		<ul style="list-style-type: none"> · Provision for inserting the thermometer to verify inner temperature. · Moving wheel to be provided · Corrosive resistant material throughout the body · Uniform temperature through the chamber
18	Power supply	230 V AC, 50 Hz

16 Hydraulic compression molding machine

S. No	Items	Specification
	Quantity	02 Unit with Cavity Moulds
	Purpose	Molding of polymeric material under compression press as per the desired size to undertake specimen preparation for various mechanical properties study.
	Principle/ Definition	It applies hydraulic mechanism for applying a large lifting force or compressive force.
	Reference Standard	ASTM D4703
<u>TECHNICAL SPECIFICATION FOR HYDRAULIC COMPRESSION</u>		
1	Clamping force	30 ton (adjustable) . <ul style="list-style-type: none"> • 12 in x 12 in polished platens for heating/cooling Capable of making compression molded plaques
2	Max. Daylight	300 mm or equivalent
3	No. of daylight	1
4	Max. mould height	300 mm or equivalent
5	Hydraulic cylinder stroke	140-160 mm
6	Ejector force/stroke	Manual
7	Total oil capacity	As per the requirement.
8	Electrical motor	2HP Motor or suitable
9	Mode of operation	Operating buttons, including two-hand anti-tie down-circuit
10	Construction type	4 post/column
11	Electrical heating of platens	400-425°C <ul style="list-style-type: none"> • Uniform temperature distribution on platen surface. • Programmable digital controller or Strip chart recorder to record temperatures of each molding assembly.
12	Hydraulic System	Self-contained, energy efficient hydraulic system with access panel and gauge for Oil level and temperature indication should be provided. It should have dual pump system and water cooled heat exchanger.
13		<ul style="list-style-type: none"> • Operating buttons, including two hand “anti-tie-down” circuit for cycle initiation.

	Control System	<ul style="list-style-type: none"> Proximately switches to control “slow close” position and “cycle reset”. Clamp pressure relief valve and gauge.
14	Cooling System	<ul style="list-style-type: none"> Water chiller cooling system to be provided which should be controlled by microprocessor based temperature controllers which are programmed for the specified cooling rate as per ASTM D4703 .
15	Safety features	<ul style="list-style-type: none"> Safety guards to be provided with the molding area with manual/automatic sliding, interlocked operator gate
15.1		<ul style="list-style-type: none"> Automatically switching from heating to cooling mode.
15.2		<ul style="list-style-type: none"> The system should have automatic low pressure system
15.3		<ul style="list-style-type: none"> Thermocouples for insertion into drilled backing plates.
16	Calibration certificates	<ul style="list-style-type: none"> Calibration of platen temperature control & pressure calibration to be provided.
17	The machine should be supplied with suitable compression Moulds as per	
	COMPRESSION MOULDS	
17.1	Mould material	Stainless Steel
17.2	Top plate	300x300x5 mm
17.3	Bottom Plate	300x300x5 mm
17.4	Cavity Plate	200x200x5 mm and 200x200x3 mm, 200x200x2 mm and 200x200x1 mm
17.5	Specimen moulds	Cavities with specimen dimensions complying to above standards to be provided
18	Mandatory Items	While supplying the Machine, 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"> Basic Tool Kit box with all necessary Tools like spanner, allen keys, scew driver set, etc ,
		<ul style="list-style-type: none"> High temperature safety gloves & goggles required for day to day activities during operation of Machine.
		<ul style="list-style-type: none"> Electrical spares of reputed brand –Cartridge Heaters-01 set, temperature sensor-01 set, solenoid valve-01 ,MCB -01no
		<ul style="list-style-type: none"> Machine should come with all other essential accessories & spares required for installation,commissioning& Operation including Hydraulic Oil .

