## Technical Specification of Processing, Testing and R&D Equipments / Machinery, Hardware & Software for Tender (Re-Tender) No.05/2019-20

**1** **MICROPROCESSOR CONTROLLED PET PREFORM STRETCH BLOW MOULDING MACHINE - 1 LITRE CAPACITY**

| S. NO. | ITEMS | SPECIFICATION |
|---|---|---|
| 1 | Container volume - ml | 50-1000 |
| 2 | Output (bottle per hour) (Min.-Max.) - Nos. | 700-2000 |
| 3 | No. of cavities - Nos. | 2 |
| 4 | Max. Bottle Height -mm | 350 |
| 5 | Moulds: Suitable for 500 ml & 1000ml product size | Please Quote |
| 6 | Preform neck diameter - mm | 25-46 |
| 7 | Microprocessor Control System | Please specify and quote |
| 8 | **OTHER FEATURES** | |
| | i) Preform preheating system | Please specify |
| | ii) Preform feeding | Please specify and quote |
| 9 | Safety | Appropriate safety features to be provided |
| 10 | Total connected load | Please Specify & Quote |
| 11 | Max. Power Consumption @full machine capacity | Specify (Lower power consumption machine will be preferred) |
| 12 | M/c dimensions | Please specify |
| 13 | Essential Spares | Please Specify & Quote |
| 14 | **Air Compressor** | **Please Specify & Quote for suitable Air compressor** |
| | i)Working Pressure - bar | 10 to 12 |
| | ii) Blowing pressure - bar | 30-40 |
| | iii) Air consumption for Machine - $m^3$/min. | 1.5-2 |
| 15 | **Chiller** | **Please Specify & Quote for suitable Air compressor** |
| | i) Operating pressure - bar | 5 to 8 |
| | ii) Temperature range - °C | 5 to 10 |
| | iii) Water Consumption - L/min. | 30-40 |

2 **Processing Simulation Software**

| | | |
|---|---|---|
| 1 | eLearning Modules and eLearning Videos | The content should be user-friendly, computer-based interactive training lessons on computer. Module should include Safety &PPE, Plastics Material, Plastic processing methods, Trouble shooting, Moulds and Mould maintenance, Mould design, DOE, Statistical Process control, Auxillary equipment training etc |

| | | |
|---|---|---|
| 2 | Operating system | Windows<br>Should run on Windows 10, 8, 7, Server 2016, 2012, 2008 |
| 3 | Hardware | Should be compatible with Intel® Core i5 processor, 4 GB RAM, and 20 GB free space |
| | | Online support for minimum 3 years with updates and perpetual licence to be provided for all modules |
| 4 | kindly specify and quote for module and Content wise | Injection Moulding, |
| | | Blow Moulding |
| | | Extrusion Moulding |

3 **Biodegradation set up - incubator type**

| S.No. | Description | |
|---|---|---|
| | Make | Bidder to specify |
| | Model | Bidder to specify |
| | **I. BIODEGRADATION SET UP** | |
| 1 | Type | Rectangular Incubator type |
| 2 | Tempertaure Range | Ambient to 80 C |
| 3 | Tempearture Accuracy | ± 1 C |
| 4 | Control panel | Accomodating digital PID temperature controller, safety thermostat, indicating lamps, temperature display and switches |
| 5 | Incubator | Double walled, Stainless steel, Powder coated |
| | | Provison for holding 24 nos of glass dessicator |
| | | 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 | 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<br>(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 Burrette | Volume: 1, 5, 10, 20 and 50 ml |
| | | Resolution: 1/1000 of burrette volume or bette |
| | | Dropping volume:<br>50 ml - 0.0025 ml<br>20 ml: 0.001 ml<br>10 ml: 0.0005 ml<br>5 ml: 0.00025 ml<br>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 (Determination of Organic Nitrogen Content)** | | |
| 1 | Construction | 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 |
| **5** | Installation and commissioning | The vendor should support necessary site preparation for installation. Vendor should carry out installation and commissioning of the machine and its accessories on a turnkey basis |

