

## Technical Specification for R & D Equipments, S. No. 01 to 15

S. No.	Name of the equipment & Technical Specification	
1	<b>BioDegradation set up as per ASTM 5338</b>	
	<b>PROCESS DESCRIPTION</b> : There are sixteen Composting Vessels and the gas from each composting vessel has to be analyzed one after the other in a sequential order. Bio-degrading process takes place in the Composting Vessel and the total gas emanating from each vessel has to be analyzed. The analyzer shall be supplied with	
	AMBIENT CONDITION	
	TEMPERATURE : 5 to 50 °C	
	HUMIDITY : 95% RH Non-Condensing	
	BAROMETRIC PRESSURE : 18 m above sea level	
	PROCESS DATA	
	SERVICE : Composting Vessel Outlet Gas	
	GAS COMPONENT : CO	
	OPERATING PRESSURE : 5000 mmWC	
	OPERATING TEMPERATURE : 60 °C	
	OPERATING DUST CONCENTRATION : Nil	
	<b>A PC based SCADA system in which it shall possible to visualize the following features:</b>	
	1. Trend of CO from each Composting Vessel for the entire degrading process which is about 45 days.	
	2. The analyzer shall also trend the CO content of the atmospheric air.	
	3. Weighted average value of CO gas for the entire degrading process for each channel.	
	SAMPLING PROBE : Not required.	
	The total process gas outlet from Composting Vessel has to be analyzed.	
	SOLENOID VALVE PANEL : Required, Vendor to furnish complete details.	
	There shall be sixteen inlet streams and one outlet stream to analyzer cabinet.	
	Each stream from Composting Vessel shall have one sampling solenoid valve preceded by a filter.	
	There shall be a vent solenoid valve upstream of filter. During Channel selected mode the vent Solenoid valve shall close and sampling solenoid valve shall remain open.	
	The common vent header shall be sized for venting all sixteen streams.	
	The above equipment shall be supplied as a pre-piped unit with all the necessary accessories.	

	It shall be possible to set the analyzing time for one stream which shall be typically 1 minutes (field adjustable). The total cycle time shall be typically 16 minutes and at the end of 16 <sup>th</sup> minute the analysis shall continue from first stream.	
	It may be possible that some Composting Vessels are under maintenance and hence it shall be possible to skip the same from auto sequence by selection from SCADA screen.	
	The required Programmable Logic Controller to achieve the above functionality shall be fitted in the Analyzer Cabinet.	
	Based on the selected stream the SCADA package shall tag the stream number and open the corresponding solenoid valve. Mixing of streams is not permitted.	
	It shall be possible to start the analyzer sampling sequence from the SCADA screen in auto mode. Suitable provision shall be made for operation of the sequence in manual mode.	
	ANALYZER CABINET : The sampling rate shall be sufficient enough to achieve stipulated response time.	
	Reciprocating diaphragm pumps shall be used to draw gas samples from process and deliver them at a small positive pressure to the gas analyzer.	
	A gas chiller with condensate drain out shall be provided to eliminate the interference moisture in the sampled gas. Adequate alarms shall be provided with respect to failure of critical components.	
	The above equipment shall be supplied as a pre-piped unit with all the necessary filters, coolers and gas/air regulators.	
	Enclosure degree of protection shall be IP-54	
	ANALYZER UNIT	
	TYPE : Micro-processor Based	
	MEASURING PRINCIPLE : Non - Despessive Infra-red (NDIR)	
	POWER SUPPLY : 230 VAC, 50 Hz, $\pm 10\%$ (Vendor to specify power consumption for the complete analyzer system)	
	OUTPUT SIGNAL : Isolated 4-20mA in to a load of maximum 550 $\Omega$	
	ALARM CONTACT : Alarm contacts with rating of 5 A at 230V AC	
	: Potential free contacts shall be provided for the following parameters:	
	- Disturbance in cooling water circuit	
	- Disturbance in Measuring Gas Circuit	
	- Analyzer system Fault Alarm	

	- High & High High Alarms for CO Measurement	
	LOCAL DISPLAY : Required	
	LOCAL DIAGNOSTIC MESSAGE : Required	
	RANGE : Vendor should Specify	
	ADJUSTABLE : By Vendor, shall be selectable locally	
	SET : 0 - 1 / 0 - 2 Volume %	
	SAMPLE FLOW RATE : By Vendor	
	ACCURACY : In case of CO , $\pm 1\%$ of FSD per 10 <sup>o</sup> C change within the permissible ambient temperature range.	
	RESPONSE TIME (EXCLUDING : Max. of 4 sec. for a 90% change in measured value. SAMPLING TIME)	
	TEST GAS CYLINDER : Required with suitable accessories for both zero and span.	
	Cylinders should be kept outside the Analyzer Cabinet.	
	Test Cylinder purity shall be better than 99.99%.	
	ACCESSORIES : Mounting Accessories like probe mounting flange with counter flange along with the required SS tubing, various other fittings etc. shall be included in Vendor's scope of supply.	
	MAKE : Siemens/ ABB/Equivalent	
	MODEL NO. : By Vendor	
	DRAWINGS & MANUALS : soft and hard copies required.	
	SPECIAL REQUIREMENTS : Consumables for commissioning to be included under scope of supply.	

