Sr No 134/ Reference No. : 141

Detailed Description of Item :

Technical specifications for -80 Ultra Low Temperature Freezer :

Upright Freezer with capacity atleast 300- 450 Liters of internationally reputed make.
System should have Programmable operating temperature from –50°C up to –86°C with 1°C increment.
It should be an energy efficient system with power consumption ≤ 15 kWh per day under standard test conditions & noise level
stem must be fully functional in operating temperature range (ambient Temperature) from 10°C upto 32°C
System should have a pull-down time from ambient temperature to -85°C ≤ 7hrs
Fully programmable microprocessor controlled with membrane keypad and eye level control panel. Accurate temperature control by Microprocessor PID control system
Construction should be of Polyurethane foam insulation.
Durable stainless-steel interior of grade 304L or better.
Tough powder coated exterior constructed on steel gauge.
Freezer should have atleast two inner insulated doors giving access to adjustable shelves to make a minimum of three inner storage compartments
Freezer should have at least 3 access ports

Freezer should have capability to enable outer door to be conveniently opened and front panel air filter.
Heavy duty lockable castors and lockable outer doors and lids.
Freezer must have battery back-up and electronic security lock for unauthorized tempering.
Freezer must have on board diagnostic software to report failures to service personnel.
Audible and visible alarms for temperature, power failure, system failure, battery low etc. and it should also have remote alarm terminal.
Freezer Should have a highly efficient compressor control system reduces cycling times to lower energy consumption and increase freezer longevity (compressors: 2 cascading compressors, power consumption :<15 kWh/day, Pull Down time with freezer empty, from ambient temperature of 22°C to -85°C of 7 hrs and warm up time with freezer 2/3 full, from -85°C to 0°C of ≤30hrs.)
Freezer must use Environment-friendly: CFC-free and HCFC-free, non-flammable refrigerants, and refrigeration system must be energy efficient and hermetically sealed cascade refrigeration system.
Inner doors should be removable for cleaning, defrosting etc.
Should have Filter check,Self-diagnostics function, Door check and Part replacement notification
Should be ISO 9001, 13485 & 14001 certified product
All equipment must be compatible with Indian electrical standards and codes. Engineering documentation on the physical sizes and weights of all major and minor components must be submitted.

Warranty: Minimum one-year comprehensive warranty against any defect from the date of installation
Installation: Installation by OEM is preferred. Training should be provided free of cost to a minimum of 5 users by a trained engineer.
The OEM should have direct support center in India to provide technical/ engineering infrastructure support
Supplier's Indian agent should have factory trained service Engineers with enough experience for after sales service. Manufacturer's Training Certificate Issued for the Supplier's Engineer must accompany the bid.
The OEM must have atleast 50 installations all over India in reputed research institutes for e.g. IITs, IISERs, NITs, NISERs etc.
Delivery and shipping charges up to IIT Bombay must be included
Optional: • Freezer racks or drawers for storage of samples compatible with quoted model of ULT freezer (can be of Indian make and quote per piece) • Cryoboxes for storage of eppendorfs or cryovials (can be of Indian make) • Cryo gloves (2 pairs) (can be of Indian make) • Extended warranty for 3 years (including damaged part repair and engineer visit) • AMC after extended warranty expires

Sr. No. 135 /Reference No. : 143 (Revised)
Detailed Description of Item :

Technical specifications for Fast Protein Liquid Chromatography system and accessories :

• The system should be inert biocompatible system for all purification and development work from microgram to gram scale.
• The system should deliver flow rate of 0.001 mL/min to 25 mL/min or higher with a flow rate accuracy of ±2% or better, without need for changing pump-heads for the entire flow range and pressure limit of 20 MPa or more.
• System pump must be capable of delivering solutions/mixtures with viscosity between 8 to 10 cP.
• The system should have a pressure sensor and alarm
• The system should be fully modular that can be further expanded to increase system capability and productivity.
• The system must contain appropriate mixing module along with stirring for efficient mixing of buffers and generating smooth gradient. A mixer volume between 1.4 mL to 1.5 mL is mandatory.
• The system must be equipped with a conductivity monitor capable of reading in the range 0.01-999 (or higher) mS/cm with an accuracy of ±2% or higher.
• System should have the capability of running with automatic pressure-flow modulation option.
• The UV lamp should not require any start-up time or warmup time and should not heat the sample/ protein.
• The system must have Xenon flash lamp in UV monitor as light source with fiber optics with multiple wavelength detection upto 3 wavelength simultaneously from 190 to 700 nm from a single lamp source.
• The Xenon UV lamp must have an operating life of more than 5000 hours with a linearity of ± 2% within 0 to 2000 mAU, which is standard detection range for most of the biomolecules.
• The UV module of the system must be able to read absorbance range from -6000 to +6000 mAU.
• To save the operational life of the UV, the system must have option to switch off the UV, when desired.
• A flow restrictor should be present in the flow path to generate a back pressure that pre-

vents the formation of air bubbles in the UV flow cell.
• The system must be supplied with having 3 outlet ports.
• Automated Sample Injection: System must be capable of automated sample injection. System should have option of loop selection for application of variable sample volumes.
• The system must be provided with software that works on a single software platform with full networking capabilities and has capability to be controlled through an independent desktop or laptop computer. • The software must have both user programmable and predefined application protocols and method templates. In addition, the software should have capability to be upgradable to different modules for multivariate analysis such as design of experiments functionality for method development and optimization. • The software must have a detailed evaluation segment for peak integration and evaluation, peak smoothening, peak offset adjustment, peak differentiation, peak addition and subtraction, peak overlay comparison of results and automated quantification of peak fractions.
• The system should be supplied with a spiral type fraction collector having following properties: - Minimize spillage using Drop Sync technique. - Allows collection of up to 175 fractions. - Allows use of 3, 8, 15 and 50 mL tubes. - Fraction volume 0.1 to 50 mL. - Automatic peak recognition using control software. - Fraction collector should be capable of being used in time, volume or peak recognition mode. - Allows using flammable liquids/solvents.
• The system should have upgradable modular capability to be integrated using I/O box with third party Detectors and Auto samplers.
• Multiuser licensed software (at least 5 licensed) should be provided.
• The system should have upgradable modular capability of having 2 UV monitors installed at the same time for giving flexibility and increased application capability for using small and large flow cells simultaneously to detect low concentration and high concentration proteins for increased application flexibility post-purchase.
• The system should have an option of upgrading to column control valve which allows connection of one column or multiple columns and has an integrated bypass function, which enables washing of the system without removing the column and allows reverse flow for increased application flexibility post-purchase.
• System should be operable at room temperature and in cold room/cabinet
• System should be ISO/CE certified and should include all accessories required to function. System should not be refurbished.
• System must be installed in over 50 reputed research institutes in India e.g. IITs, IISERs, NISERs and NITs etc.

- Delivery and shipping charges up to IIT Bombay have to be included

- Warranty: A 3-year comprehensive warranty (including damaged part replacement of all accessories and the main unit and service engineer visit)

- Installation: The system should be installed by trained engineer and at least 2 users must be trained at training centre of company on operation and maintanence

- PC: The system should be supplied with minimum of 24 inch LED monitor, CD/DVD read/write drives, USB ports. It should have latest operating system, with minimum Pentium i7 Quad or higher processor, 1TB HDD, > 16GB DDR RAM, 24 inch LCD monitor, Minimum 4 USB ports and two Ethernet ports for data acquisition and internet, and mouse.

- Accessories: Necessary kit box having all accessories, cables and several types of tubing and connectors useful for liquid chromatography applications (for columns of affinity chromatography, buffer exchange, ion exchange, gel filtration, and HIC), tubing cutter, wrench, column clamps etc. should be provided.

- Sample loops of 500ul (5 nos.), 1ml (5 numbers), 2ml (5 nos.) should be provided

Optional:

- AMC (for 2 years) after warranty period has expired

- Peristaltic pump

- 150 ml superloop

- 5 nos. of high performance 5 ml pre-packed Ni-NTA affinity columns for his-tagged protein purification

- 5 nos. of high performance 5 ml pre-packed desalting columns

- One 30 cm long prepacked gel filtration column for preparative separation of biomolecules with fractionation range molecular weight ~ 100 to ~ 7000 Da.

- One 30 cm long prepacked gel filtration column for preparative separation of biomolecules with fractionation range molecular weight ~ 10 000 to ~ 600 000 Da.

- 5 high performance 5 mL columns for purifications of glutathione S-transferase tagged proteins.

- Compatible high-end laser jet printer

Sr. No. 136//Reference No. : 144
Detailed Description of Item :

Technical Specifications for "HIGH SPEED FLOOR MODEL REFRIGERATED CENTRIFUGE WITH ROTORS" :

1. **CENTRIFUGE :**

1. Speed : 25,000 rpm or more
2. g Force : 75,000 x g or more
3. Capacity : 6 litres or more
4. Display : Large LCD touch screen display
5. Temperature Range : -10° to 40° C or better
6. Temperature Control : +/- 2° C of set temperature
7. Drive System ; Induction Drive System
8. Drive cooling : Air Cooled
9. Refrigeration System : Non-CFC refrigerant technology
10. Run Time : 1 min to 99 Hours / Hold
11. Noise level :< 62 dBa
12. Power : 230 Volts, 50Hz, (Single Phase)

2. **ROTORS :**Fixed Angle -

1. Capacity : 8 x 50ml 1 No.

   Speed : 25,000 rpm or more

   RCF : 75,000 g or more

   Polypropylene Bottles with caps and o-ring to be offered – 20 Nos

- Capacity : 6 x 250ml 1 No.

  Speed : 14,000 RPM or more

  RCF : 30,000 g or more

  Wide Mouth Polypropylene Bottles with caps and o-rings to be offered – 18 Nos.

- Capacity : 6 x 1000ml 1 No.

  Speed : 8,000 RPM or more

  RCF : 15,500 g or more

  Wide Mouth Polypropylene Bottles with caps and o-rings to be offered – 18 Nos

4. Capacity: 24 or 48x1.5 ml/1.8-2ml 1 No.
   Speed: 15000 rpm or more

3. **Warranty :**Cost should include Three years comprehensive warranty on complete system including drive, five years on refrigeration system and rotors

4. Delivery and shipping charges up to IIT Bombay must be mentioned

5. Additional :

1. Budgetary cost of (Polycarbonate, Polypropylene) bottles of 50ml, 250ml and 1000ml capacities for each rotor can be indicated separately in case IIT Bombay wishes to procure extra bottles.
2. Instruction Service Manuals with Circuit diagrams and engineering details (including Refrigeration) to be supplied along with the system. Commitment to be made in the offer.
3. Availability of local Service Support and response time for a Service Call during and after warranty to be mentioned.
4. Original Literatures containing detailed specifications and features of both the centrifuge and rotors should accompany the offer.
5. List of users in India (for the offered model) with Addresses, e-mail id's and contact phone numbers should be enclosed separately.
6. Demo of the centrifuge and adequate training to at least 5 users should be given for safe operation
7. Instrument should be installed in at least 50 reputed Indian institutes e.g. IITs, IISERs, NITs, NISERs etc.

6. **Optional:**AMC (for damaged part replacement and service engineer visit) after expiry of warranty period must be mentioned

Sr. No. 137 /Reference No. : 145
Detailed Description of Item :

Technical Specifications for Refrigerated Orbital Shaker :

Sr. No.	**Refrigerated Incubator Shaker Qty-1**
1	Speed range: ≥15 to ≤ 500 rpm +/- 1 rpm
2	Plat form size should be minimum 460mmx 460mm
3	Temperature Range: At least 15°C below ambient up to atleast 60°C, minimum set temperature 4°C

4	Temp Accuracy: ± 0.1°C at 37°C, with a uniformity of ± 0.5°C
5	1.9 or 2.5 cm (0.75 or 1 in) orbit options is mandatory
6	Viewing window for chamber visibility
7	Controller: programmable for speed up/down and temperature up or down on a timed basis, Digital control
8	Multifunction single knob operation or key pad, touch screen optional
9	Timer: 0.1 to 99.9 hours, continuous operation
10	Atleast provision of 12 or more multistep programing each with shaking time and temperature
11	Electrical motor: Brushless motor DC
12	Drive: Triple eccentric electromagnetic Drive.
13	Should have provision to be placed over/under bench/table or be stacked
14	All corrosion resistant interior for cleanability & disinfection
15	Universal tray with clamps should have capacity to hold tubes/flasks of variable sizes (25ml to 6L) and at least 6 flasks of 2000ml capacity.