| | | |
|---|---|---|
| **6** | Technical support and service | Manufacturer should have established after sales & service network in India. The vendor shall have local service and application office and infrastructure to attend by visit within 48 hours of need. Technical support personnel must have adequate experience in this field. Technical support personnel details should be submitted. Name and address of the authorized service centre/ partner in India along with the certificate of authorization should be attached. |
| **7** | Annual Comprehensive Maintenance Contract (ACMC) as optional | Vendor should quote for Annual Comprehensive Maintenance Contract for the whole system and accessories supplied after the completion of performance warranty period. Supplier has to provide service support within 48 hours. Calibration of the machine shall be a part of warranty and ACMC. It shall also be mandatory to perform calibration after every major repair or breakdown. |

4 **High Pressure Air Compressor**

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

5 **High Torque Overhead Mechanical Stirrer**

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

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

6 **FUEL CELL TEST SYSTEM AND HARDWARE**

| | |
|---|---|
| Make | Bidder to specify |
| Model | Bidder to specify |
| System | A fuel cell test system suitable for both direct methanol fuel cell (DMFC) and proton exchange membrane fuel cell (PEMFC) |
| | Impedance analyzer (in-built) for electrochemical impedance spectroscopy and high frequency resistance. System should able to measure all parameters including proton conductivity. |
| | Anode and cathode backpressure controller - standards |
| | PEMFC must be able to operate upto 180 °C with proper humidification control. |
| Fuel cells hardwares | DMFC: Single cell with active area 5 $cm^2$; and 3-cell stack with active area 25 $cm^2$. for each cell. |
| | PEMFC: Single cell with active area 5 $cm^2$; and 3-cell stack with active area 25 $cm^2$. for each cell. |
| Cell features | Thermocouple |
| | Nitrogen purge – for anode and cathode separately |
| | Current collectors |
| | Inbuilt Heater |
| | Thermal Chamber/jacket/heater for high temperature PEMFC cell. |
| | Cell should have all necessary provision for control of humidity, temperature, reactant inlet and outlet, Nitrogen gas purging; etc. |
| Operating temperature range | DMFC: 35 to 90 °C or more |
| | PEMFC: 35 to 180 °C |
| Electronic load | Max curret range: 100A |
| | Max voltage : 20V |
| | Power: 125 W or more |
| Flow controllers | For anode, MFC (Hydrogen): flow range: 0-2000 SCCM or more |

| | |
|---|---|
| | For cathode, MFC (Oxygen gas and Air): flow range: 0-5000 SCCM or more |
| | For DMFC operation appropriate good quality peristaltic pump should be inbuilt with the system. Flow rate 0.1 ml/min to 60 ml/min |
| Humidification system | Humidification system for hydrogen and air with accurate control for operation of the cell at various humidity and temperatures. Anode & Cathode humidifiers with automatic water fill. Humidity and temperature curve to be provided for verification. |
| | Humidification room temperature to 95 °C or more for both DMFC and PEMFC. |
| | Optional Bypass of humidifier by computer controlled valve |
| Proton conductivity cells | The conductive cell with appropriate humidity chamber or any other advanced system which can measure the condustivity within fuel cell fixture of the bare membrane. Standard four-point-probe cell to measure the in-plane conductivity of various bare membranes (without MEA). Conductivity measurement should be performed in various environments of varying relative humidity (25-100%) and temperature (room temperature to 95 °C or better); leading to a more accurate assessment of membrane conductivity and resistance. |
| | Fuel cell system should have appropriate software for measurement of proton conductivity of various membranes |
| | Membrane Conductivity Cell/probe and system must have all the required hardware, connectors and adaptors for complete conductivity analysis demostration at varying condition. |
| Safety features: | Interlocks with external safety alarm |
| | Safety features to include PLC controlled, alarm, nitrogen purge and emergency stop, and hydrogen leak detector. |
| | High-temperature alarm on each temperature controller |
| Computer | i7 8GB 21" 1Tb branded computer as per the requirement of software for fuel cell system |
| Softwares | Suitable softwares with licence to be included to perform all the fuel cell related analysis in the tender specifications |