## 2

### CABLE STRIPPING MACHINE

	Specifications	
	• Automated Cutting & Stripping machine for wires and cables.	
	• Wire or cable size: 3 mm to 85 mm or equivalent	
	• Wire length: 1 to 10 meters.	
	• Daily output: 500 kgs /hr or better	
	• Electrical requirement: 3kW, 3 phase	
	• Voltage: 440 V	

## 3

### Chemical Vapour Deposition SYSTEM :PLASMA ENHANCED (PECVD) –

	Make	Bidder to specify
	Model	Bidder to specify

	Applications	Graphene and CNT Synthesis; Coating on polymer/ceramic/glass/metal substrates
	Temperature Range	Ambient to 600° C or higher
	Substrate Size	50 mm dia.
	Temperature accuracy	±2°C
	Temperature Controller	PID
	Chamber	Horizontal Process Chamber with Ultra high vacuum flange
	Sample holder size	50 mm dia.
	Gas Injection Ports	O <sub>2</sub> gas injection ports
	Pressure control	Vacuum pump rotary valve with throttle valve
	Pressure Gauge	Regular Pressure gauge
	Plasma system	1000V/ 200mA, position adjustable counter electrode
	RF range	Primary source 10 MHz or above & Secondary Source less than 500 KHz
	Safety interlock	Safety interlock should be provided for pressure change
	Loading system	2 gas line loading system
	Standard gas	Acetylene, Ammonia, Nitrogen
	Purge gas	Argon
	Flow meter	Digital mass flow meter
	Vacuum pump	Rotary valve type pump
	Flow rate	20 m <sup>3</sup> / h
	Vacuum Level	10 <sup>-3</sup> torr
	Safety Provisions to be provided for	· Over heating
		· Air pressure
		· Thermocouple
		· Pump failure
	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 <sub>2</sub>

		Si <sub>3</sub> N <sub>4</sub>
		· Diamond and Diamond like Carbon thin film
		· II-V Semiconductors
		GaN, GaAs, AlGaN, InP, etc.
		· II-VI semiconductors
		ZnO, ZnS
		· IV semiconductors
		Si, Ge, Strained Si

#### 4

#### CNC CMM

	Make	Bidder to specify
	Model	Bidder to specify
	Axis Travel	
	X-Axis (mm)	500- 600
	Y-Axis (mm)	500- 600
	Z-Axis (mm)	500- 600
	Volumetric Accuracy	TP20 (2.4+ 0.4 L/100) µm
		TP200(2.3+ 0.4 L/100) µm
		SP25M (2.1+ 0.4 L/100) µm
	Scale Resolution	0.5 µm
	Table	Granite
	Table Load Capacity	500 kg or Better
	Max Velocity Vector	600 mm/sec
	Max. Acceleration Vector	600 mm/sec <sup>2</sup>
	Control System	3-Axis CNC System + Servo Amplifiers + Joystick unit with accessories
	Probe Kit	Renishaw Latest 5 axis infinite positioning probe head + TP20 module + Set of Styli
	Measuring Software	Complete modules of software in latest version
	Computer System	Bidder to specify and Quote
	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.
	Scope of supply	Attach list for scope of supply
	Installation requirements	Bidder to specify , pre-installation requirement
		Basic and Advanced training should be provided

	Installation & Training	Also the required operation, maintenance and other reference manuals should be provided for getting quality output and longer trouble free life of machine.
	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.
	Manufacturer's credential	Should have sizable installations of same model worldwide and at least two same or similar model in India.
	Warranty and guarantee	The machine shall be guaranteed for at least Three years for replacement and service against any design, manufacturing and workmanship defects.

## 5

### CONE CALORIMETER

	The Cone Calorimeter should be capable of measuring:	
	a. Heat Release Rate	
	b. Mass Loss Rate	
	c. Time to Ignition	
	d. Effective Heat of Combustion	
	The apparatus should meet the standards prescribed in ISO 5660 and ASTM E 1354.	
	Conical Heater	a) The heater element should be rated at 5 kW (or better) at 240 V
		b) The heater should be able to produce uniform irradiance over the range 0 to 100 kW/m <sup>2</sup> (or more)

		c) The heater should be encased on the outside with a double-wall stainless steel cone, packed with a refractory fiber material of approximately 100 kg/m <sup>3</sup> density
		d) The heater should be capable of horizontal and vertical orientation arrangements
		e) The heater should have three K-type stainless steel sheathed thermocouples, connected but not welded to heater element
		f) The heater should have a shutter mechanism (automatic or manual) to protect the sample area before the test
	Temperature Controller	The temperature controller for heater should be capable of holding the element temperature steady to within $\pm 2^{\circ}\text{C}$ or better, over the range of $0^{\circ}\text{C}$ to $1000^{\circ}\text{C}$ (or better) using a suitable 3-term PID controller and thyristor unit capable of switching currents up to 25 A at 240 V
	Ignition Circuit:	a) External ignition should be by 10 kV discharge across a 3 mm spark gap
		b) A power source should be a transformer designed for spark-ignition or a spark generator
	Load Cell	a) Load cell should be compensating for imbalance in the fuel
		b) It should have a readout resolution of 0.1 g or better