17

Micro Compounder with Micro Injection Moulding Machine

S. No	Items	Specification
1	Design	vertical/horizontal type with Co-rotating screws and counter-rotating screws

2	Sample quantity requirement of the Extruder	10 cm ³ by volume or higher
3	Extruder Heating	The extruder should include electrically heated controlled heating zone with an adjustable temperature range and the operating temperature should be 350°C or better.
4	Cooling of the extruder	Water and air cooling
5	Pressure measurement Sensors	The extruder must include pressure sensors capable of measuring high pressures of 150 bars or better
6	Main drive	The main drive of the extruder should include digital RPM adjustment with a provision for torque measurement. 200 RPM or better by means of a frequency controlled drive.
7	Instrument control – integrated PC based control and monitoring	PC based Data documentation, Control and acquisition rheological software. Storage of test setup and test results. The software should be operable under Window platform.
8	Essential accessory	Strand Die compatible with the extruder, Set of rod dies (0.5, 1.0, 1.5 and 2.0 mm diameter)
9	Rheological Measurements	The extruder must have a back-flow channel which should re-circulate the extrudate back to the extruder to enable control of the residence time and to measure viscosity.
10	Bypass operation	Automatic bypass operation for circulation/extrusion
11	Inert environment	Extruder should be equipped with an inert gas flush system
12	Torque on screw:	5 Nm / screw or better
13	Thermocouple	Standard thermocouple for measurement of temperature
14	Pressure sensor	Standard pressure sensor for measurement of stress
15	Computer	Standard specification
16	Standard tools	All standard accessories for handling and cleaning
MICRO INJECTION UNIT		
17	The Micro Injection Moulding Machine	Piston based injection molding system
18	Compatibility	The machine must be capable of being used as standalone unit AND in conjunction with above Micro Twin Screw Extruder with force feeder
19	Pressure requirement	Must not be more than 10 bars

20	Maximum Injection pressure (bars)	1000 or more
21	Maximum Mould temperature (°C)	250°C or better
22	Maximum injector temperature (°C)	350 °C or better
23	Mould for Test specimen	Tensile, DMA, Izod Charpy, Flexural, thermal conductivity (disc) as per ASTM
24	Standard tools	Screw type Air Compressor (10 Bar, 40 SCFM) with Air Drier and other accessories (acoustic)
25	Accessories	Bidder to specify and quote any other accessories required for the better utilisation of the equipment
26	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.

18

Micro-computer tomography

S. No	Items	Specification
1	Machine	
1.1	Make	Bidder to specify
1.2	Model	Bidder to specify
1.3	Application	Dimensional analysis and material analysis
1.4	Technology	X-ray based CT
1.5	Principal of measuring	Cone beam reconstruction or better
2	Radiation generating system	micro-focus tube
2.1	Maximum tube voltage	200-225V
2.2	Maximum tube current	3000 µA
2.3	Maximum tube power	500W
2.4	Focal spot size	7 µm or better
3	Sensor Technology	Flat panel detector or better
3.1	No. of pixels	Minimum 1024x1024
3.2	Pixel pitch	200 µm or better
4	Resolution	<6 microns
5	Accuracy	

5.1	Sphere center point error	4.0 +L/100 μ m
5.2	Probing error	3-4 μ m
6	Measuring range	
6.1	Diameter	Minimum 150 mm or better
6.2	Height	Minimum 150 mm or better
7	Work piece weight	Minimum 5 Kgs
8	Maximum work piece size	
8.1	Diameter	250 mm or better
8.2	Height	250 mm or better
9	Hardware and Software for Reconstruction/Data Acquisition	
9.1	Hardware	Suitable high end workstation with wide screen monitor and other necessary accessories for reconstruction/ data acquisition
9.2	Software	<p>Suitable software package for data reconstruction/ data acquisition and machine control</p> <p>The software shall facilitate the controls of all components of the CT system (such as the tube, detector, manipulation) and permits the control of all relevant steps during CT measurement, such as the creation of projection data sets, reconstruction of volumes, visualization of volumes and projections. It should be able to do the following tasks:</p> <ul style="list-style-type: none"> i. X-ray tube control and real time monitoring ii. Complete control and monitoring of sample manipulation iii. Recording of projections, single view, quad view, zooming, interpolation iv. Automatic detector correction (offset, gain and missing pixels) v. Image processing tools and projection filtering vi. Rapid, high-contrast reconstruction of volumes vii. Automatic Geometry Calibration - module for automatically determining the calibration value based on projections. viii. Beam Hardening Correction - Module for balancing unavoidable beam hardening artifacts in single material or multiple material samples. It should be fully automatic for single material samples. ix. Automatic ring artifact correction