| | |
|---|---|
| | Analysis: Open circuit voltage, Current scan, Voltage scan, Potential EIS, Constant load discharge, Constant voltage discharge, and AC Impedance measurement, Half cell potental etc. |
| | Optional Bypass of humidifier by computer controlled valve |
| | Preheater to avoid condensation, set temp thru software. |
| | Software must be user friendly for easy customisation and should be upgradable for life time. |
| | System should run continuously without any monitoring for durability test at least for 100 hr or more |
| | Interfacing between system and PC should have fast response with easy data monotoring and aquisation. |
| | System should provide with digital monitoring and controlling system for temperature, reactant flow rate, cell temperature, humidification, back pressure, stack monitoring, voltage, current, real time cell resistance, half cell voltage, individual cell potentail etc. |
| Spares and accessories | Gaskets for anode and cathode ( for both PEMFC (high temperature) and DMFC (each 0.5 $m^2$) |
| | Carbon cloth and carbon paper (30cm X 30cm - 2 No each) |
| | Catalysts for both anode (Pt/Ru/C 40/40/20%, 10g) and cathode (Pt/C 40/60%; 10g); and Nafion inomer solution (5% in aliphatic alcohol/water; 500 ) for electrode preparation) |
| | Digital Multimeter and other tool kit (electrical and mechanical) should be provided. |
| | Nafion 117 membrane 30cm X 30cm – 2 No. |
| | Air spray gun (with ultrafine nozzle) for electrodes preparation |
| | MEA with active area 5 $cm^2$ and 25 $cm^2$ for both PEMFC and DMFC respectively - 5 No. for each. |
| | Filled in Hydrogen, Oxygen, Air, and Nitrogen gas cylinder for system. |
| | System should have all necessary softwares and assesories for full demostation and commissing of fuel cell. |

| | |
|---|---|
| | System should supplied with all the necessary connectors, pressure gaues, tubing and other hardware for connection for $H_2$, $O_2$, Air, $N_2$ gases to the fuel cell system. |
| Certificates | Supplier should provide all Calibration certificates and data sheet related to electronic load, humidity, temperature, backpressure and flow controllers system. |
| 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 |
| Technical support and service | Manufacturer should have established sales & service network in India. The vendor shall have local service and application office and infrastructure to attend by visit within 48 hours of need. Technical support personnel must have adequate experience in this field. Technical support personnel details should be submitted. Name and address of the authorized service centre/ partner in India along with the certificate of authorization should be attached. |
| Warranty | Should provide atleast 3 years warranty for whole system. |
| 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 | **CAPILLARY RHEOMETER** | |
|---|---|---|
| 1 | Make | Bidder to specify |
| 2 | Model | Bidder to specify |
| 3 | Capillary Rheometer | Twin bore rheometer for rheological properties - R&D, advanced measurement capabilities under high pressure and high shear rate for plastics, polymer, rubber, composite, compound, recycled materials, ceramics, inks and coating. |
| 4 | Mesuring mode | Constant speed |
| | | Constant pressure/ force |
| | Piston | Lowest test speed: 0.005 mm/min or lower |
| | | Maximun speed: 1000 mm/min or higher |