16	Moisture proof internal electric socket installed in chamber for provision of running external equipment
17	Provision for shelf (with adjustable height) inside the incubator for incubating petri plates (to be provided by original equipment manufacturer)
18	Facility for future up-gradation for Gassing manifold for direct gassing into containers placed inside the shaker, Photosynthetic light for plant tissue culture, UV Light and culture drawer
19	Alarms System should have audio visual alarms if units operates at +/- 5 rpm and +/- 1 Degree centigrade of set parameters.
20	Should haveMulti-function reservoir, with built-in pluggable drain, for humidifying chamber to reduce sample evaporation as well as capture accidental spills
21	Should have Spill cover, above the drive and additionally protects electronics and mechanical components
22	Equipment should European CE/USFDA /UL certified
23	Atleast 200 installation should be there in India
24	Equipment with least power consumption will be preferred
25	Warranty- One Year comprehensive warranty (inclusive of damaged part replacement and service/engineer support)
26	Installation and training should be free of charge
27	Delivery and shipping charges up to IIT Bombay

28	100% Payment after delivery, installation and customer approval
29	Optional: Each Clamp should be quoted optionally-50ml (10),125ml (10) ,250ml (10) ,500ml (10) ,1litre (10),2litre(10),Sticky pads(2)
30	Optional: Extended warranty for 3 years

Sr. No. 138 /Reference No. : 146

Detailed Description of Item : **Digital Slope Inclinometer System (Traverse Probe Type)**

Inclusive of following Components:-

- Probe
- Grooved Casing Pipe
- Connecting Cable and Clamping Mechanism
- Data Logger

Tech Specs
*Resolution: 0.005 degrees
*Range: At least +/- 10 degrees
*Operating Temperature: 0° to 50° C
*Cable Length: 30m
*Cable Markings: At least after every 0.5m. Lesserspacing of markings is preferred. Inclinometer'sreel must have cable clamping mechanism toobtain stable readings at successive levels.
*Data Logging System: System should be such that inclinometer can be directly connected to a computer through an external/internal data logger.
Handheld pc/ tablet not required. *Casing Outer Diameter: 90 mm Φ maximum

Sr. No. 139 /Reference No. : 147

Detailed Description of Item : Item Name: **Vibrating Wire Transducer Based Contact type Earth Pressure Sensors** inclusive of **Data Acquisition System** unique to the said type of Earth Pressure Sensors
Type: Contact type Earth pressure cell[1]
-Transducer type: Vibrating wire
-Capacity: 0-500kPa
-Over Range: 1.5*Rated pressure
-Resolution: ± 0.025% F.S
-Accuracy: ±0.1% F.S.
-Linearity: <0.5% F.S.

-Cell Dimensions (H*D)(max): 15*250mm
-Temperature range: -20°C to +80°C
-Signal Cable length: at least 20 meters
-Inbuilt thermistors for automatic temperature correction and shielding from electrical interferences
-Measurement type: static and dynamic earth pressure (up to 10Hz)
-Sensor and cable should be water resistant
Type: Contact type Earth pressure cell[1]
-Transducer type: Vibrating wire
-Capacity: 0-200kPa
-Over Range: 1.5*Rated pressure
-Resolution: ± 0.025% F.S
-Accuracy: ±0.1% F.S.
-Linearity: <0.5% F.S.
-Cell Dimensions (H*D)(max): 15*250mm
-Temperature range: -20°C to +80°C
-Signal Cable length: at least 20 meters
-Inbuilt thermistors for automatic temperature correction and shielding from electrical interferences
-Measurement type: static and dynamic earth
pressure (up to 10Hz)
-Sensor and cable should be water resistant
Data Logger
- Should log data from 14 Sensors (with inbuilt thermistors and shield cable) at a time
-Accuracy: 0.02% F.S.
-Scan rate: Few times/sec to Once/hour
-Measurement type: Vibrating wire Pressure Sensors , thermocouple, strain gauges, LVDTs
-Appropriate solution for signal correction needed for 20m cable length per sensor is required
-Temperature range: -20°C to 50°C
-No hand held device required, connection should be directly to computer
-Data should be easily imported to third party application such as Microsoft Excel
NOTE: 1. The pressure needs to be measured on the soil-concrete interface of retaining wall.

Sr. No. 140 /Reference No. : 148 (Revised)
Detailed Description of Item : **Lab OC-EC Aerosol Analyzer**

Scope and Application: Thermal/Optical Carbon Analyzer For Quantitative Estimation Of Organic Carbon (OC) And Elemental Carbon (EC) In Ambient Atmospheric Aerosols Collected On Quartz Filters.

TECHNICAL SPECIFICATIONS

MEASUREMENT RANGE
- OC : 0.05 to 600 µg Carbon (C)/cm^2
- EC : 0.05 to 20 µg Carbon/cm^2

MINIMUM DETECTION LIMIT (MDL)
- OC : 0.05 µg C/cm^2
- EC : 0.05 µg C/cm^2
- TC : 0.10 µg C/cm^2

OTHER Essential requirements

- Detection of carbonaceous species should be based on FID or other well established techniques with high linearity
- Suitable wavelength for accurate, reliable and optimal detection of carbonaceous species based on optical technique
- Should be compatible with widely used NIOSH, IMPROVE, and other well established protocols.
- Should have Quartz Sample Oven and separate integrated oxidizer bed
- Oven temperate and rate of heating should be stable and accurate with minimal deviation and fluctuations (not more than ± 5°C or 2%, whichever is lower).
- Oven temperature and rate of heating should be able to follow NIOSH, IMPROVE, and other well established protocols but at least upto 850°C
- Precise gas flow measurements
- Should have proper pyrolysis correction.
- Proper detection of charring process and OC/EC split
- Should have requisite valve/ flow sensor components
- Calibration procedures should be easy and fast
- Consumable Supplies: All specialty gases, pressure regulator, supply tubing, laboratory reagents and chemicals required to operate and calibrate the instrument should be provided
- Operational Supply Kit: Kit containing all necessary accessories and supplies to operate and calibrate the instrument should be provided
- Power requirements: The instrument should be compatible with standard Indian electrical power supply specifications, like at 220 V, 50 Hz
- Electric plug style: It should be Indian 5/15 Amp
- Instrument control and data acquisition software should be provided
- Instrument specific measurement uncertainties should be made available via manual or other relevant documents
- Multiple (2 or more) peer reviewed research publications, published originally in English language in international journals of repute should be provided with the technical bid

ENVIRONMENTAL OPERATING CONDITIONS

- Indoor laboratory environment:

Temperature: 5 to 40°C

  - Relative Humidity: 0 to 80%, noncondensing

Instatllation, training and warranty

- Installation, commissioning, calibration and training should be done at IITB by bidder.
- 3 years warranty should be provided form the date of installation

Sr. No. 141 /Reference No. : 150 (Revised II)
Detailed Description of Item :

Name of the equipment: Flight Simulator:

The party to provide the following in the quote:

- **The party to provide the following in the quote:**
- The vendor/manufacturer should be direct presence in India or should be an exclusive agent of an International equipment manufacturer for minimum 5 years in India. Proof of this relationship should be included along with the technical bid.

- Attractive discount for an educational institution should be offered.
- Support of hardware and spare for a minimum period of 10 years after installation and commissioning.
- Guarantee and warranty of the product for a minimum of 3 years from the date of commissioning.
- To provide details of installed flight simulators over the last 10 years of at least 5 users of similar or higher capabilities in India (specifically in reputed institutions/organizations like IIT's, IISc, NIT's and reputed national labs like DRDO, NAL, ISRO, HAL, etc.) or abroad from reputed institutions/organizations for getting first hand feedback from them about the product and service experience.
- The price quote should provide the cost of optional 2 year annual maintenance contract (AMC) after the expiry of the warranty period of 3 years.
- The 90 % payment will be made after shipment & 10 % after successful installation. If the simulator fails to meet the specified requirements, the vendor/manufacturer will be held liable to take the simulator back at their own cost. IIT Bombay will not be responsible for any damage to the simulator until it is handed over to the user.
- The firm should be equipped with well-trained engineers to offer post warranty maintenance and service support. Number of service engineers employed in this region by manufacturer should be mentioned, along with their qualifications and experience.
- Details of service support in India that the firm can offer should be given along with the NABL calibration facility.
- Nearest service centre to Mumbai is to be mentioned.
- Well-trained engineer should install the complete setup and it should not be carried out by the agent.

Detailed technical specifications of the flight simulator:

- **Supply, Installation, Testing & Commission:** Supply, Installation, Testing & Commissioning of, a motion platform mounted flight simulator with Visual system, Aerodynamic Model for Twin Engine Aircraft and simulation of environment with academic experimentation capability. It should also be equipped with electric force feedback system for flight controls along the three axes with differential toe-brakes.

- **Simulator Computing Module:** The simulator computing module hardware shall primarily be based on 'commercial-off-the shelf equipment' based on open architecture to allow addition/alteration/deletion at a later date. The computation module should be capable of not having CPU loading of more than 75% at any given time. The visual generation module shall allow easy scene creation for both geo-typical and geo-specific data bases and all environmental conditions
- The Computing module should use suitable authentic licenses for all the software's and capable computational power for the application.

- **Mechanical Structure:** The mechanical structure needs to replicate an aircraft cockpit with capability for reconfiguration of instrument panel. The structure mounted on motion platform should be capable to withstand normal operational stress, wear and tear. The structure

should be corrosion resistant in its operating environment, should have a high-quality finish & maintenance friendly.

- Provisioning of light inside the cockpit is to be done without the filament of light source being visible to naked eye; the switches should be clearly visible without putting glare on the eye; the panel should be backlit for operating night time scenarios

- **Simulated Aircraft:** The Simulator must simulate a multi-engine propeller powered aircraft to a high degree of realism and the supplier must prescribe & demonstrate procedures for validating the aerodynamic behavior of the simulated aircraft.
- The simulator should be capable of simulating different types of engine (reciprocating, turbine, turboprop, turbo shaft & turbofan), the user should have the capability to customize the simulated aircraft (fixed and rotary) and use reconfigurable cockpit layouts.

- **Visual System:** The simulator should provide a complete, panoramic outside the window view of minimum of 180° Horizontal field of view by 70° Vertical field of view with a minimum refresh rate of 30 frames per second. This visual system should consist of a single continuous curved screen, projectors, IG HW controllers with GPU, and image generator SW. Worldwide terrain elevation model, scenery database, major and airports and airfields and weather effects of Visibility and RVR, Day/Night, Cloud layers, Rain/Snow/Hail, Icing conditions & Wind and Turbulences. The Visual System should be made up with COTS hardware with user specified specification to provide sharp and high definition imagery.
- The Supplier should also provide an interface for addition of photo realistic commercial FAA Level D capable visual system.

- **Instrument Panel:** Houses the Glass Cockpit Instruments, All the dials and gauges, should replicate the aircraft simulated. The panel should be made up of material to handle the normal operating stress and not deform over usage period. The instrument panel area containing switches and knobs should be backlit to allow for scenarios night time flying capability.
- User should be able to change the Glass Cockpit Instrument layout as per need, the supplier should provide a ready to use library of standard instrument with no additional cost.
- The vendor/manufacturer should supply replica of G1000 Flight deck used with the capability of customizing the Human Machine Interface of the Instrument Panel by being able to display custom/user-built gauges on the same replica.

- **Switch & Knobs:** The panel should have real tactile switches for operating essential avionics functions on board the aircraft with the corresponding switches and keys replicating the usage as on board the aircraft (Switch Types). These switches, knobs should be of high-quality rating for use in aviation should conform to quality standards of Avionics, they should be made of corrosion resistant material, shielded for EM Interference and Rotary Encoders, should be properly de-bounced while being capable of around 1 million rotation cycles

Figure 1: Instrument Panel & Flight Controls (Indicative)

- **Simulation Engine and Aerodynamic Fidelity:** The Simulation Engine should be licensed for academic usage at IITB, and a software development kit should also be provided to customize the simulation engine for any modification, there should be an option to tweak aerodynamic & engine models programmatically and manually.

- **Avionics (Radios and Indicators):** The simulator should be able to simulate different types of standard navigation equipment on board a modern aircraft which can be added to the aircraft as per need of IITB. The simulation should at least be able to provide capability of simultaneous usage of 2 VOR radios, 1 ILS, 1 ADF Radio & 1 GPS.

The Simulation should also be capable of providing interface for the following devices in simulation and Stimulation Mode (Actual Avionics Unit)

- NAV Radio
- Digital Flight Computers
- ADF Radios
- Auto Pilots
- Flight Control Actuators
- Flight Management System
- Flight Guidance Computer
- Flight Control & Augmentation System

The supplier must provide evidence for having experience in interfacing actual aircraft systems with simulation engine utilizing standard communication protocols like A429, AFDX, CSDB,

etc.

- **Flight Controls:** The flight controls must be available for each pilot while being mechanically linked. The two sets of flight controls should contain an electric Force Feedback System (Control Loading) capable of simulating vibration, stall buffet and aerodynamic load gain forces. The Control loading system should be customizable and user should be able to change the force feedback profile as desired. The flight control system should operate at the lowest refresh rate of 200 Hz. The control loading system should also be capable of carrying out motion of flight controls following a simulated autopilot and capable of interfacing with an actual autopilot hardware/system.

The dual linked stick control at the minimum should meet the following functional requirements:

Parameter	**Range/Value**
Peak Force Pitch and Roll	4.2 Nm /3.1 ft –lb.
Travel Pitch	20.5°
Travel Roll	20.5°
Power	300W
Operating Voltage	24VDC

- **Rudder Pedals with Toe brakes:** Complete Rudder Axis Control with range and motion similar to the controls on actual aircraft, Variable friction/load Levels for pilot ease and scenario, Independent left & right toe brake axis motion, Self-cantering with adjustable damping. The rudder should have mechanical and electrical provisions for upgrade to control loading. The rudder pedals for the two pilots should be mechanically linked and corrected. The simulator should allow for lateral movement of the rudder or the seat to adjust for pilot/operator height variations.