		c) Total weighing range of minimum 3.5 kg of which more than 500 g should be available for direct monitoring during single test
	Specimen Mountings:	a) The specimen holder should be manufactured from 2.5 mm thick stainless steel material
		b) The inside dimensions of holder should be 100 mm×100 mm and 25 mm height
		c) Retainer frame and wire grid arrangements for specimen holder should be provided
	Heat Flux Meter	a) Gardon or Schmidt-Boelter type heat flux meter to calibrate the heater temperature controller
		b) The design range should be at least 0 to 100 kW/m <sup>2</sup> with an accuracy of ± 3 %
		c) The sensing surface should be circular and flat
		d) The flux meter should be water cooled
	Calibration Burner:	a) Calibration burner to be provided to calibrate the heat release rate of the apparatus using methane of at least 99.5% purity
		b) Mass Flow Controller (MFC) to control the gas flow is preferred.
	Exhaust System	a) The exhaust system should consists of a variable speed exhaust blower capable of developing flow over a range 0.012 to 0.035 m <sup>3</sup> /s



		b) A restrictive orifice of 57 mm inside diameter should be placed between the hood and the duct for mixing and a sharp-edged orifice of 57 mm inside diameter should be located at least 350 mm downstream from the blower as per ASTM E 1354, ISO 5660
		c) The duct should be 114 mm inside diameter and manufactured from 0.6 mm thick stainless steel plate
		d) K-type stainless steel sheathed thermocouples to measure temperature of gas stream
		e) Material of complete exhaust system should be stainless steel
	Smoke Detection System	a) Helium-Neon laser beam (0.5mW, 633nm) system, silicon photodiodes as a main beam and reference detectors.
		b) 2 number of ND filters for calibration with optical density anywhere between 0.1 to 1
	Gas sampling and analysis system	a) Capable of measuring O <sub>2</sub> , CO <sub>2</sub> , CO
		b) Should incorporate a ring sampler, soot filter, cold trap, pump, desiccant, bypass system and flow controller
		c) The gas sample lines should be constructed noncorrosive material like nylon and plumbing should be using Swagelok fittings
		d) The gas sampling & analysis rack should be modular for use with both cone calorimeter and well as large scale calorimetry.

	O <sub>2</sub> Analyser	a) Paramagnetic type gas analyser with a range of 0 to 25 % oxygen
		b) The analyser should exhibit a linear response
		c) The drift of not more than $\pm 50$ ppm of oxygen and noise of not more than 50 ppm of oxygen (root mean square value) over a period of 30 min.
		d) The analyser should have 10 to 90% response time of less than 12 s
		e) Intrinsic error (accuracy) should be less than 0.02% Oxygen
		f) Absolute pressure transducer arrangement for analyser
	CO <sub>2</sub> Analyser	a) Non-dispersive Infra-red (NDIR) type with a range of 0 to 10 % CO <sub>2</sub> (v/v)
		b) The response time should be less than 20 s
		c) Intrinsic error (accuracy) should be at least 1% of range
	CO Analyser	a) Non-dispersive Infra-red (NDIR) type with a range of 0 to 1 % CO (v/v)
		b) The response time should be less than 20 s
		c) Intrinsic error (accuracy) should be at least 1% of range
	Digital Data Collection System	a) The system must have facilities to record output from the analysers, the thermocouples, the orifice meter, the load cell and the smoke measuring system.
		b) The system should be capable of recording test data at least 1 scan per 1 second or better.

		c) Mention the hardware and software (OS) specification of computer system (personal computer/laptop) to be provided by the user.
	Software	Software for showing the status of the instrument, calibrating the instrument and storage of calibration results, collecting data generated during a test, calculating the required parameters, presenting the results in a manner approved by the standards should be provided on a media.
	Optional	a) Kindly mention ability to provide the following optional. For each option please give the technical specifications (drawings if applicable) in the technical quote and extra cost of each individual option in the <u>budgetary quote</u>
		b) Additional heated analytical line (3 meter) and filter to enable taking combustion gases for further analysis
		c) Step temperature controller (for adjusting conical heater's heat flux in steps)
		d) A larger cone, which can be used for larger samples (say 150 mm×150 mm) for low heat release materials
		e) A quartz tube of 114 mm I.D. and length 100 mm should be incorporated before gas sampling ring

		f) Personal computer i7 8GB 21" 1Tb branded workstation as per the requirement of software for equipment
		g) CACC (Controlled Atmosphere Cone Calorimeter) attachment.
	Warrantee	12 months from the date of installation or 18 months from the date of invoice. Also, mention AMC (annual maintenance cost) after expiration of warranty

## 6

### CRYOGENIC GRINDING SYSTEM

	Applications	Should be programmable, user-friendly and
	Feed material	Size reduction, Mixing, homogenization compact bench top unit for grinding
	Size reduction principle	hard, medium-hard, soft, brittle, elastic, fibrous and plastic materials
	Material feed size	impact, friction
	Final fineness	1-10 mm
	Grinding Jar size	around 5 mm
	Grinding jars	Capable of batch size / feed quantity of about 5 ml to 50 ml. ( 5 ml, 25 ml and 50 ml)
	No. of grinding stations	To be leak proof,
	Speed	1
	Cooling system	Upto 2000 min <sup>-1</sup>
	Grinding modes	Integrated cooling system
	Cryogenic grinding	3 modes: Cryogenic, Wet and Dry of polymeric samples
	Materials of Grinding tools	Closed LN <sub>2</sub> system (autofill) for enhanced safety – capable of grinding at - 196°C.
	Grinding time setting	Hardened steel, Stainless steel, Zirconium Oxide, PTFE or better

	Accessories	Digital display, time: 30 s – 99 min (Programmable) or better
		LN <sub>2</sub> feeding systems
		Additional Jars
	Power	Additional Balls
		230 V 50Hz