| | | |
|---|---|---|
| 5 | | Dynamic speed ratio: 2,50,000:1 or better |
| | | Independent load cell on each piston |
| | | Advanced high resolution and accurate speed control system (vendor should furnish details of speed resolution and speed control system in details) |
| 6 | Barrel | 2 Barrels system: 2x15mm bore diemeter |
| | | Lenth: standard 290 for each barrel |
| | | MOS: Hastelloy or equivalent corrosion resistant metals |
| | | Barrles should be straight, smooth, without any tools mark. |
| | | Barrels must be easily accessible for both feeding of test samples and also for cleaning after the testing. |
| | | Each barrale should have three independet heating zone |
| | | Cleaning device and accessories should be integrated for barrel cleaning at the end of each test. |
| | | Should have inert gas purging unit for moisture and tempearature sensitive materialsr and to minimize sample degradation |
| 7 | Force | 50 kN or better |
| | | Accuracy :0.4% for whole range |
| 8 | Pressure transducer range | Pressure range : 0 to about 2000 Bar |
| | | Accuracy: <0.5% |
| | | Vendor should provide 02 sets of pressure transducers with max. pressure of about 50 bar, 200 bar,1000 bar and 2000 bar with 0.1 bar resolution |
| 9 | Temperature range and controll system | Ambient to 400 °C or more |
| | | Temperature resolution: 0.1 °C |
| | | Microprocessor based temperature control, heating rate should be in between 0.5 to 5.0 °C |
| | | Should have at least three independent temperature zones |
| | | Temperature accuracy: ± 0.2 °C or better |
| 10 | Capillary dies | MOS: Tungsten carbide |
| | | A: (i) Dia: 1 mm, length 10 mm (ii) Dia: 1 mm, length 20 mm (iii) Dia: 1 mm, length 16 (iv) Orifice Dia: 1 mm, length: 0.25 mm; Vendor should also provide Orofice dies for every die dia. diameter for Baglay correction . |
| | | B: (i) Dia: 1 mm, length 16 mm (ii)Dia: 1.5 mm, length 20 mm (iii) Dia: 0.5 mm, length 08 for wall slip |
| | | Vendors should provide other dies as required to opearte rheometer from lowest to highest shear rate for measurement of all rheological properties. |

| | | |
|---|---|---|
| 11 | Rheological properties measurements | Vendor should provide all necessary accessories for follwing measurement options according to International standards: |
| | | i). PVT |
| | | ii). Dynamic and static laser die swell measuremnt |
| | | iii). Shark-Skin (Flow instabilities) |
| | | iv). Pressure dependence of viscosity (Mesurement of pressure coefficient, wall slip's critical shear rate, Maximum pressure.); and Viscosity measurement |
| | | v). Thermal conductivity (optional) |
| | | vi). Extensional viscosity (Blown film, forms, spinning and coating materials) |
| | | vii). Melt strength measuremnt (Fiber spinning materials) |
| | | viii). Melt temperature determination |
| | | ix). Melt cutting unit |
| | | x) Constant shear test; extensional test; Die swell; Wall slip analysis; Melt fracture; thermal stability; Low speed degradation; Stress relaxation; Intrisci melt viscosity; Viscosoty dependent on temperature; Fitting equation for viscosity at zero shear arte and relaxation time etc. |
| 12 | Standards | ISO 17744 (PVT; Dtermonation of specific volume of plastics as a function of temperature and pressure; measurement under constant pressure or constant temperature)); |
| | | ASTM D3835 (Measurement of melt viscosity, sensitivity or stability with respect to temperature and polymer dwell time; and die swell ratio, shear sensitivity when extruding under constant rate or stress); |
| | | ASTM D5099 measuremnt of rheological characteristics of raw rubber |
| | | DIN 5930 (Thermal conductivity of plastics in the range from -40 to 400 C; conductivity range 0.08 to 2 W/m.K ; covering thermoplastics, thermosets, rubber and filled and reinforced) |
| | | ISO 11443 (DIN 54811) (fluidity of plastics melt useful in determining melt viscosities from 10 Pa.S to $10^7$ Pa.S in extrusion shear rate of 1 $S^{-1}$ to $10^6$ $S^{-1}$ |
| 13 | PC | Rheometer should be integrated with a branded PC, with latest processor (i7 and above), 3.0 GHz or higher, 8 GB RAM, 21” LCD/TFT color monitor, at-least 1.0 TB hard disk, CD/DVD writer, 2 serial, 1 parallel port, keyboard, branded scroll mouse and a ethernet port. |