The rudder pedal should meet the following force feedback and travel requirement:

Parameter	**Range/Value**
Peak Force	70 Nm
Travel	130mm / 5.1 in (linear)
Power	200W
Operating Voltage	24VDC

- **Electric Control Loading:** The Flight Control System must include an Electric Control Loading system to recreate the control forces experienced by a pilot while operating flight controls in normal and abnormal flight phases, with the capability to edit and program the forces experienced by the pilot.

- **Motion System:** The simulator should also include a 3 axis motion system with electro-mechanical actuators, frame, necessary drives and power supply, computer and safety system.

The motion system should be interfaced with the simulation scenario for motion cueing while providing the provision to IITB to update the motion cueing logic and interface as and when needed. This motion system capable of providing motion cuing in 3 axis should be supplied with a user usable payload of more than 500Kg and overall payload of more than 1200Kg. The system must provide cuing for 15° Roll and 20° Pitch and should have a travel of more than 3 inches for simulating heave. The minimum rate of actuator motion should be able to simulate +/- 1 G and actuator velocity of 100m/sec for heave and 40°/sec for rotation. The motion code should also provide for user tuning and user software control for the motion platform.

- **Vibration Augmentation:** The simulator should also be equipped with a system for augmenting and adding vibration feedback to flight control and the motion base as per the flight scenario.

- **Control Trims:** The user should have a mechanism to control trim tabs as per the simulated aircraft with IITB be able to activate and de-activate the controls as per need.

- **Flaps Control:** The Simulator should have a generic flaps control for all the flap settings as in the aircraft.

- **Seats:** The Simulator should have 2 seats for the Pilot & Copilot. The simulator should have ample space for users to easily occupy the seats and exit.

- **Maps and Navigation:** The cockpit should have to a capabilty to display navigation maps with updatable & user customizable navigation databse. The should also be simulation for widely used system for using such maps for navigation and available with G1000 system

Figure 3: Garmin G1000 (Indicative)

- **Multi Headset & Inter-communication Provision with Playback:** The simulator should contain an intercom system to provide for communication between Pilots, Co-Pilot & Instructor via VOX and PTT (push to talk) lines using the headsets the system should also be capable of recording the communication for playback. The intercom system should be based on VoIP technology and allow for future scaling in the number of participating radio operators

- **Instructor Station for Supervisory Control and Data Acquisition:** The Instructor station should contain the following:

- Setting of Aircraft Position on

- Any Runway across the globe
- Runway Hold Positions
- Runway Circuit Positions
- User Specific Position
- Slew Control

- Weather Control
  1. Setup Ambient Pressure, Temperature, Time of Day
  2. Rain and Snow with Variable Intensity
  3. Up to 3 Cloud Layers with User controlled cloud coverage
  4. Runway Visibility Range and Fog Height
  5. General Visibility
  6. Up to 3 Layers of Wind with Gusts & Turbulence
  7. Lightning
  8. Wind Shear & Microbursts

- Program or Set Aircraft System & Create Failures
  b. General Engine Failures like Fire
  c. General Instrument Failures like Pitot Icing, Power & Fuel Failure

- Manage Fuel and Load
  1 Manage Overall Fuel Load
  2 Manage Passenger Load
  3 Visualize and Control Centre of Gravity

- Record Flight Data and Plot Graphically in real time with Ability to export Flight data to commercially available geo-maps & as a "comma separated values" file for analysis
- Pause, Flight Freeze Scenario
- IOT Enabled for Remote Diagnostics and Troubleshooting
- Navigation Database Manager
- Moving Maps with Capability to Reposition via Map
- Primary flight information in PFD format
- Approach View (Lateral & Vertical profile) and real time plot using approach plates or data driven charts
- Diagnostics - Real time health monitoring (sub systems) & dashboard for easy maintenance

- **Academic Usage Interface for Software:** The simulator should be capable of interfacing with commonly used software like MATLAB, LabView, and Visual Studio etc. The supplier should provide source code for usage with rights to IIT to make changes to the source code. The Supplier must supply library example of at least a Flight Data Recorder and 3 axis Flight controllers.

  IITB should also be provided the capability to add and design an Aircraft as per need to the simulator with the capability of adding programmatically controlled traffic.

- **Industry Standard Usage:** The simulator should be capable of or based on industry standards like HLA, DIS, FOM, and SISO etc.

- **Experimentation Capability:** The supplier should provide a list of experimentation that can be carried out for study flight performance, flight Control, flight guidance and navigation. The Supplier should provide a Lab Manual of sort and work with IITB to add experimentation.

- **Hardware Package:** Hardware Package should include Cockpit, Instrument Panel, Flight Controls, Pilot Seats, Sim Controller with GPU, IO Boards, GPUs, Routers, PDU, Rack, etc.

- **Software Package:** Software Package should include Prepar3D Professional Plus with Software Development Kit (SDK), Aircraft Models, Aircraft Configurations, Windows OS, G1000 and Instrumentation SW, IO SW & Diagnostic Utilities, etc.

- **Academic Package (Generic):** Academic Package (Generic) should include SDK, Flight Data Recorder (FDR), Experimentation Capability, Aircraft Design Capability, etc.

- **Cockpit Live Share:** Cockpit Live Share (at least 10 Instances) with required Software Version should be provided.

- **Faculty, Staff and Student Development Program:** The supplier should also carry out extensive training program as part of the delivery and should support future recurrent training programs on request as and when needed by IITB to train faculty members, staffs and students on various aspects of the simulator including software and hardware interfacing, experimentation and development of components and adding them to the simulation.

- **Provision of Cooling/Ventilation:** Provisions should be made to dissipate the heat generated by the Equipment. Provisions to be made to maintain the cockpit environment well ventilated.

- **Provision of Speakers:** To give an actual feel of the ground run, provision to create the sound using speaker is to be provisioned

- **Provision for Remote Cockpit Desktop for Large Audience:** The simulator should have provision to allow basic instruments and outside view to be shared with a larger audience by the use of a Projector or Cockpit Sharing Equipment. The cockpit sharing system shall duplicate the simulated instrument panel and outside displays using a console to replicate the actual cockpit positions of such views.

- **Certification Package:** This Certification Package should include Do 178 C Software Considerations in Airborne Systems and Equipment Certification as well as DO 333 Formal Methods.

- **Installation & Commissioning:** The simulator shall be installed in full functionality and handed over in full functional condition to IITB at the location designated for delivery.

- **Training, Technical Literature, Deliverable:** Training is to be conducted at IITB, for the user which shall include delivery of training material / documents, maintenance and usage. All Software manual used in the hardware shall be handed over. Detailed specifications of components utilized in making the hardware also required to be covered.

- **Maintenance:** IITB Unit will nominate few people for a thorough training by the vendor/manufacturer to carry out necessary maintenance and troubleshooting. They will also work with the vendor/manufacturer as a point of contact for remote diagnostics using the internet and minor fixes and repair activities.

- **Warranty:** A minimum of THREE year warranty on site from the date of commissioning. During the warranty period, any un-serviceability in the simulator has to be attended and rectified by the seller at the installation site. All Repair/Replacement/Spares cost during warranty period will be fully borne by the seller.

- **AMC:** Post warranty, minimum TWO year annual maintenance contract (AMC) services as required on the site. During the AMC period, any un-serviceability in the simulator has to be attended to and rectified by the seller at the installation site.

    - Please specify the following:
    - Power requirements
    - Drives are all electric or not. If not, which drives are electric?
    - Separate the costs of Certification Package with specifications and 2 year AMC

- The simulator software and interface should be capable of supporting and also interfacing with PC desktop, 3-Axis Angular Motion Simulator, and Hardware-In-Loop Simulation (HILS).

- Instantiation and Commissioning by the supplier at no cost.

- Detailed manuals of hardware and software in English along with electronic copies.

- Upgradation of software should be free for first 5 years, which will be compatible to any higher version of windows operating system.

Safety

1. At all times, the simulator facility should ensure the operator's safely. Please specify in the technical bid the safety features, precautions and capabilities of your simulator hardware and software.

Integration of hardware plus software:

Kindly specify:

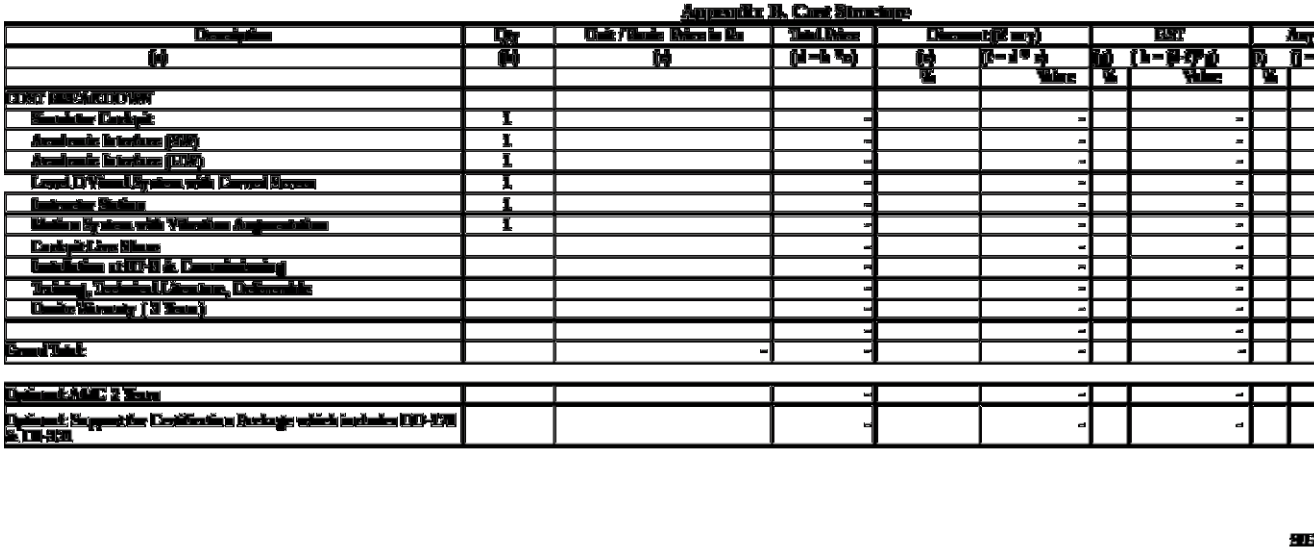
- The time required for installation and commissioning
- The requirement of civil, electrical, plumbing work etc. to be carried out by IIT for the simulator
- Other, if any

Training to laboratory personnel after installation and commissioning at IIT Bombay:

- Kindly specify the training period and method of training

Appendix A. RFP Compliance

RFP Paragraph	Requirement	Proposal Reference	Vendor Compliance	Vendors comme[nts]
2	Simulator Computing Module: Based on Latest COTS Components with licensed softwares	YES/NO		
3	Mechanical Structure: Reconfigurable Instrument Panel, Mounted over Motion Platform	YES/NO		
3	Mechanical Structure: Tested for operational stress & assembly	YES/NO		
4	Simulated Aircraft: Multi Engine Aircraft with Capability of Different Engine Types	YES/NO		
5	Visual System shall have a Vertical Field of View of 70° and Horizontal Field of View of 200°	YES/NO		
5	Visual Systems with Worldwide Terrain Database and Weather System	YES/NO		
5	Visual Systems will maintain a refresh rate of 60 Frames per Second	YES/NO		
5	Visual Systems will have (3) Professional-Grade Level D Visual	YES/NO		
6	Instrument Panel: Glass Cockpit Based for a Instrument Panel Replica of B737	YES/NO		
6	Instrument Panel: Glass Cockpit built for flight flying operations	YES/NO		
6	Instrument Panel: Reconfigurable Human Machine Interface	YES/NO		
6	Instrument Panel: Library of standard instrument panel programs for use by NTB	YES/NO		
7	Switches & Knobs: Aviation Grade hardware with extended usage life	YES/NO		
7	Switches & Knobs: Supplier Manufactured Interface for Switches and Knobs	YES/NO		
8	Simulation Engine: Licensed for use by NTB with Software Development Kit	YES/NO		
8	Simulation Engine: Capability for adding new design and proprietary aircraft models	YES/NO		
8	Simulation Engine: Capability for adding supplied aircraft models (1 Fixed Wing & 1 Rotary Wing)	YES/NO		
9	Avionics: The simulator should be able to simulate standard navigation systems	YES/NO		
9	Avionics: Minimum 2 VOR Radios, 1 ADF Radios, 1 ILS and 1 GPS Radio	YES/NO		
9	Avionics: Interface capability for Actual Aircraft Hardware Units: NAV Radio	YES/NO		
9	Avionics: Interface capability for Actual Aircraft Hardware Units: Digital Flight Computers	YES/NO		
9	Avionics: Interface capability for Actual Aircraft Hardware Units: ADF Radio	YES/NO		
9	Avionics: Interface capability for Actual Aircraft Hardware Units: Auto Pilots	YES/NO		
9	Avionics: Interface capability for Actual Aircraft Hardware Units: Flight Control Actuators	YES/NO		
9	Avionics: Interface capability for Actual Aircraft Hardware Units: Flight Management System	YES/NO		
9	Avionics: Interface capability for Actual Aircraft Hardware Units: Flight Software Computers	YES/NO		
9	Avionics: Interface capability for Actual Aircraft Hardware Units: Flight Augmentation Systems	YES/NO		
9	Avionics: Capability & Experience for Avionics Protocols like A429, CSDB, ARINC etc.	YES/NO		
10	Flight Controls: Mechanically Linked Dual Pilot Flight Controls	YES/NO		
10	Flight Controls: Flight Control Refresh of 500Hz, Autopilot Following, Electric Force Feedback	YES/NO		
11	Rudder Pedal: Dual Rudder Control Mechanically Linked and Electric Control Loading	YES/NO		
11	Rudder Pedal: Electric Force Feedback	YES/NO		
11	Rudder Pedal: Toe Brake Independent for Left and Right	YES/NO		
12	Electric Control Loading: Electric Force Feedback System to generate control forces	YES/NO		
12	Electric Control Loading: Forces for normal and abnormal flight operations	YES/NO		
12	Electric Control Loading: Forces for vibration and flight control defined failures	YES/NO		
13	Motion System: Providing motion using 6 Stroke with electro mechanical actuators, base, necessary drives and power supply, computer and safety system.	YES/NO		
13	Motion System: Must provide using for 25° Roll and 25° Pitch and should have a heave of more than 8 inches for simulating heave	YES/NO		
13	Motion System: Within user usable payload of more than 1000kg and overall payload of more than 2000kg	YES/NO		
13	Motion System: Should be able to simulate +/- 1 G and a minimum velocity of 100cm/sec for heave and 40°/sec for rotation	YES/NO		
13	Motion System: Motion System programming interface for NTB for modifying Motion Cueing	YES/NO		
13	Motion System: Motion cueing should provide for user tuning and new software module for the motion platform, and and software SDK for user development should be provided.	YES/NO		
14	Vibration Augmentation: Vibration for Flight Controls & Motion System as per Flight Scenario	YES/NO		
14	Vibration Augmentation: Vibration system Programmable control for NTB	YES/NO		
15	Control Wheel: Control Wheel for all trim buttons and others available on the Aircraft	YES/NO		
16	Flaps Control: Physical Control for Flaps with NTB, and electric interface for flaps as per A/C	YES/NO		
17	Seats: Dual Seats for Pilot & Co-Pilot with Lateral Movement Control	YES/NO		
18	Maps & Navigation: Updatable Database and airfield routing for all airfields like B737, OTH 737 etc for the usage	YES/NO		
19	Multi Headset & Intercom System: PTT and VOX system for Pilot, Co-Pilot and Instructor	YES/NO		
19	Multi Headset & Intercom System: Capability to Record	YES/NO		
20	Instructor Station : Position Controls: Any Runway, Runway Hold, Runway Visual Position, GPS Specified Location, Other Controls	YES/NO		
20	Instructor Station : Weather Controls: Ambient Temperature & Pressure, Rain, Snow, Cloud Layer (up to 3), Wind Layers (3), Clouds, Lightning, Turbulence, Snow, Windshear, Runway Visibility, Fog Height, Ground Visibility	YES/NO		
20	Instructor Station : Weather Controls: Aircraft & System Failures: Engine Fail, Fire & Instrument Failures	YES/NO		
20	Instructor Station : Fuel & Load Controls: Overall Fuel Load, Passenger Load, Weather Centre of Gravity	YES/NO		
20	Instructor Station : Record Flight Data and Pilot Graphically in real time with Ability to export Flight data for commercially available post-export time of "custom specified values" file for analysis	YES/NO		
20	Instructor Station : Freeze, Flight Freeze Control	YES/NO		
20	Instructor Station : Record/Playback & Timeline Directory	YES/NO		
20	Instructor Station : Navigation Database Editor	YES/NO		
20	Instructor Station : Moving Maps with Capability to Reposition via Map Control	YES/NO		
20	Instructor Station : Approach View (Lateral & Vertical profile) with real time data Aircraft units	YES/NO		
20	Simulation Software Interface: Interface for MATLAB, LabVIEW, VISUAL STUDIO	YES/NO		
20	Simulation Software Interface: Example source code for Data recorder	YES/NO		
20	Simulation Software Interface: Example source code for 3 Axis Flight Controller	YES/NO		
21	Experiments: Supplier provided lab manual for NTB & Supplier Recommended List of Experiments for Aircraft Performance, Flight Controls & Flight Software	YES/NO		
22	Faculty & Student Development Program: Class time along with Delivery Training for various aspects of simulator hardware, hardware and software and detailed training in simulator usage and research capability	YES/NO		
22	On request Additional training in future as per the needs of NTB	YES/NO		
23	Indigenous Manufacturing Provisions	YES/NO		
24	Provision for Spectators in possible extend/control cockpit operation in the cockpit	YES/NO		
25	Provision for Remote Cockpit Displays	YES/NO		
26	Installation & Commissioning at NTB designated location	YES/NO		
27	Training & Technical Literature for Simulator Usage and Maintenance Activities	YES/NO		
28	Simulator software and hardware: Should be capable of supporting and also interfacing with PC desktop	YES/NO		
28	Simulator software and hardware: Should be capable of supporting and also interfacing with 3-Axis Angular Motion Simulator	YES/NO		
28	Simulator software and hardware: Should be capable of supporting and also interfacing with Hardware-In-Loop Simulation (HILS)	YES/NO		
29	Hardware Package: Should include Cockpit, Instrument Panel, Flight Controls, Pilot Seats, Bus Controller with EPU, IO Boards, EPUs, Devices, PSU, Rack, etc.	YES/NO		
[illegible]	Software Package: Should include all Player/3D Professional Plus with Software Development Kit (SDK), Aircraft Models, Aircraft [illegible]	YES/NO		



Sr. No. 142 //Reference No. : 151

Detailed Description of Item :

Name of the equipment: Software In-Loop Simulation (SILS) facility :

The party to provide the following in the quote:

- The vendor/manufacturer should be direct presence in India or should be an exclusive agent of an International equipment manufacturer for minimum 5 years in India. Proof of this relationship should be included along with the technical bid.
- Attractive discount for an educational institution should be offered.
- Support of hardware and spare for a minimum period of 10 years after installation and commissioning.
- Guarantee and warranty of the product for a minimum of 3 years from the date of commissioning.
- To provide details of installed SILS facilities over the last 10 years of at least 5 users of similar or higher capabilities in India (specifically in reputed institutions/organizations like IIT's, IISc, NIT's and reputed national labs like DRDO, NAL, ISRO, HAL, etc.) or abroad from reputed institutions/organizations for getting first hand feedback from them about the product and service experience.
- The price quote should provide the cost of optional 2 year annual maintenance contract (AMC) after the expiry of the warranty period of 3 years.
- The 90 % payment will be made after shipment & 10 % after successful installation. If the SILS facility fails to meet the specified requirements, the vendor/manufacturer will be held liable to take the SILS facility back at their own cost. IIT Bombay will not be responsible for any damage to the SILS facility until it is handed over to the user.

- The firm should be equipped with well-trained engineers to offer post warranty maintenance and service support. Number of service engineers employed in this region by manufacturer should be mentioned, along with their qualifications and experience.
- Details of service support in India that the firm can offer should be given along with the NABL calibration facility.
- Nearest service centre to Mumbai is to be mentioned.
- Well-trained engineer should install the complete setup and it should not be carried out by the agent.

Detailed technical specifications of the Software-In-Loop Simulation (SILS) facility:

The Software-In-Loop Simulation (SILS) facility provides a complete real-time computer-based system to carry out all the Software-In-Loop Simulation tests that are required for the testing of the performance of the Controller/ Unit Under Test (UUT) hardware and software. These can be broadly classified into the following two categories:

- Hardware/Software Integration Tests
- Verification and Validation Tests

Scope of Work:

The works involved in the Supply of Real-time Model based SILS Facility (Hardware, Software and Services) are listed below.

- Supply of items as listed Section-A.

Section-A:

The purpose of the SILS is to provide hardware interfaces with the various subsystems of the Controller/UUT and some other interconnected subsystems that are identical to what the subsystems interface in the vehicle as well as interfaces for some of the ground support equipment that are required for the operation of the Controller/UUT. In order to meet these requirements, the resources of the SILS has to contain computers with various Input/Output (I/O) interfaces, connection methods for connecting the Controller/UUT and other Line Replaceable Units (LRUs) to the hardware resources of the SILS, peripherals, etc.

Number	Specification	Specification in Details	QTY
1	**Simulator Chassis**	Simulator Chassis shall be rack mountable	1
		Powerful target computer, with Multi Core Processor, Minimum Quad core	
		Minimum supported speed 3.0Ghz	
		Supported HDD, Minimum 512 GB	
		Supported DDR RAM, minimum 16GB	
		4U, Xeon E5, 4 Cores, 10M cache	
		RCP/HIL Artix 7 FPGA-based Real-Time Simulator	
		PCIe slots to support third party cards/custom made cards	

		High Speed duplex multi-mode SFP optical fibre 1 to 5Gbps	
		Should have the LED indicators for synchronization status, target computer status etc.,	
		Should have standard ATX computer connectors like USB ports, monitor, network ports etc..	
		Should support Lab grade environmental conditions	
		Integrated Patch panels for 16 Channels of I/O for monitoring parameters	
		One Artix -7 FPGA to drive the I/O cards	
		I/O expansion chassis with the required process capabilities, the integrated patch panels for signal monitoring, the Aritix-7 FPGA and the required software license.	
		A suitable rack should be provided to mount all these.	
2	**Analog Input**	2x16 Ch with 16 bits	1
		400kS/s /ch simultaneous sampling	
		Minimum 2.5 µs conversion time	
		All channels simultaneously captured	
		Voltage range configurable up to ±20 V true differential input	
		400 kOhms input impedance	
		Conversion time should be directly controlled by the FPGA	
3	**Analog Output**	2x16 Ch with 16 bits	1
		1 MS/s/ch simultaneous output	
		1 µs update time	
		15mA (35 mA with optional fast driver)	
		All channels simultaneously generated	
		Short circuit protected	
		Voltage range configurable up to ±5V, ±10V, ±16V	
4	**Digital Input**	2x32 channels	1
		Push pull type	
		40 ns propagation delay	
		All inputs are sampled simultaneously, at up to 10 MSPS	
		4.5 V to 50 V, same module can be used up to 50 V	
		Short circuit protected, Galvanic isolation with Op to coupler transition delay of 50 ns	
5	**Digital Output**	2x32 channel	1
		Push pull type	
		50 ns propagation delay	
		5 V to 30 V	
		Short circuit protected	

		Galvanic isolation	
		All outputs are simultaneously generated with a maximum transition delay of 50 ns	
		Adjustable via user-supplied external voltage	
		50 mA max	
		Same module should be used for PWM generation, software configurable	
6	**Serial RS232/RS422/RS485**	Two, Four or eight asynchronous serial ports, in various electrical interface configuration	2
		Support full duplex (4 wire) with RTS/CTS flow control, half duplex (2 wire) with auto TxD echo cancellation and multi-drop (4 wire) full duplex communication modes in RS-422/485	
		Maximum data speeds of 921kbps (RS-232) and 1.8432Mbps (RS -422/485)	
		Optional multi-strike surge suppression: IEC 1000-4 compatible on all signals, all port	
8	**Target License**	Target software allows the offline Simulink model to run in Real-Time, and shuold allow the model to interact with real world signals, through Analog voltages and currents, also through means of communication protocol	2
		Real Time Operating System should be used dedicatedly for the real time simulation. RTOS used will be COTS based	
		Hard Real Time scheduler	
		TCP/IP Host target communication	
		IO Management	
		Driver block should be a Simulink Model based and should be user configurable	

09	MIL 1553B	Multi-Function and should be easily configurable to operate simultaneously as Bus controller, 31 Remote Terminal and BUS Monitor with variable voltage transceivers. Specifications are;
		• Dual Channel, Dual-redundant MIL-STD-1553 A/B Notice I channels
		• Simultaneous Bus Controller, 31 Remote Terminals and Bus Monitor
		• High-level API for Windows XP, Linux, RTOS
		• Card should be PCI based
		• Bus Controller
		  • Programmable control over:
		  • Major and minor frame content and timing
			2

		• Intermessage gap times • Response time-out and late response • Multiple BC retry • Modify messages, data or setupwhile card is running • Insert aperiodic messages into a running BC list • "Oneshot" mode for simplified BC operation • Conditional message sequencing based on real-time message data or status Selectable interrupt generation and status messages Full range of system conditions All detected errors **1** Remote Terminal • Multiple RT simulation (up to 31 RTs) • Modify data, status words or setup while card is running • Programmable message content • Interrupts can be generated on a per message basis upon End of Message and error conditions • RT Map Monitoring **2** Bus Monitor • Capture 100% fully loaded bus traffic with: • Time-tagging • Error status • Word status • Message status • RT response time • Interrupts can be selected by RT/SA/WC • Real-time bus playback with RT edit mode • 45-bit, microsecond resolution time tagging • IRIG-B Receiver (AM or DC/TTL)/Generator (DC/TTL) 18 Accessories : Mating connectors with mating backshell. Stub with transformed couple with terminators- 1Set	
10	**Real-Time Communication Link**	Link Speed : 40 GBPS PCI Express : Base Spec 2.1 Cable Connection : x8 PCI Express Connection Drivers : Required drivers Interface between the two systems with minimum 2 meters cable	1
	Integrated Development Environ-	• IDE software must be installed on the user provided system.	1