## 7

### Dielectric Thermal Analyzer

	<b>Applications</b>	
	Investigation of the curing behavior of thermosetting resin systems, composite materials, adhesives and paints.	
	➤ Suitable for films, liquid and powdered materials.	
	➤ To determine glass transition of delicate polymeric films and membranes.	
	➤ To study the dependence of temperature and frequency on dielectric properties.	
	➤ Provide information on capacitance and conductivity of materials.	
	Frequency range	12Hz to 200kHz Up to 50 frequencies in same experiment
	Temperature range	-150°C to 350°C or better
	Ramp Rate	2°C / min
	Heating/Cooling rate	Heating rate 0 to 20°C/min
		Cooling rate 0 to 40°C/min
	Coolant	Automatic cryomode for measurement at sub ambient temperature using liquid nitrogen
	Voltage range	0.005 to 20 V
	Electrode type	➤ Parallel plates: 10mm, 33mm, 40mm
		➤ Cup: 40 mm
	Data acquisition /operating system	➤ System should be capable of determining the dielectric constant, permittivity, loss factor, dissipation factor, glass transition, and other secondary transitions with the DETA.

		➤ Should have DETA data system which is based on Microsoft Windows10 operating system for instrument control, data acquisition, data analysis, quantization, automation & customization with online and offline sessions provided.
	Voltage range	AC: 0 mV to 1.3V in 5mV step
		DC: 2V internal DC Bias and 30V external Bias 200mA max
	Capacitance range	10pF to 10 $\mu$ F
	Dynamic impedance	$10^{-5}\Omega$ to $10^5$ k $\Omega$
	Tan $\delta$ resolution	> 0.0001
	Humidity control chamber	20°C to 90 °C
		Dry purge gas
	➤ Should be equipped with an efficient furnace for precise temperature control. Liquid nitrogen can be easily connected (automatic mode) to allow for sub-ambient measurements.	
	➤ Bidder should specify the sample thickness and dimension	
	<b>Accessories</b>	
	Branded latest suitable PC compatible with GC-MS system having HDD Graphics display, 20" LCD/LED Monitor along with a good quality printer (should specify the PC and printer model).	
	UPS: 7 KVA UPS with at least 60 min back up is needed.	
	Mechanical accessories (tool-kit etc.) and consumable spares for the operation and maintenance of the instrument should be provided to meet our needs for at least 1 year.	
	<b>Other terms and conditions</b>	
	The system must be factory tested and a certificate should be provided.	
	A minimum of three years warranty from the date of installation should be given for the complete DETA system.	
	The entire system should be installed by the company professionals at our site. A thorough technical training (minimum 2 days) in analyzing and troubleshooting should be given by the technical professionals.	

	A list of references in India, where similar systems have been installed, must be provided and this will be taken very seriously while making the decision. Your post sales service feedback will certainly be a deciding factor.	
	A minimum of three years warranty from the date of installation should be given for the complete DETA system.	
	The entire system should be installed by the company professionals at our site. A thorough technical training (minimum 2 days) in analyzing and troubleshooting should be given by the technical professionals.	
	A list of references in India, where similar systems have been installed, must be provided and this will be taken very seriously while making the decision. Your post sales service feedback will certainly be a deciding factor.	

8

### Dry Blending

	Batch Capacity	250 kgs or its equivalent volume in liters
	No. of container	1
	Auto Timer	Digital
	Drum Material	Stainless Steel
	Temperature accuracy	± 1°C or better
	RPM range	20-500
	Mixing Tools	Stainless steel
	Other Mandatory Items	While supplying the Machines, the supplier should also provide the following items apart from above:
		· Hard copies of Operational & Service Manual- 01 Set .
		· Machine should come with all other essential accessories & spares required for installation, commissioning & Operation.
	· The supplied system should have the facility of additives (powder form) & colour /pigments blending with master batch.	
	· The system should have the facility to change the speed, electronic timer to set the required batch time etc.	

	· The system should be equipped with requisite safety features needed for smooth operation.	
	· Entire structure powder coated / PU paint	
	· AC drive for variable speed control	

**9**

### **Dust Catcher**

	Suction Pressure:	min of 300 mm of water or more
	Suction Inlet	: 2 x 100 mm OD or equivalent and adjustable
	Cap. Dust Drawer	0.10 M cube or equivalent
	Flow Rate:	900-1100 cfm
	Noise Level:	70-100 db AT 1 Meter Distance
	Motor	: 3-5 HP, 440 VAC, 50 Hz, 3 Ph
	Shaker	Manual
	Dust collection Efficiency:	98% or better

**10**

### **ELECTRO-SPINNING UNIT**

	Make	Bidder to specify
	Model	Bidder to specify
	Applications	Preparation of fibers from polymers solution and metal and metal oxide fibres
	X, Y and Z- axis stage	Programmed on the operation unit through PC
	Spinning direction	Vertical, should be controlled Individually
		Co-spinning (optional)
	Safety system	Safety door lock system to avoid electrical shock and an exhausting system to evacuate evaporated solvents and flying nanofibers.
	Power supply control unit	0 - 50kV with emission current less than 50 $\mu$ A, 50Hz
		One movable syringe pump.