| | | |
|---|---|---|
| 14 | Softwares modules and features | Vendors should provide lienced softwares with re-installation capability when required, full functionalities for measurement and analysis of following rhelological properties : |
| | | i). PVT |
| | | ii). Dynamic and static laser die swell measuremnt |
| | | iii). Shark-Skin (Flow instabilities) |
| | | iv). Pressure dependence of viscosity (Mesurement of pressure coefficient, wall slip's critical shear rate, Maximum pressure.); and Viscosity measurement with Slit Capillaries |
| | | v). Thermal conductivity (OPTIONAL) |
| | | vi). Extensional viscosity (Blown film, forms, spinning and coating materials) |
| | | vii). Melt strength measuremnt (Fiber spinning materials) |
| | | viii). Melt temperature determination |
| | | Softwares module should be user-friendly with following capabilities: |
| | | i). All operations such as parameter setting, test start, data acquisition and processing, saving and re-processing controlled through software |
| | | ii). Online and real-time display should be for raw data signal (load/pressure) etc. |
| | | iii). Should have automatic Rabinowitsch/Bagley/Hagenbach corrections and non-Newtonian index calculations with appropriare hardwares |
| | | iv). Should be able to export raw data as well as processed data to excel or any other data management system. |
| | | v). Should be able to perform other calculations such as application of viscosity models (Cross, Cogswell or Carreau, etc.) to viscosity data or application of temperature shifts to data using some standard relations. |
| | | vi). Should enable to feed in any shear rates (increasing/ decreasing/ arbitrary) for testing. |
| | | vii). softwares must be capable of dislapying raw data during experiment |
| 15 | Safety features | Protective cover, hood, limit and safety switches and any other required safety provisions must be in place. |
| 16 | Scope of supply | Vendors must provide separate complete list of accessories needed as per tender specification. It should include any other optional accessories. |
| 17 | Tool Kit | Vendor must provide complete tool kit for maitainace |

| | | |
|---|---|---|
| 18 | Calibration | Vendor should provide Hand tools for: charging and cleaning barrel, scouring brush, Sample filling funnel, Die nut removal wrench, cleaning capillary dies, Go/No Go gauges, Barrel Bore Calibration kit etc. for easy operation and maitanince of rheometer. |
| 19 | Calibration | Vendor should furnish all certificates traceble to international standard for : force clibration, Pressure transducer calibration, temperature calibrations and dies dimension. |
| 20 | Documentation: | All Claims made by the vendor with regards to the above specifications should be supported by specification sheets / brochures / data available on company website. No claims with regards to laboratory data will be accepted. |
| | | Complete original operating & service manual hardcopy along with softwares pack |
| | | if any deviation in tender specification, vendor must clearly mention during compliance statemnt according to their quoted model |
| 21 | Warranty | Vendors should provide at least thrre years warranty of whole rheometer including temperature sensors, pressurse transducers etc. |
| 22 | Reference materials | Reference Plastic material of Low Viscocity & High Viscocity -01 kg each |

8 **TORQUE RHEOMETER**

| | | |
|---|---|---|
| | Make | Bidder to specify |
| | Model | Bidder to specify |
| | Applications | Machine could capable to study the following properties |
| | | Viscosity, flow behaviour |
| | | Compounding formulation and recycling of polymer |
| | | Blend ratio |
| | | Extrusion and injection moulding processability |
| | | Morphology |
| | | |
| | | Influence of the screw design on the viscosity |
| | Temperature Range | ambient to 450ºC |
| | Torque Range | 150 Nm higher |
| | Rotor Type | Roller, Cam, Sigma and Banbury Rotor available |
| | Heating zones | 4 or more |
| | Feed section | Air and water cooled |
| | Temperature controller | Electrical |

| | | |
|---|---|---|
| | Screws | single and twin Parallel, Segmented – co-rotating |
| | Screw speed (rpm) | 0-200 or higher |
| | Software | Suitable software for control / measurable parameters (torque, speed, temperature and time) evaluation, and materials response to be provided. Compatible to windows 10 |
| | Overload protection | Electrical cut-off to be provided |
| | Feeding system | Manual and Pneumatic |
| | Peripheral devices | Extrudate cooling baths |
| | | Blown film unit tower |
| | | Feeders |
| | | Pelletizers |
| | | Melt pumps |
| | Heating & Cooling systems | Integrated heating & cooling systems to be provided |
| | Dies | Capable for producing profiles like flat films, sheet, blown films, rod and multi-strands, wires, filaments as well as screen life tests. |
| | Batch mixing Features | Conical type bowl and rotor in axial direction |
| | Accessories | Please quote for essential and optional accessories separately |
| | Work station ( computer) | i7 8GB 21" 1Tb branded workstation as per the requirement of software for equipment |
| | Operating system | Windows 10 original |