		x. Automatic selection of region of interest avoiding hull of air surrounding the
9.3	Types Software	Vendor should specify and quote suitable software's for the following
		- Meteorology
		- Fiber Orientation
		- Material analysis (such as porosity, contamination etc)
10	Hardware and Software package for data analysis and	
10.1	Hardware	Suitable high end workstation with wide screen monitor and other necessary accessories for data analysis
10.2	Software	Suitable software with complete module for data analysis and visualization. The software should be
		a. Perpetual/ permanent licensed copy of 3D visualization software for creating pseudo color rendering. The license should be perpetual/ permanent and it should be such that it can be used at multiple places with two places simultaneously. It should have the following features:
		i. 3D visualization software for creating pseudo color rendering. AVI animated films and section plane images from any direction.
		ii. Image processing functions: Various processing functions should be given to enable live image, full screen mode, 'shading' correction, distortion correction of image chain (geometric correction of the image), integration
		iii. Real time contrast enhancement
		iv. Different sharpen, smooth, morphologic and rank operator image filter
		v. Pseudo-3D images, Pseudo colors
		vi. Precise distance measurement
		vii. Image save (TIF, BMP, RAW, JPEG)
		viii. Single and quad view
		ix. Text annotations and profile function
		x. AVI animated films and section plane images from any direction.
		xi. AVI-file creation.

		<p>xii. Automatic detection of material discontinuities and other anomalies in Composite, Polymer and Plastic parts such as delaminations, fiber mis-orientation, pores and inclusions; color-coded visualization of the detected defects according to the defect volume; statistical defect size analysis: overall percentage of porosity and defect volume histogram</p> <p>xiii. High performance reporting function with text and images for output in various formats (CSV, HTML, RTF, PDF, etc.)</p> <p>xiv. Data files required for operation files, ready for processing with VG Studio to be provided like raw, stl and point cloud data.</p> <p>xv. Software for wall thickness analysis</p> <p>xvi. Software for visualization and voxel datas</p>
11	Accessories and Spares	All necessary accessories and mounting for the operation should be included in the offer
12	Calibration sets and fixure plates	Vendor should supply required calibration sets and fixure plates for the machine
13	Safety Requirements	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
14	Scope of supply	Vendor should supply complete start up package necessary to prove the machine and provide training. List for scope of supply to be submitted.
15	Environment Protection	The machine and all the accessories supplied should be safe to use without emission of any hazardous gases, noise level and radiation without any need for additional equipment, provision or training and meet current international standards
16	Other consumables & accessories and their availability	List all such material that will be used in building part. 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
17	Price list of material, spares and consumables	Price list of each material with minimum order quantity, machine spares and consumables are to be quoted.

18	General Compliance	The machine should comply with standard, safety and protection. Vender should provide necessary details regarding standard, safety and protection
19 Installation, Commissioning and Training		
20	Installation requirements	Vendor 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 the following items required for installation such as UPS, vibration isolation and compressed air supply
21	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
22	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
23	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.