11	**ment(IDE)** Software	• The IDE software must provide development of scalable real-time platform for mathematical models of dynamic system built using RT-LAB/ MATLAB/ Simulink for simulation and control testing.
		• Should provide High-fidelity Plant Simulation of
		  • Real-Time Simulation for System Integration
		  • Physical Components Testing with Virtual Systems
		  • Operator Training
		  • Controller Development
		• Control System Prototyping
		  • Prototyping Controller Connected to virtual Plant
		  • Control Testing with Real Plant
		  • Hardware-in-the-Loop with Real Controller
		• Embedded Data Acquisition and Control
		  • Should be able to run the models in embedded Mode. Once the controller is flashed on the system it should be able to work like controller ever system is rebooted multiple times in embedded mode option.
		  • High-Speed Signal Capture and Data Logging
		• Should Run Simulink models in real time on HILS platform
		• Must work with industry standard I/O
		• Should offer fast execution, small fixed-step sizes
		• Must support SMP or distributed targets for faster execution
		• Run on a reliable, industrial-grade RTOS
		• Must provide Integrated Signal Visualization and control Panel
		• Should provide High-Fidelity Plant Simulation
		• Support for 3DVirtual Reality Visualization Tools	

- **<u>Faculty, Staff and Student Development Program</u>:** The supplier should also carry out extensive training program as part of the delivery and should support future recurrent training programs on request as and when needed by IITB to train faculty members, staffs and students on various aspects of the SILS facility including software and hardware interfacing,

experimentation and development of components and adding them to the simulation.

- **Installation & Commissioning:** The SILS facility shall be installed in full functionality and handed over in full functional condition to IITB at the location designated for delivery.

- **Training, Technical Literature, Deliverable:** Training is to be conducted at IITB, for the user which shall include delivery of training material / documents, maintenance and usage. All Software manual used in the hardware shall be handed over. Detailed specifications of components utilized in making the hardware also required to be covered.

- **Maintenance:** IITB Unit will nominate few people for a thorough training by the vendor/manufacturer to carry out necessary maintenance and troubleshooting. They will also work with the vendor/manufacturer as a point of contact for remote diagnostics using the internet and minor fixes and repair activities.

- **Warranty:** A minimum of THREE year warranty on site from the date of commissioning. During the warranty period, any un-serviceability in the SILS facility has to be attended and rectified by the seller at the installation site. All Repair/Replacement/Spares cost during warranty period will be fully borne by the seller.

- **AMC:** Post warranty, minimum TWO year annual maintenance contract (AMC) services as required on the site. During the AMC period, any un-serviceability in the SILS facility has to be attended to and rectified by the seller at the installation site.

- Please specify the following:
- Power requirements
- Drives are all electric or not. If not, which drives are electric?
- Separate the costs of Certification Package with specifications and 2 year AMC

- The SILS facility software and interface should be capable of supporting and also interfacing with PC desktop and 3-Axis Angular Motion Simulator.

- Instantiation and Commissioning by the supplier at no cost.

- Detailed manuals of hardware and software in English along with electronic copies.

- Upgradation of software should be free for first 5 years, which will be compatible to any higher version of windows operating system.

- **Safety**
  2. At all times, the SILS facility should ensure the operator's safely. Please specify in the technical bid the safety features, precautions and capabilities of hardware and software of your SILS facility.

Integration of hardware plus software:

Kindly specify:

- The time required for installation and commissioning
- The requirement of civil, electrical, plumbing work etc. to be carried out by IIT for the SILS facility
- Other, if any

Training to laboratory personnel after installation and commissioning at IIT Bombay:

- Kindly specify the training period and method of training

Sr. No. 143 /Reference No. : 152

Detailed Description of Item :

Gas turbine engine with instrumentation:

Sr. No. 144 //Reference No. : 153

Detailed Description of Item :

Nanoparticle Tracking Analyzer

Sr. No. 145 /Reference No. : 154

Detailed Description of Item :

Inductively Coupled Plasma - Atomic Emission Spectrometer (ICP-AES)

Concentration resolution at particular wavelength: 5 to 8 pm

RF Power for plasma: 1400 to 1500 W

Wavelength range for elemental analysis: 170 to 776 nm

Plasma view: Dual

Optical System: Polychromator

Nebulizer: For both low TDS and high TDS samples

Peristaltic pump: Required

Autosampler: Required

Detector type: CCD/CID

Startup time: < 30 minutes

Argon consumption: 8-16 L/min

Water Chiller: Required

Standard solution for multi-element calibration: Required

Microwave Digester: Required

Computer with required software: Required

Argon gas cylinder with regulator: 2 argon gas cylinders with regulator required

Warranty:At least for 3 years

AMC: Upto 2 years beyond 3 year waranty is desirable, for possible inclusion

Sr. No. 146 / Reference No. : 155

Detailed Description of Item :

TAP-KPC (Temporal Analysis of Products – Kinetic Processing and Characterisation) Multi-experiment system

Te m p o r a l A n a l y s i s o f p r o d u c t s - K i n e t i c P r o c e s s i n g a n d Characterisation system with the following specifications and accessories

-Removable reactor chamber configuration that allows different reactor chambers to be mounted. Vent to vacuum system. Should allow atmospheric pressure as well as high vacuum operation.

-Microreactor assemblies (SS) with temperature probe and controller

-QMS Mass spectrometer attachment with Faraday cup and electron multiplier (1-500 amu). To have direct access to the reactor chamber with suitable valve arrangement.

-Above units capable of operating at high vacuum (10-8 torr)-Kinetic probe assembly with computer controlled positioning system

-Pulse valve manifold capable of admitting pulse sizes 1014 to 1016 molecules, complete with power supply, pneumatically operated continuous flow valve.

-Suitable liquid nitrogen trap vacuum chamber

-Suitable support platform with cabinets for system power supplies, gauges and controllers.

-Control and data acquisition system complete with computer and requisite software, with connections to mass spectrometer, temperature controller, valve controller etc.

-Vacuum equipment and gas mixing system for the required range of operation as mentioned above. Adequate number of gauges to be provided

-Training to be provided for system installation operation and maintenance1

Sr. No. 147 /Reference No. : 156

Detailed Description of Item :

Wide angle X-ray diffractometer with high temperature and electrochemical attachment.

- BASIC: Diffractometer cabinet (radiation enclosure) with suitable electronics rack and system controller for basic & additional electronics (e.g. non-ambient controllers), also

equipped with suitable doors for easy access to the diffractometer. The cabinet complies to the regulations on X-ray, electrical and mechanical safety. The emission level is below 10 microSievert per hour at 10 cm distance from the system surface. Also included is suitable data acquisition software Data Collector that contains the following functionality such as: data acquisition based on suitable format,, measurement strategy determination tools, configuration and measurement management, automatic processing, data conversion and viewing functionality for X-ray diffraction systems.

- X-RAY GENERATOR TUBE: The sealed tube X-ray generator (Copper) should be designed for an enhanced stability of the focal spot to use with various optics such as Slits, X-ray mirrors, Xray Multi graded Mirror, hybrid and Johansson monochromators etc. The X-ray tube should be equipped with one window for line focus and one for point focus. Minimum power of generator being 3 kW. Voltage not less than 20 kV.
- SAMPLE STAGE:
    - SPINNING SAMPLE & NON-SPINNING SAMPLE STAGE: Fixed WAXS stage and Spinning Sample stage for sample spinning with programmable phi-axis positioning or scanning for analysis of powders or solid samples
    - AUTO SAMPLE CHANGING STAGE: An auto sample changing stage for powder samples is to be provided for a minimum of 6 samples and option for spinning.
    - CIRCULAR HOLDERS FOR REFLECTION: Sample holder having both bottom and top plate used for the back-loading or front-loading of powder specimens, either manually or semi-automatically. 10 nos.
    - LOW BACKGROUND SAMPLE HOLDER : low background or zero background sample holder for small sample quantity – 5 nos.
    - CIRCULAR HOLDERS FOR TRANSMISSION: Sample holders for measurement of samples in transmission geometry.
    - Powder Sample Preparation Kit.
- INCIDENT BEAM OPTICS FOR LINE FOCUS BASED ON SLITS:
    - Soller slit 0.02 radians or near about equivalent aperture in deg./mm for incident beam optics, exchangeable with Soller slit of 0.08 radians or near about equivalent aperture in deg./mm.
    - Divergent beam optic to perform Bragg-Brentano measurements.
- GONIOMETER:
    - Radius not less than 240 mm.
    - Minimum step size of 0.0001 degrees
    - Minimum range of 0 to 120 degrees in two theta
    - Minimum scan speed of 0.05 degree per minute or less
    - Maximum scan speed of 10 degree per minute or more

- DETECTORS AND MONOCHROMATORS
    - Semiconductor detector for both line and point detector X-ray diffraction applications having following features
        - Maximum global count rate of more than 1 X 10^8 (one hundred million) CPS
        - Active area more than 100 mm squared
        - Energy resolution around CuK better than 25 % or less than 2000 eV for Cu Kα at 25°C
        - 0D, scanning and static 1D functionality
    - Ni Beta filter.
    - Fixed Anti scatter slit assembly
    - Diffracted beam linear detector (1D) monochromator

- Soller slit 0.02 radians or near about equivalent aperture in deg./mm, for large aperture it should be exchangeable with Soller slit 0.04 radians or near about equivalent aperture in deg./mm.

- SOFTWARE

Performs data treatments and XRD phase identification on various systems. Allows installation of the software on one additional device. Includes the following features:

- Search-match algorithm uses peak and profile data
- Auto-residue scoring
- Advanced reporting functions
- Graphics for examining, displaying, and editing diffractograms
- Supports any number of user-defined reference databases
- Includes batch feature for auto function of a sequence
- Automation ready - can be launched from a command prompt
- Similarity analysis of scans (cluster analysis up to 50 scans)
- Referenced Intensity Ratio (RIR) for estimation of quantities of all identified phases
- Percent crystallinity
- Very fast profile fitting
- Line profile analysis, microstructure analysis by profile fits
- PLS partial least squares to determine/quantify one property directly from raw data
- Preparing automated Rietveld analysis 64-Bit Windows 10 Professional compliant
- Unit cell indexing and Unit cell refinement
- Space group testing and unit cell transformation
- Structure reviewing, distances and angles
- Structure solution
- Line profile analysis, microstructure analysis by profile and structure fits
- Mixed fits from structure-, HKL- and profile data
- The vendor must also provide the latest ICDD PDF4 database original license for search match functionality with 3 years validity from the date of purchase.

ADDITIONAL ATTACHMENTS/ACCESSORIES:

- Sample heating stages capable of heating from ambient to 1500 ^{o}C in inert or vacuum with suitable software to collect XRD scans at intermittent temperature.
- Electrochemical stage with electrical feedthrough through the X-ray chamber and potentiostat for in-situ analysis for aqueous electrochemistry applications.
- Compatible Chiller unit, Suitable UPS for XRD as well as water chiller, branded computer & laser printer should be offered.