| | | |
|---|---|---|
| 9 | **Vibration lab** | |
| 1 | Make | Bidders to specify |
| 2 | Model | Bidders to specify |
| | **Modal shaker with power amplifier.** | |
| | Max. Force Sine/Random Conventional | 150 N |
| | Max. Displacement(mm) peak- peak | 12 mm |
| | Max. Acceleration | 65g |
| | Table diameter | Ø 50 mm |
| | Maximum Load | 5 Kgs |
| | Effective mass | 0.4- 5 Kgs |
| | Frequency Range | 5Hz – 5 kHz or better |
| | Excitation output | 10-32 mounted stingers |
| | Max. operatingcurrent | ≤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 |
| 3 | 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 | **Dynamic Signal Analyzer,** | |
| | **(i) Hardware specification** | |
| | Portable all-in-one data acquisition system, rugged industrial design | |
| | Dynamic channels -4 | |
| | Type of input connection- BNC | |
| | Universal analyser | |
| | Additional Speed/Trigger channels- 2 | |
| | Output channel - 1 | |
| | Sampling rate >100 Ks/s – 24 sigma delta ADC | |
| | Resolution – 24 bits(144 DB) input range at 1kHz - ±0.05 DB Temp variability - <0.1 DB / 10 degree C | |
| | Type of inputs - AC/DC/ICP/TEDS/FLOAT - ± 17.5 mV to ± 10 V | |
| | Dynamic range > 120 dB | |
| | Filters: High/Low pass- Stop/pass band – Integrator(Simple/double) – Differentiator – A/C/Z | |
| | Frequency range - DC – 40kHz - ±10 V range | |
| | 64 X over sampled (upto 6.4 MHz) – resolution: > 160 ns ±10 V range | |
| | 1 Inbuilt force DSP | |
| | Ac – 100 V to 240 V, DC – 10-28 V | |
| | Interface -1 Gb/s Ethernet | |
| | Maximum weight - 1.4 Kgs | |
| | **(ii) Software specification** | |
| | Software features: | |
| | Graphical: Windows Management - Trace Management – Zoom & Translation – Scale management – Markers/Cursors | |
| | Display: Time series – Narrow band – Profiles – View Meter – 3D | |
| | Data Management:Setups – Load, save and recall workbook withMeasurements – Save selected results and raw data automatically. Projects – Project manager tree –filters | |
| | Project Manager | |
| | Measurements – Save selected results and raw data automatically | |
| | Real time analysis: Gap free recording – 4 ch; 40 kHz.Real time FFT – 4 ch | |
| | Output/Generators: Pure tone – 1 independent fixed sine. Noises – 4 uncorrelated random | |
| | Swept sine – 1 to 6 simultaneous outputs | |
| | **Import/Export:** Signal import(time series) – OROS wav | |
| | Result import(others)- AE2 | |
| | Export – UFF –TXT - SDF | |
| | Report – MS WORD- Excel | |