24	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.
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19 **Microprocessor controlled automatic injection moulding**

S. No	Items	Specification
1	Clamping Tonnage	80 Tons
2	L/D Ratio	20 and above
3	Screw Diameter	40-50 mm
4	Maximum Daylight	800 mm and above
5	opening Stroke	350 mm and above
6	Distance Between Tie Bar	450 x 450 mm and above
7	Platen Size	Please specify
8	Minimum Mould Thickness	150 – 200 mm
9	Ejector Stroke	Min. 100 mm and above (Multi Stage & Multi Point)
10	Shot Capacity Minimum	250 gms and above
11	Injection Pressure	1600 kgf/cm ² and above Multi- Stage
12	Injection Rate	200 cc/sec and above
13	Injection Speed	160 mm/sec and above
14	Hydraulic Multiple core pulling unit	Please specify and quote
15	Screw speed	Multi Stage please specify
16	Motor	Please quote for servo motor drive type
17	Total connected load	Please specify
18	Multi stage Air Ejection - Upto 5 Stage	Please specify and quote
19	Interface for Gas Assisted Injection	Please specify and quote
20	Robot Interface	Please specify and quote
21	Hot Runner Inerface	Please specify and quote
22	Hydraulic Multiple core pulling attachment	Please specify and quote
23	Water inlet/ out let manifold for Mould cooling	Please specify and quote

24	Bimetallic screw barrel	Please specify and quote
25	Computer connectivity	Please specify and quote
26	Essential Accessories	Bidder to specify and quote the accessories essential for effective utilization of machine such as
		• Chiller Unit of required capacity
		• MTC unit for temperature 150°C or more
		• NRV set
		• Thermocouples (for Nozzle & barrel)
		• Heaters
		• Nozzle for Nylon/LCP
		• Multipoint ejector rod
		• Limit switches
• Set of seal kits, etc.		
27	Optional accessories	Bidder to specify and quote the optional accessories available for effective and better utilization of machine such as
		• Water inlet / out let manifold for mould cooling
		• Bimetallic screw barrel
		• Interface for Gas Assisted Injection
		• Hopper drier with loader etc.
28	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.
29	Pre-Installation Requirements	State space required and condition of floor and any other requirement for installation of the machine/equipment.
30	Installation & Training	Minimum of 5 days training for three candidates at machine manufactures site.
		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.
		Basic & Advanced level training schedule and plan to be submitted.
31	Manufacturer's credential	Should have sizable installations of same model worldwide and at least two same or similar model in India.
32	References	Tenderer shall give complete contact details of existing customers having such supply in India.
33	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.

34	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.
35	Price list of spares and consumables	Price list of each material with minimum quantity, build plates, spares and consumables are to be quoted.
36	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.
37	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.

20

Modulated Differential Scanning Calorimeter (MDSC)

S. No	Items	Specification
1	Make	Bidder to specify
2	Model	Bidder to specify
3	Purpose	<p>Measurement of the following properties of polymers, rubbers, elastomers etc</p> <ul style="list-style-type: none"> · Measures heat absorbed or released by a sample as a function of time, temperature and environment · Glass transition temperature (T_g) · Melting temperature (T_m), · Crystallization temperature (T_c) · % of crystallinity, · Curing temperature · Degree of cure · Purity · Activation energy · Heat of enthalpy · Heat of fusion · Kinetic studies (isothermal/non-isothermal) · Thermal stability · Oxidation/decomposition · Oxidative-Induction Time (OIT) · Specific Heat
4	Principle/Definition	MDSC is a thermo-analytical technique to investigate the response of polymers to heating cycle.