	Traverse width	10- 300 mm with digital display of transverse speed.
	Angle	0 to 45 degree.
	Nozzles:	Metallic needles; Single nozzle & multi nozzles
	Syringe unit	Four syringe (each for two syringe pump)
	Syringe pump feed rate	0.1-60 ml/min
	Syringe Traverse Speed	10-100 mm/min
	High Voltage Power Supply Device	0-50 KV digital display & voltage control device with complete safety to operator
	Inner Diameter of Nozzle	100-500 nm
	Drum Rotation Speed	60-3000 rpm
	Temperature	Room Temp. to 80 ° C inside stink cupboard
	Temperature controlling system, precision	±0.1 °C
	Collector system	i. Plate Collector, (Disc area: A5 size (< 370 cm <sup>2</sup> ) (approx.))
		ii. Disc Collector, (Disc circumference: 600 mm (approx.), Rotating speed : 500 – 3000 rpm (approx.))
		iii. Drum Collector (Fiber Deposition area: 870 cm <sup>2</sup> (approx.) Rotating speed : 500 – 2500 rpm (approx.))
	Safety measures	A door lock and static electricity removal device.

## 11

### ELECTROSTATIC SEPARATOR

	Feed Capacity	500kgs/hr or better
	Material type	Dry, Free flowing
	Feed temperature	Upto max 120°C
	Electrode polarity	Positive / Negative
	Electrode Position	Adjustable
	Type of electrode	Corona
	Number of outputs	01 each for Conductor, Non-conductor & others
	Roll speed	Adjustable
	Roll brush	Rotary fiber brush
	Splitter	Adjustable on each roll

	Feed system	Electromagnetic Vibratory Feeder
	Digital display	Roll Speed & DC voltage
	Feeder control	DC voltage control
	Roll speed control	Emergency stop, Fault indicator
	Other Mandatory Items	While supplying the Machines, the supplier should also provide the following items apart from above:
		· Hard copies of Operational & Service Manual- 01 Set .
		· Machine should come with all other essential accessories & spares required for installation, commissioning& Operation.

<b>12</b>	<b>FE-SEM with EDAX and Gold &amp; Platinum Sputtering Device</b>	
	Make/Model	Bidder to specify
	Applications	To study morphological features of polymers and multiphase polymer systems.
	Electron Gun	I. Schottky Field Emitter with High brightness.
		II. Filament or its replacement must be provided for at least 3 years from the date of installation
	Accelerating Voltage	200V to 30 kV or better (continuously adjustable)
	Resolution	Resolution with in-beam/in-lens SE Detector
		• 0.7nm or better @ 15 kV
		• 1.0nm or better @ 1 kV

	The definition of resolution and the method used to determine the resolution should be clearly specified and resolution should be determined at the site of installation on standard gold on carbon sample at supplied accelerating voltage
Magnification	20x (or lower) to 10,00,000 X or better
Probe current	Suitable for all applications. Upto 100 nA
Imaging Modes	(i) SE, (ii) BSE
Detectors	SE detector, BSE detector and In-column or In-lens detector with beam deceleration (BD)
Vacuum System	<p>I. Suitable vacuum systems having Ion getter Pump/sputter ion Pump, Turbo molecular Pump and Rotary Pump/Oil free/Dry Scroll Pump must be provided.</p> <p>II. All necessary gauges and valves must be included. Pump down time should be 5 minutes or less.</p>
Chamber	<p>I. Chamber should accommodate a sample size of 1.5 cmx 1.5cm or more.</p> <p>II. Minimum number sample Ports: 8 or more for future expansion</p> <p>III. Details of chamber dimensions to accommodate the above sample size for characterization should be clearly indicated</p>
Sample stage	<p>I. PC controlled 5 axis motorized stage. (X ~100mm, Y~80mm, Z=25 mm</p> <p>Tilt=0-60° R=360°</p>

	II. Ease for specimen exchange.
	III. Stage movement should be controllable through both computer and manually with joystick.
Sample holder	For adding 8 or more 1 cm <sup>2</sup> samples
Camera	CCD camera with IR illumination for in chamber viewing
EDS system	<p>I. Detector size/Chip size: 30 mm<sup>2</sup> or more</p> <p>II. Resolution: 129 eV or better@ Mn K<math>\alpha</math></p> <p>III. LN2 Free, Peltier cooled detector</p> <p>IV. Detection from B(5) to U(92).</p> <p>V. Supplied EDS server and analysis software should be capable of performing data acquisition storing and transfer in common windows based application formats, qualitative &amp; quantitative analysis, line scanning, elemental or dot mapping including spectrum imaging and phase mapping with specimen drift correction.</p> <p>VI. Standard samples for calibration should be provided.</p> <p>VII. Interactive ZAF/PB and Phi <math>\rho</math> z based quantification software with tilt correction and manual background correction and peak deconvolution as an integral part of the software.</p>
Image Acquisition and display	<p>I. 24-inch HD LCD or LED Screen: 02 no.</p> <p>II. Image size: 5120 X3840 pixel or better.</p>

	III. Image depth: up to 16 bits or better
	IV. Image format: BMP, TIFF, JPEG, JPEG2000, GIF, PNG, etc.
	V. Software should be capable of automatic generation of report in MS-Office. MS-office be provided.
	VI. Image acquisition system should be compatible with Windows 10 or recent operating system version of windows.
Sputter Coater system	I. Sputter coater system: Metal Sputtering and Carbon coating system to be provided.
	II. Metal Target: Au, Pt, Au-Pd to be provided,
	III. Vacuum pump and other necessary items to be provided.
	IV. 01 set of additional/spare targets to be required.
Sample holders and consumable	I. Sample holders for 6-inch wafers – 2 Nos.
	II. Cross section and tilted sample holders – 5 Nos. each of 45° and 90°
	III. Pin/regular stubs 1 inch – 50 numbers
	IV. Conductive carbon adhesive tapes – 5 Nos.; (Length: 20 m; Width: 8mm – 1 No.; 10mm – 2 No.s; 20 mm – 1 Nos.; 50 mm – 1 No.)
Essential Accessories	I. A filament replacement warranty card.
	II. Track ball for imaging operations/ Joystick/ Control panel