| | |
|---|---|
| | **Standard plug-in:** Bandwidths – 1 independent bandwidths |
| | Tracks – Upto 128 tracks |
| | Modes – Start to time –Start to stop |
| | **Narrow band spectra:** 401 lines (for 801, 1601,3201, 6401 lines multiply requested SPU respectively by 1.25,1.5, 2, 3) |
| | 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 | **Modal Analysis Software (3D visual),** |
| | Basic geometry modelling ,display and revision of test data in time or frequency domain ,overall modal parameter identification of SIMO single frequency point in full frequency range ,Frequency based ODS 3D motion simulation ,3D simulation of modal shapes . |
| 6 | **Tri-axial Accelerometer with connecting cable,** |
| | Built-in IEPE preamplifier Tri-axial (x,y,z) miniature accelerometer Single 4-pin Connector. |
| | Measuring Range: ±700g |
| | Sensitivity : 10mV/g |
| | Frequency response, 0.5dB : 1 to 8,000 Hz |
| | Mounting Resonance Frequency : 40,000Hz |
| | Resolution 1-10,000Hz : 0.0001 g rms |
| | Maximum Transverse Sensitivity : ≤ 5 % |
| | Non-linearity :< 2% |
| | Weight : Not more than 1 gram |
| | Connector : Single 4 pin connector |
| | Mounting provision : 10-32 |
| | Housing materials : Stainless steel |
| | Seismic element : ceramic |
| | Sensing geometry : shear |
| | Sealing : welded hermetic |
| | Excitation voltage: 18 to 28 VDC |
| | Constant Excitation: 2 to 10 , typical 4 mA |
| | Output impedance :<100 |
| | Output bias voltage : 10 to 14 VDC |
| | Noise, 1 to 20,000Hz: <0.002 |
| | Shock limit , ±peak : 1000g |
| | Temperature range, operating : -40 to +250 ˚F |
| | Transient temperature : 0.01 g/˚C |
| | Base strain sensitivity : 0.0002 g/με |
| 7 | **Accessories** |
| | Calibration certificate |
| | 10-32 mounting stud |
| | Single 4 pin connector with 5meter length and 3 BNC male connector end. |
| 8 | **Fixture with test specimen.** |
| | Mechanical fixture for modal ,free and forced vibration setups , |

| | | |
|---|---|---|
| | 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 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. |
| 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. |

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

| | | |
|---|---|---|
| 13 | Security & Manageability | Hard Disk, BIOS Password,TPM 2.0,Virus protection for boot sector |
| 14 | Monitor | 24" standard Monitor |
| 15 | Keyboard | OEM make standard Keyboard |
| 16 | Mouse | OEM make USB Optical Mouse |
| 17 | Form Factor | Minitower / Microtower (With Optimized thermal management, low-noise chassis and silent fans) |
| 18 | UPS | 1000 VA / 230 V - APS or better |
| 19 | Accessories | Bidder to specify any other standard/optional accessories |
| 20 | Warranty | 3 Years Onsite Warranty |

11 **Name of software : CREO**

| Sl. No. | Description | Minimum No. of Licenses |
|---|---|---|
| 1 | CREO Parametric 3D Modeling Software (academic version) with complete modules for training purpose. | 20 |
| **GENERAL TERMS & CONDITIONS** | | |
| a) The above Software should be supplied with latest versions | | |
| b) The quote shall be supplied with reference to the module | | |
| c) The Software should be supplied in DVD / CD media for latest windows OS | | |
| d) The license must be perpetual | | |
| e) Warranty & AMC : Bidder should specufy the warranty period from the date of acceptance of installation and training .Also submit quote for AMC as option separately. | | |
| f) The Installation and training will be the responsibility of the supplier | | |
| g) During the above period of maintenance, any upgrades released will be supplied free of cost | | |
| h) Training : 7- Days Training shall be provided at the site after installation | | |

12 **3-matic software for Light Weight Structure**

| Sl. No. | Description | No. of Licenses |
|---|---|---|
| 1 | Latest Academic Research version 3-matic software for Light Weight Structure experience software with complete modules. | 5 |
| **GENERAL TERMS & CONDITIONS** | | |
| a) The above Software should be supplied with latest versions | | |
| b) The quote shall be supplied with reference to the module | | |
| c) The Software should be supplied in DVD / CD media for latest windows OS | | |
| d) The license must be perpetual | | |
| e) The Installation and training will be the responsibility of the supplier | | |
| f) During the above period of maintenance, any upgrades released will be supplied free of cost | | |
| g) Training : 7- Days Training shall be provided at the site after installation | | |