5	Reference Standard	ASTM D 3417-99, ASTM D 3418-15, ASTM E 1356-08(2014), ISO 11357-1:2016, ASTM-D 3895-14
6	System	System shall be capable of running in conventional DSC mode as well as modulated DSC mode
7	Temperature Range	-150 °C to 700°C
8	Temperature Accuracy	± 0.1C or better
9	Temperature Precision	± 0.05°C or better
10	Heating/Cooling Rate	0.01 °C/min to 100°C/ min or higher
11	Oscillating (modulated) heating rate	± 1.0 °C/min. Or better
12	Furnace	To be constructed of corrosion resistant material suitable for rapid heating/cooling and should have long lifetime.
13	Calorimeter Sensor	Cromel/ constantan TZero Thermocouple
14	Maximum Calorimetric Sensitivity	0.2 µW or better
15	Calorimetric Precision (based on metal standard)	±0.08%
16	Dynamic Range	± 500 µW
17	Temperature Calibration	5 points calibration over the full temperature range
18	Baseline Noise (max. peak to peak)	0.2 µW or better
19	Software	<ul style="list-style-type: none"> · Operating software and analysis software shall be user friendly and shall be running on windows 7/10 version · Analysis software shall have the provision to smoothen to evaluate peak temperature, onset temperature, glass transition temperature, melting temperature, crystallization temperature % of crystallinity, purity, curing temperature, activation energy, heat of enthalpy, heat of fusion, kinetic studies, Oxidative-Induction Time (OIT), X-scaling w.r.t time, temperature, etc. · The software shall have the provision to view total heat flow, modulated heat flow, total heat capacity signals in real time during experiment. · Software for kinetic studies (to be supplied with one licence as the same can be used with TGA) for single and multiple steps through non-linear regression

		<ul style="list-style-type: none"> The data analysis software should be unkeyed or multi-user licensed to allow installation at minimum 3 PCs Calibrations shall include baseline, cell constant and temperature. Scheduling capabilities must be present, such that these calibrations and/or verifications can be programmed to perform during normal quiescent periods, such as overnight or on weekends.
		<ul style="list-style-type: none"> The data file format should easily allow sharing/transfer of data files as individual electronic documents, which are readable by the same data analysis package.
		<ul style="list-style-type: none"> The operating software should also be capable of periodically and automatically checking for updates via an Internet connection, and downloading/installing those updates if desired.
		Library,
		Compatible to Windows 7 or higher OS (32 and 64 bit) and should have the capabilities to heating rate, temperature setting, etc. and capable of collecting data on heat flow, heat capacity enthalpy change, Cp, Tg, Tm, Tc, peak area, peak onset, etc.
20	Measurement Atmosphere	N ₂ or O ₂ or air or helium
21	Provision for cooling	Inbuilt cooling system & accessories with variable cooling rates as specified above.
22	Control system	Built in Gas mass flow control system with auto gas switching option within the test run.
23	Accessories	DSC shall include:
		<ul style="list-style-type: none"> 01 no. of Platinum pan with lid,
		<ul style="list-style-type: none"> 01 no. of Graphite pan with lid
		<ul style="list-style-type: none"> 100 nos. of Copper pans for OIT test
		<ul style="list-style-type: none"> 800 nos. of TZero Aluminium pans with lid.
		<ul style="list-style-type: none"> Standard samples such as Indium, Cobalt, Tin, Sapphire, Adamantane, zinc with Traceable calibration Certificate for calibration purpose.
		<ul style="list-style-type: none"> Crimper and die set to be supplied along with the Instrument for sample preparation of both dry powder and liquid samples.
		<ul style="list-style-type: none"> Cooler System for -150 to 700 C range
		<ul style="list-style-type: none"> Dewar Flask of Min. 50Ltr capacity for Liquid Nitrogen handling-01No
		<ul style="list-style-type: none"> Gas Tubing & fittings-01Set
		<ul style="list-style-type: none"> Moisture dryer-01Set
		<ul style="list-style-type: none"> PC of required configuration with original software
		<ul style="list-style-type: none"> 01 no of filled N2 gas cylinder with two stage SS Gas