	III. Touch alarm safety detector for specimen stage and detectors.
	IV. Remote control hardware & network software for on line fault diagnosis using internet TCP / IP open protocols.
	V. All essential commissioning and operating accessories like Air compressor, Chillers etc., to be provided
	VI. Essential tool kit to be provided
	VII. A suitable 10 kVA or more UPS for 1 Hour or more backup on full load to be provided
	VIII. Suitable printer
	I. Suitable hardware and software for equipment control, data acquisition and analysis.
	II. No public domain software is acceptable. Manufacturer must offer their licensed software developed by them. Updates to the instrument control/data collection and automated structure solution and refinement software will be provided as available free of charge and in perpetuity.
Data storage and analysis softwares	
Standard/ calibration samples	I. Standard samples such as Co, Mn, Gold magnification standard Faraday cup, a brass duplex standard for BSD calibration, etc. should be provided for calibration.
	II. All other optional standard samples may also be quoted as optional items

General	<p>I. FESEM quoted must be compete in all respect with stage of art technology. It should have capability to image thin films, polymers, ceramics, semiconductors and magnetic specimen at high mag. FESEM should have suitable technology for optimum performance of all the detectors particularly In-Lens SEI.</p> <p>II. The quote should include all accessories required to image. Thin films, polymer, ceramics, semiconductor and magnetic samples.</p> <p>III. FESEM should include safety devices for protection against Failures in vacuum, water, power etc.</p>
Installation and training	<p>I. After installation one week of through training must be provided on site. Details should be indicated.</p> <p>II. Installation must include:</p> <p>a. Resolution check.</p> <p>b. EDS resolution check; 129 eV or better; Mn K<math>\alpha</math> and also detecting B(5) to U(92).</p> <p>c. Operation using standard samples on all modes of imaging</p> <p>d. Elemental mapping, line scan, etc. in case of EDS</p> <p>III. Standard samples to require a certificate from standard certifying bodies</p>

	IV. Complete set of manuals on operation, maintenance of the system in hard copy as well as soft copy should be provided in English.
Warranty	5 years comprehensive warranty should be quoted as standard
	password protection
	library for polymers, additives, monomers, etc.
Accessories	Instrument Should have Automatic accessory detection
	1) Transmission module for transmission measurement should be included
	2) Magnetic KBr Pallet holder
	3) Magnetic film holder with magnetic strips
Optional Accessory	Single Bounce ZnSe ATR
Workstation	Branded Desktop PC ( i7, 8 Gb RAM, 1Tb HDD 21 " LCD display,) Inject colour Printer & Branded UPS
Warranty	Modulator (10-year), laser(10-year), source(2-year)

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### Fusion Deposition Modelling

<b>MACHINE</b>	
Technology	Solid based additive manufacturing system (Latest Fused Deposition Modelling system)
Make	Bidder to specify
Model	Bidder to specify
Build Volume	Minimum build volume 400 x 350 x 350mm
Layer Thickness	Various nozzles diameter between 0.05 mm to 0.3 mm
Part accuracy	+/- 0.1 mm or better
Support structure	Soluble and breakaway
Machine Control	Machine should be controlled in real time
<b>MATERIAL</b>	



Material	Machine must have the ability to fabricate parts with open material option for ABS, PC, PLA, Flexible Rubber, Nylon, Polyetherimide (PEI) etc. Provide list of all material option available. Vendor should list all other available materials that are suitable for the quoted machine. Machine should have the option to upgrade for currently available material and also for future materials.
Material Quantity	Vendor should quote all possible materials and supply 5 Nos. of Canister on each material, excluding the quantity of material required for installation, training and calibration. Machine should be calibrated to fabricate parts with all the materials mentioned above at the time of installation.
Customised material guidance	Machine should have the provision of testing materials developed by the customer and professional guidance should be given to adhere to the system compatibility and configuration
Material Quality	Vendor should attach the quality certificate of each material with test report evaluating the parameters according to standards.
Material Property	Vendor should also supply proven parameters for all the suitable materials with clear documentation and statistics of the mechanical properties with respect to build orientation and layer thickness.

<b>SOFTWARE</b>	
Process Software	It should control the building process and have an ergonomic operating interface
Software feature	Software should have the feature of addition, deletion and updation of part information during the time of fabrication with the option to continue to build from the same layer. Automatic and manual 3D nesting should be possible.
Slicing and data editing software	Software should have complete module for conversion of part data in the STL format and optimization of layer data. Should allow both manual error fixing and auto fixing of STL data. Should have a provision to add text or batch numbers to the STL file. Software should support other CAD file formats like STEP, IGES. Vendor should list all other supported file formats
Control and reporting	The software should report the job & part specific build data for quality requirements. It should generate statistical QA reports that can be reviewed in real time and for future documentation
Desktop Software	Vendor should supply independent software that operates on independent offline PC to prepare and evaluate the total build time that would be required to finish the job
License	License must be perpetual
<b>ACCESSORIES</b>	
Support removing system	As per the requirement to be quoted by the bidder