13 **REFRACTOMETER**

| | | |
|---|---|---|
| **Quantity** | | 01No |
| **Make, Model,Series & Sr. No.** | | To be specified by Bidder for all including accessories |
| **Purpose** | | Capable to Measure Refractive Index and Abbe number for Solid and Liquid Samples at different wavelengths.<br>The refractive index curve as a function of wavelength to be obtained. |
| **TECHNICAL SPECIFICATION** | | |
| 1 | Refrative index range | 1.3 to 1.7 |
| 2 | Wavelength Range | 450 nm to 1100 nm with suitable filters |
| 3 | Light Source | LED |
| 4 | Display | LCD |
| 5 | Interface | RS 232 with PC. |
| 6 | Accessories | Suitable attachments for solid, liquid and film samples, Spare lamp, Standard reference material with known refractive index for calibration |
| 7 | Other Mandatory Items | While supplying the Machines, the supplier should also provide the following items apart from above:<br>• Hard copies of Operational & Service Manual-01 Set .<br>• Tracebale NABL Calibration certificate for the Standard Reference Material.<br>• Machine should come with all other essential accessories & spares required for installation, commissioning & Operation.<br>• Onsite free operational Training |

14 **CONTOUR CUTTER**

| | | |
|---|---|---|
| **Quantity** | | 01No |
| **Make, Model,Series & Sr. No.** | | To be specified by Bidder for all including accessories |
| **Reference Standard** | | ASTM 638, ASTM D790-17, ASTM D5930-17, ASTM D257-14, ASTM D3039-17, ISO 294-1, 294-2, IS -14151 Part-1 Type-2 dumbbell, For Tensile specimen - ISO 527-2-2012, Parts-4 and 5, IS 12701 (Tensile and Flexural specimen), IS 4984-2016, IS 13360 (Part-5 sec 6) rectangular |
| **Purpose** | | For preparation of test specimens out of thermoplastic (rigid) materials & composite sheets to be used for Testing as per various Standards. |
| **1** | Table size (LXD) | 330 x 375 mm or equivalent |
| **2** | XYZ axes stroke | 310 x 220 x 160 mm or equivalent. |

| | | |
|---|---|---|
| **3** | XYZ axes movement resolution | 3 µm or better |
| **4** | XYZ axes positioning repeatability | 0.02 mm or better |
| **5** | Fraise head holder movement | Through a step motor and suitable dia.ball, screw without backlash, 5 mm pitch. |
| **6** | Max speed (mm/sec) | 100 |
| **7** | Fraise rotation speed (rpm) | 8000 to 24000 set manually according to the material type |
| **8** | Shield opening safety lock | Timed door lock release. |
| **9** | Emergency stop | Red panic button (Mushroom type) |
| **10** | Voltage(V) | 230 |
| **11** | PC connection | series RS232 |
| **12** | Dimensions | 600 x 800 x 700mm or equivalent with safety shield closed (L x W x H) |
| | | 600 x 850 x 900 mm or equivalent with safety shield open (L x W x H) |
| **13** | Other special features | ·Vacuum system for dust collection to be included |
| | | ·Set of cutter for various type of materials and for different type of finish |
| | | ·Speed control |
| | | ·Dimension control |
| **14** | Personal Computer (PC) | A Personal Computer (PC) of reputed make (bidder need to mention the make & model while quoting) having latest configuration. All software shall be loaded in the hard disk with appropriate partitions. All original CDs/DVDs must be provided. |
| **15** | Other Mandatory Items | · Hard copies of Operational & Service Manual-01 set. |
| | | · All templates as per standards mentioned above with traceable calibration certificates |
| | | · Machine should come with all other essential accessories & spares required for installation, commissioning & operation |
| | | · Onsite free operational Training |

15 **VIBRATION LEAKAGE TESTER**

| | | |
|---|---|---|
| Make | | Bidder to Specify |
| Model | | Bidder to Specify |
| 1 | Shall conform to | Standard IS 2798 Clause 6.2 |
| 2 | Capacity | For testing of containers upto 20 litres |
| | | Vibration table size 300mm x 300 mm (Approx) |
| 3 | Frequency | variable upto 8 Hz |
| 4 | Digital Accelerometer | 0.5 to 1.1 g ( with calibration certificate ) |
| | | Spring loaded motorized vibration arrangement |
| | | Digital display of Set frquency & Acceleration |

| | | |
|---|---|---|
| 5 | Other Features | Variable frequency drive should be provided for variable speed |
| | | Shall be suitable for replacing the frame on the vibration table for testing various products as desirable |
| Calibration certificate traceable to NIST should be provided for frequency and acceleration | | |