		<ul style="list-style-type: none"> · regulator of best quality with tubing fittings · 01 no of filled O2 gas cylinder with two stage SS Gas regulator of best quality with tubing fittings.
24	Calibration Certificate	Calibration certificates for supplied reference material traceable to NIST and internal calibration report to be provided.
25	Personal Computer (PC)	<p>A Personal Computer (PC intel core i3-4th gen processor/8GB RAM/1Tb SATA Hard Drive/DVD Writer/keyboard/mouse/window 10 professional/with 24" TF) /3 years warranty) having latest configuration.</p> <p>All softwares shall be loaded in the hard disk with appropriate partitions. All original CDs/DVDs must be provided</p> <p>1GB Graphic Card.</p>
26	Power Requirement	100-240 Volt, 50/60 Hz
27	Others	<ul style="list-style-type: none"> · Modulated DSC shall have the ability to apply sinusoidal temperature wave to sample by amplitude and frequency. · Modulated DSC shall include the ability to perform quasi-isothermal experiments i.e. holding isothermal with a small temperature modulation. · Modulated DSC should be able to show the following signals in real time during the experiment: Total Heat Flow, Total Heat Capacity, Reversing Heat Capacity, Reversing Heat Flow, Non-Reversing (Kinetic) Heat Flow, Modulated Temperature, Modulated Heat Flow, Heat Flow Phase, Reference Sine Angle, Temperature Amplitude, and Heat Flow Amplitude. · DSC shall allow for the direct measurement of specific heat CP i.e. in one single scan.
28	Other Mandatory Accessories	<p>While supplying the Machines, the supplier should also provide the following items apart from above:</p> <ul style="list-style-type: none"> · Basic tool Kit-01 set · Hard copies of Operational & Service Manual-01 set · Necessary Hoses & Nipples required -01 set · The Machines should come with all other essential accessories & spares (as per ASTM & ISO standards) required for installation, commissioning & operation.

21

Plastic freeformer

S. No	Items	Specification
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1	Build Chamber	
1.1	Usable build space	230 x 130 x 230 mm or better
1.2	Positioning accuracy of axes	+/- 0.002 mm
1.3	Build chamber temperature	50 – 100 °C or Higher
2	Material preparation	
	Processing temperature	Ambient to 350°C or Higher
3	Discharge unit	
3.1	Material pressure at Nozzle	500 – 1300 bar or better
3.2	Nozzle diameter	Min. three nozzles 0.15, 0.2, 0.25 mm
3.3	Discharge volume	Min.Three levels at 5, 10 and 20 cm ³ /h
4	Machine versions	2 component technology (two materials /colours)
5	Layer thickness	0.20– 0.35 mm or better in three variation
6	Minimum wall thickness range	0.6 to 1.0 mm in three variation
7	Component precision	±0.15 mm or better in X and Y direction
8	Electrical systems and interfaces	<ul style="list-style-type: none"> · Liquid-cooled control cabinet according to safety standard · Heat exchanger with closed cooling circuit · USB interface · Host computer interface (OPC UA)
9	Control panel	<ul style="list-style-type: none"> · High-performance industrial PC with inbuilt multi-touch screen · Operator authorization via transponder cards (RFID) · Data storage on Compact Flash cards · Integrated data preparation (slicing) of 3D geometries in STL format · Intuitive operation by means of gestures · Automatic machine set-up on the basis of component data
10	Build carrier	<ul style="list-style-type: none"> · Construction table movable on three axes with two additional compact rotary axes (five axes) · Liquid-cooled linear motors with high-resolution position measurement (glass scale) · Component mounting via structured carrier plates · Rapid, reversible securing of the carrier plate by means of a vacuum device

11	Material preparation	· Homogeneous material preparation with short three-zone screw and precisely closing non-return valve
		· Energy-efficient servo-motors with absolute position encoders
		· Precise, maintenance-free planetary roller screw drive
		· Processing of two components with a second material preparation
12	Discharge unit	· Clocked nozzle closure with piezo technology
		· Selection of different nozzle sizes
13	Material	
13.1	Model Materials for printing	ABS, PC, polyamide, TPU etc. and other materials if any.
13.2	Support Material	Bidder to specify and quote
14	Software	
14.1	Process Software	To control the building process and ergonomic operating interface of the touch screen.
		The process software should be able to work closely with the internal production and generate statistical QA reports which are preferred to subjective method of reporting.
14.2	Slicing and data editing software	Complete module for conversion of part data in the STL format and optimization of layer data.
14.3	Software license	The entire software license must be perpetual.
15	Networks Connectivity	10/100 base T connection. Ethernet protocol
16	Regulatory Compliance	Machine should be Regulatory Compliance - CE / FCC Relevant documentation to be attached.
17	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.
18	Essential Accessories	
18.1	Support system removing	Bidder should specify and quote as per the requirement