Sr. No. 148 /Reference No. : 157 (Revised)
Detailed Description of Item : **MiniVol TAS PM2.5 and PM10 sampler**

PORTABLE AIR SAMPLER, MiniVol TAS

Description :

- To collect particulate matter of different sizes (PM2.5 and PM10) for monitoring and laboratory analysis purposes
- Flow: Active flow Control, Flow range: 0-10 LPM, with a nominal flow: 5LPM
- Sampler Dimensions: Should be < 11" x 13" x 8"
- Sampler Weight (ready to sample with basic configuration): < 5 kg
- Portability: Should be portable, rugged for carrying and filed operations.
- Sampling method: Should be impaction based, well established method, approved by some reputed, well known environmental regulatory agency (FRM compliant). Should have its own internal pump which is stable, rugged and long lasting
- PM collection: Should be compatible with 47 mm filter media, both PM2.5 and PM10 measurement should be possible; simultaneously or separately
- Power supply: Should be battery (rechargeable) operated for field deployment, battery should last for 24 hrs or more at a stretch and should be replaced easily. Should be compatible with Indian power supply and/or required accessories should be included.
- Timer and auto shut off: Should have programmable timer and auto shut off facility (during low battery and major flow fluctuation situations)
- Low maintenance: Should be rugged, requires less manual intervention and maintenance
- Publication: Multiple (2 or more) peer reviewed research publications, published originally in English language in international journals of repute should be provided with the technical bid

Sr. No. 149 /Reference No. : 158

Detailed Description of Item :

Test electronics mainframe Specifications:

- Controller slot plus seven 6U Instrument Card Slots
- Expandable with slave mainframes of same or similar type – combined to get total of 16 slots
- Atleast 600 Watt internal Power Supply
- Voltage monitoring points
- Sufficient ventilation fans
- Low Noise Support for expansion Cards
- Atleast Quad-core i7 Processor
- Atleast 32 GB RAM
- On-board HDD up to 2.0 TB (Atleast 256 GB SSD additional)
- Rack-mountable or bench-top use
- USB 3.0, Gigabit Ethernet
- On-board Video for up to 3 displays
- 2 FullHD 27 inch or more Displays
- DVD burner
- Windows 10 Pro
- Configurable FPA graphical automated test software installed
- Image post NUC and pixel replacement and data reduction and FPA performance analysis
- Test report generation
- Automated test routine support
- Software provision for timing pattern creation and editing, control for clock drivers, power biases and ADC system

- To include DLL, documentation and Labview drivers
- Mainframe installed in a 28U instrument opening w/AC line filter and isolation transformer
- Digital Multimeter Keithley 2000 DMM or equivalent, rack mounted
- and 1GHz, 5GBPS Oscilloscope rack mounted
- All cables and accessories
- Detailed drawing and specification need to be provided to the customer to qualify conceptually in addition to other technical validations

Sr. No. 150 /Reference No. : 159

Detailed Description of Item :

Test electronics power, analog, digital cards Specifications:

- Capable of installing in Instrument mainframe Card Slots
- Modular cards
- Clock generator card – low jitter programmable upto 400MHz, external clock inputs and outputs; <100ps jitter; 4channel;
- Pattern Card – upto 16 channels of TTL output upto 250MHz programmable; <100ps jitter; <600ps channel to channel skew
- Clock driver cards – programmable upto 8 channels, -5V to 8V ptorammable
- 12 Channels of programmable low noise DC bias between -8V to 8V, 100mA
- 8 ADCs 16 bits 10MHz with programmable or configurable filter, input ends
- 8 channel Preamplifiers -8V to 8V
- Two Dual channel Digitizer – Acquisition cards upto 100MHz per channel with sufficient RAM
- Optic lens to support MWIR to LWIR, f/4 atleast
- All cables and accessories
- Detailed drawing and specification need to be provided to the customer to qualify conceptually in addition to other technical validations

Sr. No. 151 /Reference No. : 160

Detailed Description of Item :Test Dewar Specifications:

- Test Dewar, 2-stage closed cycle.
- Water/Air cooled compressor.
- 100 signal lines, 1 test sample mount, 10” dia. format.
- Radiation shields maybe included.
- Cooled filter assembly, dual filter, Aperture fixures
- Configured for a 1.30” distance from cold pedestal to external lens mounting surface.
- Preinstalled vacuum getter
- Test set assembly kit options - 84-, 100-,pin LCC sockets.
- Variable temperature from atleast 50K to 300K
- Temperature stability – <50mK
- Cradle mount assembly
- Four External coax cable assemblies
- 50-pin header to 25 BNC (M) plugs.
- Three 50mm x 5mm Antireflector coated windows covering MWIR to LWIR.
- Temperature sensors installed at two strategic places
- Cartridge heater at location with little to no thermal gradient within the test device
- Temperature controller with GPIB interface.
- PID tunable, PID controlled temperature lock
- Communication Cable, Dewar to temperature controller cables.

- Software support for Lakeshore Temperature Controller, including setpoint, readback, variables, and looping.
- Detailed drawing need to be provided to the customer to qualify conceptually in addition to other technical validations

Sr. No. 152 /Reference No. : 161 (Revised)

Detailed Description of Item :

Thermal Conductivity/Diffusivity Measurement Apparatus The requirement is of an instrument to measure the **thermal conductivity**, **thermal diffusivity** and **specific heat** of a wide range of materials using the flash diffusivity technique. The measurement should be possible as a function of temperature. Detailed features and capabilities are listed below.

Capabilities

- Thermal conductivity measurement in the range: 0.1 - 2000 W/(m.K) or more.
- Thermal diffusivity measurement in the range: 0.01-2000 mm^2/s or more
- Specific heat measurement of solid samples
- Thermal diffusivity measurement of bulk, powders, thin films (cross plane) and liquids
- Temperature range : room temperature to 1250 ^0C or similar

Key Specifications

5. Flash lamp should be Xenon or Laser: Pulse energy up to 10 Joules/pulse or higher, Possibility of variable pulse width in the range 10 to 1500 µs or similar,
6. Infrared detectors for temperature measurement in the range : RT- 1250°C or similar.
7. The setup should be operable in various atmospheres like Inert, oxidizing, static and dynamic vacuum. Provision for sample chamber evacuation and back filling should be provided.
8. Data acquisition interval upto 2 MHz or higher (adjustable measurement time depending on thermal conductivity, thickness of specimen). Provision for data acquisition, storage and viewing of real time data should be provided with the setup.
9. Wide range of sample holders suitable for solids, thin films, powders and liquid samples. Indicate possibility for auto sampling.
10. Possibility of fast sample heating: maximum around 50 K/min
11. Accuracy of the measurement should be:· Thermal diffusivity: ± 3% , Specific heat: ± 5% or higher
12. Precision or Repeatability of the measurement should be : Thermal diffusivity: ± 2% , Specific heat capacity: ± 3% or higher.

Sr. No. 153 //Reference No. : 162

Detailed Description of Item :

Gravimetric fuel flow meter: Dynamic fuel balance with flex fuel -

Specifications of the Automatic gravimetric fuel consumption meter requirements –

1. Must be compatible with fuels like alcohols (Methanol, ethanol and butanol), gasoline, diesel, biodiesel.

2. Must be able to give fuel consumption over a specified period, fuel consumption rate and fuel time for a given mass of fuel to be consumed.

3. Must be compatible with common rail, MPFI and GDI systems.

4. Must be capable of taking the return fuel line from the engine.

5. Must have a fuel venting line.

6. Must be able to work with gravity feed of fuel.

7. The weight should be measured by a high precision capacitance-based load cell.

8. Provision for automatic calibration should be available.

9. It should be possible to select different measuring masses based on the capacity of the engine.10. The accuracy must be better than 0.15% of reading.

11. Must be able to do running average of more than 50 consecutive readings.

12. Measuring frequency in the rate mode (more than 5 Hz).

13. It must be capable of being connected to other standard automation systems (e.g. remote control by computer) and data acquisition system.

14. Should have a measuring range of at least 100 kg/h

Qualifying conditions: 1.The bidder should have supplied at least quoted product or equivalent in specifications or higher in specifications to NATRIP testing centres (National Automotive Testing and R&D Infrastructure Project)/Reputed automotive OEMs (Original Equipment Manufacturers) in the last five years for automotive applications with BS IV capability or higher. Proof of supply must be provided along with the bid.(NATRIP testing centers include ARAI (Automotive Research Association of India),ICAT (International Centre for Automotive Technology),GARC (Global Automotive Research Centre) and NATRAX (National Automotive Test Tracks).)

2. The supplier should be the sole representative of the manufacturer of the offered item in India.

3. The supplier should be able to offer complete after sales service support in Mumbai.

4. Warranty should be for three years.

5. Any other support systems that are needed for the functioning of the equipment but do not form a part of the instrument should be specified in the technical bid.

General terms and conditions:

1. Terms of Delivery -The item should be supplied to our Departments as per Purchase Order. In case of import supply, the item should be delivered at the cost of the supplier to our Institution. The Installation/Commissioning should be completed as specified in our important conditions. Equipment must be delivered and installed within two months after PO received to the bidder.

2. Delivery schedule-The system should be supplied, installed and commissioned within eight weeks after acceptance of technically clear Purchase Order.

3. Prices -The price should be quoted in net per unit (after breakup) and must include all packing and delivery charges to Urja Lab, IIT Bombay. The offer/bid should be exclusive of taxes and duties. The percentage of tax & duties should be clearly indicated separately. IIT Bombay is eligible for concessional GST and relevant certificate will be issued. In case of import supply, the price should be quoted without custom duty. IIT Bombay is exempted from levy of IGST on Imports and eligible for concessional custom duty (not exceeding 5%) and the price should be quoted on EX-WORKS and CIP basis indicating the mode of shipment.

4. IIT Bombay reserves the full right to accept / reject any tender at stage without assigning any reason.

Sr. No. 154 /Reference No. : 163 (Revised)
Detailed Description of Item : ReactiThermm with Accessories

Specifications for Reactitherm & Accessories
The detailed specifications for the Reactitherm with accessories are as follows:

1. Programmable Stirring, Chilling & Heating Block, suitable for 230 V
2. Aluminum Blocks for Microcentrifuge Tubes
3. Aluminum Blocks for Test tubes of varying diameter (11 to 21 mm)
4. Temperature Sensor

Sr. No. 155 /Reference No. : 164 (Revised)
Detailed Description of Item : HPLC with Diode Array Detector and Fluorescence Detector

Specifications for HPLC with Diode Array Detector and Fluorescence Detector
The HPLC system should comprise of the following components:

1. Solvent Delivery System (Pump)
2. Auto sampler
3. Column Oven
4. Photo Diode Array Detector
5. Fluorescence Detector
6. Chromatographic Software
7. PC& Printer
8. UPS

Below are the minimum required specifications for each of the individual modules and all modules should be compatible with each other.

1. Solvent Delivery system (Pump):
   - The pump should provide error-free programming of pump parameters including flow rates, operating pressure limits, compressibility compensation, calibration and diagnostic.
   - It should be capable of operating with 2 or more solvents at a time during gradient operation limits, compressibility compensation, calibration and diagnostics.
   - It should have an adjustable flow rate range from 0.001 to 10 mL/min, in 0.001 mL/min increments.
   - Must have an operating pressure range of 0 – 600 bar.
   - Flow rate accuracy should be ± 1% or ± 2 µl/min of the set value or better.
   - Flow rate precision should be ± 0.07% RSD or better.
   - The precision in composition must be within 0.2% RSD.
   - The system should haveat least 4 solvent bottles complete with fittings.
   - It should incorporate degassing unit with at least 4 flow lines.
   - It should allow for module-wise and system-wise upgradation capability in future.

2. Auto sampler:
   - The Auto sampler must have a capacity to hold at least 100 standard size autosampler vials
   - It should allow sample injection volume in the rangeof 0.1 µl to 100µl.
   - Carry over should be less than 0.004%.
   - The injection precision should be within 0.3% of RSD.

- It should have both flow line/needle rinse capability both before and after sampling.

3. Column Compartment:
   - The Column Compartment should be thermostatic with heating upto 80^{o}C
   - At least two columns up to 250 mm should be accommodated.
   - Two HPLC columns together with guard columns for analysis of polynuclear aromatic hydrocarbons (PAHs) and pharmaceuticals, respectively, should be provided.

4. Photodiode Array (PDA) Detector:
   - The wavelength range should be 190 nm - 800 nm or more.
   - The photo-diode array detector should have 512 or 1024 elements.
   - A deuterium lamp [D2] and a Tungsten lamp [W] should be available as light Source.
   - Wavelength accuracy should be within ± 1 nm.
   - A standard flow cell of 12-13µL volume, 10 mm path length and 12 MPa should be available.
   - The detector should have variable slit width for high resolution as well as high sensitivity.
   - The Drift should be 0.9×10^{-3} AU/h or less.
   - The Noise should be 0.7×10^{-5} AU or less.
   - Linearity should be equal or more than 2 AU.

5. Fluorescence Detector:
   - The light source of fluorescence detector should be a Xenon lamp.
   - The wavelength range should be 200 nm to 650 nm or more.
   - Wavelength accuracy should be at least ± 2 nm.
   - Wavelength reproducibility/repeatability should be ± 0.2 nm.
   - Raman peak signal to noise should be 1200 or more.

6. Chromatographic Software:
   - Genuine and compliant chromatographic software should be supplied with the HPLC system. The latest version of software should be provided.
   - The software should be genuine & original.
   - It should allow full control of the instrument together with the detectors.

7. PC and Printer
   - PC along with latest configuration with LCD/LED monitor, optical mouse and key board should be supplied together with a laser printer

8. UPS for avoiding power fluctuations should be provided with the system.

9. All the necessary accessories for smooth operation of the system should be provided, such as: kits with stainless steel capillaries, PEEK tubing and fittings, cutter, PTFE frits, solvent inlet filter; tool kits & other accessories.

Service, Warranty and Training

1. The quote should include delivery, installation, commissioning and training (at least 4 users)
2. Warranty for complete equipment for a period of 12 months from date of installation should be provided at no extra cost for parts, repair and service engineer

3. Vendor to provide service guarantee. Should the system require service during the warranty period, the vendor must guarantee turn-around-time within 24 hours
4. Vendor must provide a site-preparation checklist
5. Vendor must demonstrate that it has a proven appropriate set-up and capability to provide after-sales service efficiently and effectively. The supplier should have in his facility a similar system to that proposed in this tender for training purpose
7. The vendor must be reputed and must have experience of at least 10 years for supply of HPLC with the quoted Detectors. They must have more than 500 installations in India. Preferably they should have their own facility to provide demo / training on similar instrument. Vendor must have service as well as application engineers based in Mumbai.