Consumables	Vendor should supply minimum quantities of consumables like build platforms, nozzle for all layer thickness, wiper blade, brush etc., required for 6 months
Compressor	Vendor 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.
De-humidifier	Vendor should supply suitable de-humidifier to maintain room humidity level within suitable range for machine operation.
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.
Workstation with accessories	Vendor should supply suitable OEM workstation computer system with complete accessories and UPS. It should have minimum of i7 (3.4 GHz, quad core) processor of latest configuration, 32GB RAM (2400MHz, DDR4), 1TB hard disk (7200 RPM), and 2GB graphics card or better configuration, with windows operating system

Tool kit	Vendor should supply standard tool kit for startup, removal of parts and cleaning (list to be attached).
Any other accessories required	Vendor should supply all the other accessories, material transport trolleys / carts and spares required for effective and better utilization of machine. All the required accessories should be listed
<b>OTHER ESSENTIAL REQUIREMENTS</b>	
Benchmark part	Vendor should submit two numbers of benchmark parts in two material which should be built in the quoted machine same is to be built during prove out of the machine at the site
Manufacturer's Credentials	Manufacturer should have sizable installations of same model worldwide and at least three same or similar models in India
Supplier's Credential	Supplier should have sizable installations of same model worldwide and at least three same or similar models in India. Supplier should submit complete contact details and acceptance letter from the recent customers
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

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.
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
OTHER ESSENTIAL REQUIREMENTS 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
Price list of material, spares and consumables	Price list of each material with minimum order quantity, machine spares and consumables are to be quoted.
<b>INSTALLATION, COMMISSIONING AND TRAINING</b>	

Installation and 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 Transformer, chiller, UPS, Air conditioner, Dehumidifier, separate special earthing, vibration isolation and compressed air supply
Training and documentation	<p>Minimum of 5 days training for five persons which includes basic &amp; 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"> <li>· Software instruction</li> <li>· Maintenance and trouble manual</li> <li>· Training</li> <li>· Installation and Commissioning</li> <li>· Handling of accessories</li> <li>· Software key (if any)</li> <li>· Software CDs</li> </ul>
Installation and requirements 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

Warranty	The whole system and its accessories should be given three years warranty for replacement and service against any design, manufacturing and workmanship defects from the date of installation and commissioning
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.
Annual Comprehensive Maintenance Contract (ACMC)	Vendor shall 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

Model / Make	Bidder to specify
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Applications	Separation and identification of solids/liquids/gaseous and their mixtures that includes unknown samples, polymers, pesticides, organic compounds, pharmaceutical ingredient etc.
General Technical	
Gas Chromatograph system	1. Solid, inert triple quadruple based mass chromatographic system 2. Instrument detection limit should be $\leq 4$ fg.
Ionization mode	Electron Impact (EI)
Detector	Flame Ionization Detector (FID) should be provided which can be coupled with the Gas chromatographic system.
Data acquisition /operating system	System should be capable of supporting two inlets and two detector ports simultaneously; should have electronic pneumatic / pressure controls for all the gases and should have Chromatography Data system which is based on Microsoft Windows operating system for instrument control, data acquisition, data analysis, quantization, automation & customization with online and offline sessions provided.
Gases flow control	Should be adjustable/ controlled by software with no manual control.
Provision	Should be provided with Backflushing system
Column Oven	
Columns	Provision to install at least two column
Operating temperature	450°C or more
Temperature set point resolution	0.1°C or better
Maximum temp ramp rate	120°C /min or more
Cooling rate	From 450°C to 50°C: within 4 minutes or better 4.



Temperature programming	Should have minimum 15 ramps & 16 plat
Pyrolyzer	
Model & Make	<i>Bidder to specify</i>
Type	Multi-shot pyrolyzer compatible with GCMS
Temperature range	Upto 1000°C or more
Furnace cooling rate	Temperature to go down from 800°C to 50°C within 10 min
Sample to be analyzed	Solid and viscous liquid
Control	Should be supplied with control software
Head Space Analyzer	
Injection system	Loop based or syringe based system
Sample	Should able to handle all type of VOC
Incubation Temperature	25°C to 200°C or more
Head space vial	20 or more
Injection port	
Injection port	1. Split/Splitless injection port with electronic pressure control (EPC)/programmable pneumatic control (PPC)/advanced flow control (AFC) with fast GC capability
	2. Programmable temperature vapor (PTV) injector
	3. Possible to use capillary columns of 100 µm to 530 µm columns
	4. Digital display of gas flow, temperature etc.
	5. Manufacture's software controlled (AFC/EFC/APC/EPC controlled).
Pressure range	140 psi or better
Maximum temperature	400°C or more
Heating zones	Should have independently heated zones
Auto Injector-liquid	
An automatic injector device having a capacity to hold at least 8 vials capacity should be provided.	
GC Detector Specifications (FID)	