18.2	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 and support material each type for 3 months of running. Minimum two sets of Nozzles for different layer thickness minimum to maximum for all types of materials.
18.3	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.
18.4	De-humidifier	Vendor should supply suitable de-humidifier to maintain room humidity level within suitable range for machine operation.
18.5	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.
18.6	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)
18.7	Tool kit	Bidder should supply standard tool kit for startup, removal of parts and cleaning (list to be attached).
18.8	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.
18.9	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.
19	Terms & Conditions	<p>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.</p> <p>Manufacturer of the supplied equipment must be ISO Certified</p> <p>Authorization Letter from OEM</p>

		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.
20	INSTALLATION, COMMISSIONING AND TRAINING	
20.1	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.
20.2	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
21.3	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.
21.4	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.

Universal Testing Machine (UTM) with Environmental Chamber

S. No	Items	Specification
1	Control System	Microprocessor controlled
2	Maximum Load Capacity	100 kN
2	Cross head Travel distance	Min 1000 mm
3	Horizontal daylight	Min. 400mm
4	Cross Head Speed	
4.1	Minimum	0.5 mm / min
4.2	Maximum	1000 mm/min
4.3	Accuracy for Cross head speed	± 0.1 mm/min
5	Load cells	100 N, 1 kN, 10 kN & 100 kN
6	Load cell Accuracy	≤ 0.5 %
7	Grips & Fixtures	Neumatic and Manual Tensile (suitable for plastics, rubber, film and fibre) compression, flexural, and shear fixtures. All fixtures should be suitable for low temperature testing and can be accommodated in to environmental chamber Rigid plastics (self lock winch grip, opening up to 12mm), plastic/composite rod (upto 12 mm dia) woven sacks (50mm width), rubber, fibre/filament.
8	Test Conform to	Tensile: ASTM D 638, ASTM D 882, and ISO 527 Flexural: ASTM D 790 and ISO - 178 Compression: ASTM D 695 Shear: ASTM D 732
9	Extensometer	Advanced Video Camera Extensometer -Non Contact 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	(a) Software attached & data storage for sample test methods

		(b) Software should automates data acquisition, machine control, analysis, and reporting for a wide range of test requirements.
		(c) In addition, data compilation and provision for stress relaxation and creep shall be provided as per relevant ASTM Standards
		(d) Window's based graphical user interface.
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
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 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.
17	Terms & Conditions	<p>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.</p> <p>Manufacturer of the supplied equipment must be ISO Certified</p> <p>Authorization Letter from OEM</p> <p>List of clients in last five years to be provided.</p> <p>Manufacture/Supplier should have sizable installations of same model worldwide and at least Fives in India.</p>
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	<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
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.

23

Vacuum Infusion Equipment

S. No	Items	Specification
1	Vacuum Delivery Conveyer (VDC) Vacuum Degassing Chamber	<p>Chamber capacity 10 litres.</p> <p>Complete with a 20 m³/hr Vacuum Pump, vacuum gauge, valves and connecting pipe work.</p> <p>Fitted with a clear acrylic chamber top to monitor the process within the vacuum chamber.</p>

2	Resin Infusion 'Auto' Resin Infusion Pump Stations	Resin traps 10 litres. Complete with a 20 m ³ /hr Vacuum Pump, vacuum gauge, valves and connecting pipework. Vacuum Breach included for plastic bag connection. Fitted with clear acrylic chamber top with 'Qwik tight' compression fitting .
3	Oil Mist Filters	Oil Mist Filters compatible with Vacuum Pumps
4	Work Table	Wooden table with Glass top
5	Acessories & Consumables	Vacuum Bagging flim, Release flim, Peelply, Green Mesh- each 50 Sq. Mtrs. Poly hose and poly spiral- each 100 Mtrs. T fitting, Elbow, Ploy valve - each 20 Nos. Double side tape -2 Roles Metal Clamp- 2 Pices Mould release agent - 3 lits. Wax-500 grams Raw materials- 5 Kg mat and 10 Kg. Resin Scissor -1 No.
6	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.
7	Scope of supply	Bidder should submit complete scope of supply (Machine, standard acessories, Optional Acessories etc with make model) in the technical bid withour price.Bidder should supply complete start up package including material necessary to prove the machine and provide training.
8	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.
9	INSTALLATION, COMMISSIONING AND TRAINING	