Sr. No. 156 /Reference No. : 165
Detailed Description of Item :
Portable Raman Spectrometer -

Portable Raman system: having a single source of 785 nm excitation wavelength and a resolution of 5 cm^{-1} or better for the range of 100 to 3200 cm^{-1}

OR

having dual source with an excitation wavelength of 785 nm & 1064 nm with a resolution of 9 cm^{-1} or better and cover a range of 100 to 2300 cm^{-1}.

The detector should have low background noise and should be cooled to -2°C or lower temperature. The scan time of the system should cover the range of 100 ms to 600 sec. The system should have a fiber-optic probe/attachment for sampling both solid and liquid samples. The power of the source should be adjustable from 0 to 400 mW. The associated software should have a feature for creating libraries for new chemical compounds for identification and detecting peaks in the spectrum. The system should have the option of battery backup for on-field sampling.

Accessories:

3. Sample holder for solid samples like SERS substrate on a glass coverslip, paper, etc.
4. Sample holder for liquid samples,
5. The stage for holding and aligning (X, Y & Z) the fiber-optic attachment over the sample surface.

Sr. No. 157 /Reference No. : 166 (Revised)
Detailed Description of Item : Ultra Precision Machining Facility

We intend to purchase CNC Diamond Turning Machine (DTM) as a part of Ultra Precision Machining Facility for research, laboratory and industrial applications. The application ranges from ultraprecision machining of components required optical, electro-optics, automobile applications. Quotations are invited from the eligible bidders for providing the mentioned products as per detailed technical specifications provided in technical requirements section. The proposed system

should be equivalent with or better than each of the specifications listed in the technical requirement section.

Please follow the instructions carefully and comply your bid accordingly. If any of the instructions are not followed or violated, a submitted bid will be subjected to disqualify.

Ultra-Precision Four Axis CNC Diamond Turning Machine	
Machine Base	Granite to control any thermal expansion
Configuration	Turning (X-Z-B-C Axis)
Linear Travel	X-Axis: ≥ 210 mm (Linear)
	Z-Axis: ≥ 210 mm (Linear)
Travel Feedback Resolution	≤ 0.010 nm in all linear axis
Additional Axes (Rotary)	C-Axis: Speed: ≥1500 rpm Positioning Accuracy: ≤ ±1 arc-sec Feedback Resolution: ≤ 0.010 arc-sec
	B-Axis: Hydrostatic Oil Bearing Positioning Accuracy: ≤ ±0.1 arc-sec Feedback Resolution: ≤ 0.005 arc-sec Rotation can be physically locked/unlocked using the machine controller
Spindles	Type: Air Bearing
	Speed: ≥6000 rpm
	Ultimate Load Capacity: ≥ 85 kg @ 100psi ; ≥ 200 kg @150psi
	Motion Accuracy Axial/Radial: ≤ 20nm
Straightness	Horizontal: ≤ 0.3 microns, over full travel in all linear axis
	Vertical: ≤ 0.4 microns, over full travel in all linear axis

Feed rate	Maximum feed rate should be at least up to 2000 mm/min
Drive System	Should have independent linear motors for motion of all three axis and rotary motion
Enclosure	Stainless Steel compatible with water-based flood coolant

Performance	• Surface Finish: Sa ≤1.5 nm over any 1 mm^2 surface area on a 12.7 mm diameter nickel phosphorous surface, • ≤ 5 nm anywhere over the aluminium surface of diameter 100 mm
	Figure Error (PV): ≤ 0.15 microns over 75 mm spherical convex surface, 250 mm convex sphere
Performance Evaluation Criteria	Based on a toric surface fabrication in freeform way
Control System	CNC control system windows based on real time operating system
Types of workpiece surface profile	Flat, Sphere, Asphere, Freeform The machine should have the possibility to upgrade in future by in-corporating attachments fly-cutting (tool post), micro-milling, FTS
Accessories	Suitable pneumatic vibration control system
	CAM software for aspheres, diffractives, freeform profiles
	Milling or Grinding Spindle with horizontal mount to B tabletop Spindle chiller
	Suitable sliding/flexing tool holder
	Vacuum chuck: ≥ 200 mm diameter
	Optical tool setting station, Tool setting software
	Integrated gauge amplifier
	Suitable collet adaptor for spindle
	~~Air Temperature Unit~~
	Air Compressor, online UPS with backup of 30 minutes, filters, dehumidifier and air driers suitable for running the machine
	Hydrostatic slides oil, Spindle chiller coolant, tool posts, Small size vacuum chuck
SC Diamond Tools	• Positive Rake: 0.75mm, 1.5mm Tool Nose Radius • Zero Rake: 0.5 mm (2 nos.) Tool Nose Radius • Negative Rake (10, 15): 0.5mm, 1mm, 1.5mm Tool Nose radius
Additional Requirements	6 System should be upgradable to accommodate Fast Tool Servo (FTS) system 7 Should provide warranty for 2 years 8 Should have AMC for 3 years after the warranty period. 9 Installation and training at IIT Bombay. 10 If the machine failed to meet the specified requirements, the vendor

		will be held liable to take the machine back at their own cost. IIT Bombay will not be responsible for any damage to the machine until it is handed over to the user.
	11	Must have done installation of the same base model during the 3 years in the government academic institutions and R&D labs in India to be supported with installation reports obtained from the Institutions. The names and contact details of the Institutions where the instruments are supplied and installed should be given so that the Technical Committee can ascertain the veracity of the information provided and take that as an input to determine the vendor.
	12	The supplier should have a service center in India and a trained technician should be stationed in Mumbai and available for three years.
	13	Door to door duty delivery paid. IIT Bombay would provide the exemption certificates as applicable.
	14	All other standard accessories.
	15	Door to door duty delivery paid. IIT Bombay would provide the exemption certificates as applicable.
	16	All other standard accessories.

Following technical details are to be furnished by the supplier along with the offer:

- Environmental requirement (room preparation) for operating the machine including the power requirements.
- Overall dimensions of the equipment including sizes and weight and space requirements
- Other requirements of utilities like dry air, voltage stabilizer, compressed air line, water line etc.
- List of spares required for 3 years of operation of the machine
- The mechanism for rendering after sales service without causing any delay
- The company's policy regarding supply of system software as and when it is upgraded by the manufacturer.
- Commitment for the supply of spare parts in future at least for five years.

Sr. No. 158 /Reference No. : 167 (Revised)

Detailed Description of Item :

Additive subtractive (hybrid) manufacturing system for metals and accessories.

Hybrid Additive-Subractive Manufacturing Technology

	Detailed Technical Specifications for **Additive Module** (Hardware & Software Requirements)	
SL	**Description**	**Specifications**

1	General Features	a) The additive machine should be capable of integrating with a 5 axis vertical milling cnc machine, with the deposition head attached to the spindle. b) The machine should be able to build small to large 3D-parts in metal using metal powders and wires. c) The machine should be able to deposit within a localized inert atmosphere zone to reduce contamination. d)The machine should be able to change material or adjust composition as per programmed instructions. e) Should be capable of additive deposition of alloys of: Ni,Al,Ti,Co,Fe,W & Cu or more.
2	Laser	a) Ytterbium Fiber Laser (Should be from very reputed manufacturer with global presence in multi kilo-Watt power Yb-fiber laser market for more than 10 years). b) Must be a diode laser. c) Maximum laser power: 6 kW. d) Total laser power must be divided into 3 or 6 independent laser source units. e) Wavelength 1070 nm+/-10 nm f) Operating mode: Continuous/Pulse g) Power tunability: 10~100% or better h) Out power instability: < ±2% for 8 hours of continuous operation. i) Should be provided with fiber length of 10 m or longer from laser source to the deposition head.
3	Deposition Head	a) Highly Compact Monolithic Deposition Head. b) Multiple (3 or 6) off-axis independent lasers and on-axis material feeds. c) Must be capable of simultaneous multi-powder (4) and multi-wire (2) deposition. d) Hot wire feed capability (preheating depositing wire/powder) e) Must have provision for diffusion of commonly used inert gases (argon, C02, N2,He) over the meltpool. f) Deposition head must have a protective enclosure against contaminants and lubricants. g) The deposition nozzle should be able to provide continuous flow for all the range of metallic alloys. h) Minimum feature size should be mentioned. Desirable minimum feature size is 800 microns or smaller. A thin wall thickness can be taken as minimum feature size. i) Optics and nozzles should be capable of both fine deposition and bulk deposition. j) Nozzle should be suitable for continuous powder deposition for at least 10 hours without any need to stop.
4	Powder feeders	a) Powder Feeder Type: Rotating disc type b) Feed Rate Control: Option to control feed rate externally as well as via CNC codes. c) There should be option for changing carrier gas flow rate and it should be able to controlled externally or by CNC codes. d) It should have 4 Hopper of 1.5 liter capacity each or more. e) Powder flow rate (mass flow rate): 1 - 30gm/min or more (per hopper) (For Steel or Ni or Ti-6Al-4V alloy)

5	Wire Feeder	a) Must be capable of simultaneous multi-wire (2) deposition and can be changed by programming. b) Hot wire feed capability c) Should be capable of long ? and uninterrupted wire supply. d) Feed rate?
6	User Interface and accessibility	The machine functionality should be accessible by: a) A simple and user friendly interface (touch screen) accessible on the machine. b) A tablet or computer through a local wireless network or via an Ethernet connection. c) Or a Computer connected directly to the machine. d) All functionalities should be controllable by CNC codes (M-codes).
7	Software	a) Custom designed software to allow easy access to process parameters. This should have the following features: # Option for uploading/import of standard CAD files (.stp file format). # There should not be any restriction on file size. # Software should be able to generate sliced layers # Option for user defined build strategy as well as tool path sequencing strategy # Build processor to generate process theme. It should have option to change build parameters and create user defined build strategy and process theme. # Generation of program and AM operation # Software license without any time limit and with all the updates for at least next 3 years. # All Software should be provided in CD/DVD/Pen drive also (As a backup in case of any failure) OR supplied through cloud sharing platforms/websites b) The machine should be capable of being used with commonly used CAM software (MasterCAM, Seimens etc). c) MasterCAM or equivalent Toolpath Generation Software with Additive Manufacturing Plug-in compatible to the quoted machine d) MasterCAM Mill 3D Professional or equivalent Software User Network License. e) MasterCAM University minimum 12-week on-line training subscription. (Mill Designs & Toolpaths) f) ADDITIVE PLUG-IN for MasterCAM Professional or equivalent (compatible to the quoted machine) User Network License g) 2 days on site training for Additive Plug-in Professional (Training may be conducted during System Install) h) Simultaneous 5-axis Mastercam Software (for Siemens 840D Controller or equivalent) i) Simultaneous 5-axis Post Processor j) All Software Maintenance for five years. k) Laser and Deposition parameters (power, feed-rate, pulse frequency (?),composition of final powder, hot wire-feed) should be controlled via CAM CNC codes. l) All Software should be provided in CD/DVD/Pen drive also (As a backup in case of any failure) OR supplied through cloud sharing plat-

		forms/websites
8	Control system	Based on Siemens 840D Controller Interface or HAAS Controller Interface
9	Material Processing Capability	a) The machine should be capable of producing additive parts using wire and powder form the following alloys: # Inconel # Steel and iron alloys # Aluminum alloys # Titanium alloy # Cobalt alloys # Copper alloys # Tungsten alloys b) Submit list of all the suitable materials for which process parameters and build data/parameters will be supplied. It must include SS316, Inconel 718, Inconel 625, Ti-6Al-4V and AlSi10Mg. c) Wire size: commercially available welding wires (0.8mm to 1.2 mm?) d) Powder size: 45um to 90um ? e) Machine should have minimum two wire feeds and 4 powder feeders. f) There should not be any restrictions on use of powders and wires from external sources. Qualification / suitability criteria for the powders and wires should be provided. g) There should not be any restrictions in changing process parameters for process optimization.
10	Material Recipes	Large Volume, Small Volume & Thin Wall Recipes for the above alloy system.
11	Feedback Control system	a) Process control Closed-loop: laser, wire and powder modulation based on process in-situ feedback. b) External input to control the process should be provided.
12	Monitoring devices	a) In-situ temperature monitoring for melt pool. b) Continuous build chamber oxygen monitoring
13	Accessories	a)Wire drum and two k300 spools b)Process chiller: Active water-cooled, process interlocked for - Cooling deposition head - Cooling laser source units c) Laser personnel safety kit (eye-ware, etc) d) Metal Powder safe vacuum cleaners. e) Full Powder sieving (Powder recovery) system should be quoted as optional. f) Powder and Wire storage canisters g) Nitrogen/Argon cylinders