FID detector	Having an MDL: <1.5 pg c/s or better
Linear dynamic range	107 or better
Carrier gas head pressure setting	Should be more than 950 kPa
MS Specifications	
Mass range	m/z up to 1000 unit or better
Mass Analyzer	Should have inert quadrupole mass filter with pre-filter
Mass axis stability	Should be $\pm 0.10$ amu over 48 hrs
Scan speed	up to 10,000 u/sec or more
Ion source temp	up to 350°C or better and it should be programmable.
	· It should be cable less source for easy cleaning and maintenance.
	· Additional a pair of filament should be provided.
Ionization mode	EI
Filament	Dual and automatic switching
The sensitivity of system should be as followed and demonstrated at site	EI Scan sensitivity S/N ratio >2000:1 or higher for 1 $\mu$ L of 1pg/ $\mu$ L of OFN m/z 272.
Turbo Molecular Pump (TMP)	With 300L/sec or better capacity.
Resolution	2-1000 amu or better
WorkStation Instrument Control Software	
GC and MS systems should be combined with the same workstation for simultaneous settings and programming.	
Should have Auto tune (to optimize MS parameters automatically) feature	
A user friendly automatic data collection and analysis system compatible with Microsoft Windows OS and Microsoft Office suite applications	
Library search through Retention Index function should be provided as standard in the software.	
Spectral Library	
Latest mass spectral library (NIST) to be supplied in CD	
Accessories	
Branded latest suitable PC compatible with GC-MS system having HDD Graphics display, 20" LCD/LED Monitor along with a good quality printer (should specify the PC and printer model).	

UPS: 10 KVA UPS with at least 60 min back up is needed.
High quality He, H <sub>2</sub> , N <sub>2</sub> & Zero Air gas cylinders along with compatible regulators, gas purification panel for the above mentioned four gases, and required tubings should be provided.
Syringes for manual and auto sampler injection (minimum pack of 10 each), Filaments (minimum 2 no.), capillary column (minimum 1 no., desired 2 no.).
Mechanical accessories (tool-kit etc) and consumable spares (Vials, Septa, Ferrules etc.) for the operation and maintenance of the instrument should be provided to meet our needs for at least 1 year.
Other terms and conditions
The system must be factory tested and a certificate should be provided.
The entire system should be installed by the company professionals at our site. A thorough technical training (minimum 3 days) in analyzing and troubleshooting should be given by the technical professionals.
A list of references in India, where similar systems have been installed, must be provided and this will be taken very seriously while making the decision. Your post sales service feedback will certainly be a deciding factor.
<a href="#">Complete set of manuals on operation, maintenance of the system in hard copy as well as soft copy should be provided in English.</a>

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### Gel Permeation Chromatography (GPC)

GPC	Gel Permeation Chromatography System with complete control of all components from computer is required for analysis of polymeric compounds. The system should have the following specification:
Standard	ASTM D6474 – 12, ASTM D 5296, ASTM D 6579 - 11(2015) (for hydrocarbon solvent)
Solvent Delivery system:	I. Isocratic Pump with on-line vacuum degasser.
	II. Operating pressure : 0 to 6000 psi
	III. Flow rate : 0.01 – 10.00 ml/min
	IV. Flow accuracy : ± 1 %
Sampler	I. Suitable Manual Universal Injector system
	II. Auto-sampler
Molecular weight range	500 to 20,00,000 g/mol or better

Auto sampler	I. Injection programmable from 20 to 200 $\mu$ l
	II. Precision < 0.5 % RSD
	III. Minimum 100 vials of 1.0 ml or more capacity
Column Oven	I. Minimum two columns of suitable length along with guard column.
	II. The temperature range should be ambient to 80°C.
Detector systems	I. All the detectors should have provision for temperature control from 30 °C to 60 °C or more.
	II. Refractive Index Detector (Range 1.00 to 1.70 RIU) or better
	III. UV –Visible light Detector
	IV. Light Scattering Detector (should be equipped with 2 or more angles. One at right angle light scattering (RALS) & other at low angle light scattering (LALS))
Column	GPC standard columns along with Guard columns for organic, aqueous and mixed solvents.
Computer and Software	I. Branded PC with configuration windows 10 original software, i7, 1TB HDD, 19 inch TFT monitor and Laser printer should be supplied along with the instrument.
	II. Should provide validated software with single point control of the entire GPC system.
	III. Ability for GPC data handling, customizable data reports, report publisher and compatibility with RI, UVVis, DAD, RALS/LALS detectors etc.

Spares & Consumables	IV. The software should be able to perform conventional, universal and triple/tetra detection measurement and calculations Mn, Mw, Mz, Mp Mw/Mn etc.
	V. Original software CD with license with life-time validity should be provided. It should be GLP compliance and up-gradable.
	I. Solvent Filtration Kit (Aqueous and Organic) of Mol. Wt. range 500 to 2,000,000 Daltons, including vacuum pump, 1 litre Flask, Membrane filters, etc.
	II. Polystyrene standard kit (Mol. Wt range 500 to 2,000,000 Daltons),
	III. GPC standards for Polyethylene glycol (PEG), and Polysaccharides.
	IV. Sample extraction kits (SPE) for 1000 samples, molecular weight range 500 to 2,000,000 Daltons.
	V. Atleast 6 sets of 12 different molecular weight standards for low to high molecular weights for calibration of instrument and RALS/LALS detector. There should be traceability to the relevant certifications.
	VI. On-line sine wave UPS of minimum 5kVA rating with isolation transformer and 2 hour. backup facility of reputed brand. (Make & model of UPS should be furnished)

	Installation and training	I. Vendor should visit the site and provide pre-installation requirement free of cost before installation.
		II. Free of Cost. Training should be given for staff and students.
		III. The entire system should be installed by the company professionals at our site. A thorough technical training (minimum 3 days) in analyzing and troubleshooting should be given by the technical professionals.
		IV. Complete set of manuals on operation, maintenance of the system in hard copy as well as soft copy should be provided in English.
	Warranty	V. Minimum 5 Year full instrumentwarranty