9.1	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.
9.2	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
9.3	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.
9.4	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.

24

Vacuum Oven

S. No	Items	Specification
1	Temperature range	25 to 200 °C or higher
2	Vacuum range	Upto 25 in. Hg Vacuum release port
3	Volume	60-100 L
4	Temperature	Resolution: ±1 °C

		Uniformity: ± 4 °C or better
5	Temperature controller	PID control, Digital display of set value (SV) and present value (PV).
6	Timer	99 hours 59 min
7	Pressure display	Digital / Analogue
8	Shelf positions	3 (Removable SS shelves)
9	Working chamber	Stainless steel SS 304 (SS 316 preferred).
10	Inert gas	· Diaphragm valves for inert gas · Inert gas outlet
11	Door and Gasket	· Solid door with clamp & toughened glass window · High temperature silicon gasket
12	Others	· Suitable oil free vacuum pump with at least 35 L/min capacity · Digital vacuum control through solenoid valves · Necessary tubing and standard fitting for inert gas and vacuum.

25

Vibration Lab

S. No	Items	Specification
1	Make	Bidders to specify
2	Model	Bidders to specify
3	Modal shaker with power amplifier.	
	Max. Force Sine/Rand	150 N
	Max. Displacement(mm)	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 -
	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) –
	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
	Display: Time series – Narrow band – Profiles – View Meter – 3D
	Data Management:Setups – Load, save and recall workbook
	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
	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
	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	<p><u>Modal Analysis Software (3D visual).</u></p> <p>Basic geometry modelling ,display and revision of test data in time or</p>
6	<p><u>Tri-axial Accelerometer with connecting cable,</u></p> <p>Built-in IEPE preamplifier Tri-axial (x,y,z) miniature accelerometer Single 4-pin</p> <p>Measuring Range: $\pm 700g$</p> <p>Sensitivity : 10mV/g</p> <p>Frequency response, 0.5dB : 1 to 8,000 Hz</p> <p>Mounting Resonance Frequency : 40,000Hz</p> <p>Resolution 1-10,000Hz : 0.0001 g rms</p> <p>Maximum Transverse Sensitivity : $\leq 5 \%$</p> <p>Non-linearity : < 2%</p> <p>Weight : Not more than 1 gram</p> <p>Connector : Single 4 pin connector</p> <p>Mounting provision : 10-32</p> <p>Housing materials : Stainless steel</p> <p>Seismic element : ceramic</p> <p>Sensing geometry : shear</p> <p>Sealing : welded hermetic</p> <p>Excitation voltage: 18 to 28 VDC</p> <p>Constant Excitation: 2 to 10 , typical 4 mA</p> <p>Output impedance : <100</p> <p>Output bias voltage : 10 to 14 VDC</p> <p>Noise, 1 to 20,000Hz: <0.002</p> <p>Shock limit , $\pm peak$: 1000g</p> <p>Temperature range, operating : -40 to +250 °F</p> <p>Transient temperature : 0.01 g/°C</p> <p>Base strain sensitivity : 0.0002 g/$\mu\epsilon$</p>
7	<p><u>Accessories</u></p> <p>Calibration certificate</p> <p>10-32 mounting stud</p> <p>Single 4 pin connector with 5meter length and 3 BNC male connector</p>
8	<p><u>Fixture with test specimen.</u></p> <p>Mechanical fixture for modal ,free and forced vibration setups ,</p>

	Cantilever test specimen for study 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.