14	Warranty/Guarantee	machine. b)The system must be under guarantee / guarantee for a period of minimum three years (un-conditional warranty) from the date of its satisfactory installation, commissioning, and demonstration against all manufacturing defects. If the system is found to be defective during this period, the whole equipment or part thereof will have to be repaired/replaced by the supplier free of cost to IIT Bombay. During the guarantee / warranty period, the downtime of the equipment will be recorded with the details of date and type of complaint/fault. The vendor should attend it and make the equipment operational within reasonable and stipulated time. The downtime more than the stipulated time after reporting the complaint/fault will be added to calculate cumulative downtime. The guarantee/warranty period will be extended automatically by this cumulative downtime. However, if the items are under guarantee/warranty for a period of more than three years, it may be specifically mentioned in the quotation. In case the supplier fails to rectify the defects and equipment is not put to proper function to our satisfaction, the supplier will replace the whole equipment to our satisfaction or purchase
15	Others	a) CAD models of the Machine to be used with CAM. b) Standard spare kit and tool kit should be provided with the supplied system
16	Pre-Dispatch Inspection	a) IIT BOMBAY selected components have to be built as a part of technical bid. The sample component must be manufactured in the same machine in presence of IIT BOMBAY researchers. The generated sample will be used for technical qualification. Sample will be analyzed for geometrical accuracies, surface roughness and Oxygen content in the build. The generated samples will be bench marked against the sample supplied with the technical bid. The sample quality should be on par with the sample submitted with technical bid. b) Demonstrate the operation of the system as per OEM standards c) Demonstrate functionality of all peripheral equipment and software as per OEM standards d) Demonstrate quality of build in entire build area as per OEM standards e) Certificate of conformance of the machine suiting IIT BOMBAY specification from your quality department need to be produced before dispatch of the machine
17	Installation	a) The offer should include Packaging, System Shipment including insurance from Factory to Airport. b) Installation and commissioning of the machine to be done by the supplier at IIT Bombay and proving out of the machine and demonstration of all the features is to be carried out by the supplier at IIT Bombay c) The layout, pre-installation requirements and foundation drawing of the offered machine and all the peripheral equipment should be enclosed with the Technical offer. d) Installation and set-up of the System includes Travel & Living Expenses.

		e) Installation must include full integration of the additive module with a 5 axis CNC system.
18	Training	Suitable training to enable safe, efficient operation and maintenance of the machine. The training must include: ➢Machine operation, system handling ➢Application development with design and build rules ➢Build optimizations and process knowledge. ➢Detailed software training for basic and advance operations ➢Preventive maintenance training for unscheduled and specialized maintenance requirements, troubleshooting etc ➢Process development using non-standard powders ➢Handling of post-processing equipment for powder recovery and otheraccessories ➢Material development training
19	Inspection	Inspection: a) IITB selected components have to be built on the CNC-Additive system. The sample component must be manufactured in the same machine in presence of IITB personnel. b) Demonstrate the operation of the system as per specification c) Demonstrate functionality of all peripheral equipment and sub-systems as per specifications d) Demonstrate quality of build in entire build area e) Safety compliance f) Demonstration of all the safety interlocks as per International safety standard
20	Safety	a) Entire machine should be as per International / European safety standards (EN ISO12100:2010 and EN60204-1) during entire operation with respect to radiation safety, powder safety, electrical safety, laser safety. b) It should have necessary protective enclosures, all safety accessories and safety interlocks. The Supplier should comply with all Safety features and incorporate all safety for controls and operator while in operation from possible damages and injury. c) Automatic machine shutoff/warnings in the event of malfunctioning beyond pre-set limits. d) X-ray radiation leakage should be well within limits mentioned in international safety standard table 1.0 of AWS C7.1-2004 OR EC Directive 96/29 EurAtom
21	Consumables	SS alloy powder-200kg Inconel powder-200kg Ti alloy powder-200kg Al alloy powder-200kg Cobalt alloy powder-200kg Copper alloy powder-200kg Tungsten alloy powder200kg # All powders should have spherical morphology and Particle Size Distribution (PSD) suitable for usage in the Additive module, and as per the quality standard of the Additive module. # Material data sheet and test report should be enclosed. Ti-6Al-4V and In718 alloy should have certification as Aerospace grade.

		SS alloy wire-200kg Inconel wire-200kg Ti alloy wire-200kg Al alloy wire-200kg Cobalt alloy wire-200kg Copper alloy wire-200kg Tungsten alloy wire-200kg # All wire should be of suitable size for usage in the Additive module, and as per the quality standard of the Additive module. # Material data sheet and test report should be enclosed. Ti-6Al-4V and In718 alloy should have certification as Aerospace grade.	
		Any other consumable/part that needs to be changed in 3 year interval (Nozzle, lubricants, seals, o-rings, oils, etc) ?.	
23	Documentation	The following documents in English Language to be provided to IIT BOMBAY: a) User manual, operation manual and maintenance manual (for mechanical, electrical) of the entire system and sub-systems. b) Maintenance manual- shall cover detailed system configuration with the help of sketches. The safety instructions, maintenance schedule, preventive maintenance schedule with possible errors and troubleshooting to be provided. c) Standard operating procedure (SOP) d) Original software licenses for all the software included in the supply e) Calibration certificates as per OEM standard of all the artifacts. Reference standard used for the same shall be provided to IIT BOMBAY. f) All the data and results of testing of the entire system at manufacturer's site as well as at IIT BOMBAY shall be properly documented and supplied to IIT BOMBAY g) Certificate for general compliance with standard, safety and protection.	
SL No.	**Item**	**Description**	**Quantity**
1	**CNC**	CNC single spindle Universal Machining Centre for 5 Axes Simultaneous machining. The machine should be based upon FEM-optimized, rigid and ribbed cast iron components and a machine base should be made of vibration	
	Specifications		
		No of axis: 5 axis	
		Type: Vertical Machining Center	
		Usage: High speed machining	
		Axis	
		Minimum Travels: 1016 x 635 x 635 mm	
		Maximum Spindle Nose to Platter: 737 mm	
		Minimum Spindle Nose to Platter: 102 mm	
		Spindle	
		Speed: 15,000 RPM	
		Power: 22.4 KW (30HP)	
		Torque: 122 Nm @ 2000 rpm	

	CNC	Inline Direct-Drive	**1 Unit**
		Adequate spindle cooling to be provided.	
		Taper type: HSK-A 63 taper	
		B-axis Tilt	
		Travel: 120 ° to 35- °	
		Max Speed: 170 °/sec	
		C-axis	
		Travel: 360 ° continuous	
		Speed: 179 °/sec	
		Platter/Table	
		Diameter: 635 mm	
		Maximum weight: 454kg	
		Electrical	
		220 VAC or high-voltage transformer (380 - 480 VAC)	
		Early Power-Failure Detection systems	
		Coolant system	
		208 liter Coolant Tank with flowrate: 19.9 L/min @ 2 bar.	
		Software, Interface & Connectivity	
		Ethernet and wireless access should be available	
		Minimum 1 GB of onboard memory for program storage and backup.	
		Wireless and Wired connectivity options for the CNC Control, Remote Monitor	
		Software features that simplify job setup for 4- and 5-axis machining (Dynamic Work Offsets and Tool Center Point Control, Rotary Axis Calibration Tool)	
		Remote Jog Handle with touchscreen display	
		CNC Control System	
		Latest Siemens 840 D/ Heidenhain TNC 640 Control system CNC, NCU ,PLC, PCU & Operating console should be of latest version. Electrical wired up panels to confirm to CE norms and AC panel cooler to be provided. Linear measuring system for axes. 5 axes simultaneous control.	
		Working condition	
		The machine and its accessories should be tropicalized. Permissible ambient temperature range: +15°C to +35°C	
		Probing system	
		Wireless probing System.	
2	**Others**		
		Through-Spindle Coolant system	1 Unit
		Auxiliary Coolant Filter System	1 Unit
		Cabinet cooling system	1 Unit

		Chip Conveyor (Belt-Type Chip Conveyor)	1 Unit
		Enclosure Exhaust	1 Unit
		Wireless Camera	1 Unit
		Expanded Memory	32 Gb
		Spare M Functions	8
		M-code/MFIN Cable es	1 Unit
3	**Accessories**		
		Coolant chiller	1 Unit
		UPS power supply	1 Unit
		Static Voltage Regulator	1 Unit
		Air compressor with Air Dryer	1 Unit
		Clamping Kit T16 M14	1 Set
		Standard Tooling Set HSK63 Milling	1 Set
		HSK63 Tool holder set	1 Set
		Standard Hand Tools Set	1 Set
		Drawer Trolley (HSK63)	1 Unit
		Chip Trolley	1 Unit
4	**Consumables**		
		Coolant Concentrate	3 years worth of consumables
		Spindle Lubrication Oil	3 years worth of consumables
		Liquid Grease for LM guideways lubrication	3 years worth of consumables
		Tool bits	3 years worth of consumables
	Warranty		
		a) The warranty must cover usage of the CNC within laser based additive deposition module. b)The system must be under guarantee / guarantee for a period of one year (un-conditional warranty) from the date of its satisfactory installation, commissioning, and demonstration against all manufacturing defects. In case the supplier fails to rectify the defects and equipment is not put to proper function to our satisfaction, the supplier will replace the whole equipment to our satisfaction or the purchase amount of the equipment will be refunded by supplier to IIT Bombay. In case of breakdown during Guarantee/warranty period, a competent service engineer of the supplier should make as many visits as are required to rectify the problem and replace the faulty parts, without any liability of cost. These should include:	

		- System Online & Telephone Support - Limited Application Online & Telephone Support - Software Updates & System Field Change Orders - One Preventative Maintenance Visit by the manufacturer and four visits by Indian Agent, per annum. -Software maintenance and version updates for 5 years.	
6	**Safety**		
		a) Entire machine should be as per International / European safety standards during entire operation with respect to electrical safety. b) It should have necessary protective enclosures, all safety accessories and safety interlocks. The Supplier should comply with all Safety features and incorporate all safety for controls and operator while in operation from possible damages and injury. c) Automatic machine shutoff/warnings in the event of malfunctioning beyond pre-set limits.	
7	**Installation and Packaging**		
		a) The offer should include Packaging, System Shipment including insurance from Factory to Airport. b) Installation and commissioning of the machine to be done by the supplier at IIT Bombay and proving out of the machine and demonstration of all the features is to be carried out by the supplier at ARCI c) The layout, pre-installation requirements and foundation drawing of the offered machine and all the peripheral equipment should be enclosed with the Technical offer. d) Installation and set-up of the System includes Travel & Living Expenses. The training must include: -Machine operation, system handling -Application development with design and build rules -Build optimizations and process knowledge. -Detailed software training for basic and advance operations -Preventive maintenance, detailed maintenance training for unscheduled and specialized maintenance requirements, troubleshooting etc -Process development using non-standard powders -Handling, operation and maintenance of other	

		subsystems and accessories	
8		Onsite 24x7 service support and application support	3 years

Sr. No. 159 /Reference No. : 168 (Revised)
Detailed Description of Item : Electron Beam Additive Machine :

Technical Specifications for Electron Beam Additive Manufacturing (AM) Machine. The Electron Beam AM system should be based on Powder bed fusion technology. Detailed Specifications are as follows:

1.0 Build Chamber:
1.1 Maximum Build Size (W x D x H): 200 x 200 x 180 mm or more
1.2 Maximum Beam Power: 3000 W or more
1.3 Cathode Type: Single crystalline
1.4 Minimum Beam Diameter: 140µm or lower
1.5 Maximum EB Translation Speed: 8000 m/s or more
1.6 Vacuum Technology: Pumping should be done by rough pump followed by turbopump
1.7 Vacuum Pressure:
i. Column Pressure: 10^{-7} mbar or better
ii. Chamber Pressure: $5x10^{-4}$ mbar or better iii. Build Atmosphere: 4×10^{-3} mbar or better
1.8 Helium consumption during the Build process: 1 liter/h or less
1.9 Helium consumption during Build cooldown: 50 - 75 liters/build cycle or lower
1.10 Maximum processing temperature (Bed Temperature): 850°C or above
1.11 The system should be capable of processing all the standard materials listed below. Process parameters, process data, and process themes/recipes for these standard materials should be provided.
Standard Build materials:
i. Titanium Ti-6Al-4V Grade 5 ii. Titanium Ti-6Al-4V Grade 23

1.12 The EBM system should be able to process these non-standard alloy powders (IIT BOMBAY developed powders or any third-party powders) without affecting the warranty. Required training to create process data or process theme for all the non- standard alloys/ third party alloys should be provided. Any criteria to check the suitability of powder for the Electron beam AM system should be provided. Any restriction on types of powder should be described in detail.

a.	Typical Porosity:	0.2% or lower
b.	Typical Surface Roughness:	Sa value 35µm or
c.	Typical Geometrical Accuracy:	+/-0.4mm or better min
d.	Typical Resolution in Feature thickness:	0.6mm or better

1.13 Build Properties for Ti-6Al-4V:
1.14 Quality of the build should be the same at entire build area as per OEM standards

2.0 Powder Recovery System
Powder recovery systems for Titanium powder. The unmelted powder should be removed from the built components by blasting in a closed chamber. The recovered powder should be usable after sieving. The powder recovery system should have all the operational provisions mentioned above for the efficient recovery of powder. The powder recovery system should include:
i. Powder recovery cabinet including magnetic separator ii. Ti6Al4V blast plate
iii. Small powder barrel of 30L – 1 pc iv. Large powder barrel of 50L – 1

pc v. Powder scoop large vi. Powder scoop
small vii. Brush for powder viii. Wheel for
1x barrel
ix. 60Hz Russel finex sieve with 150-micron mesh x. Ti6Al4V powder for initial clean of machine

4.0 Consumable Pack enough for 2 (two) years of operation. Each pack should include the following items:

Sl. No.	Name	Quantity	Unit
1	Rake blades 280 mm 48pcs	1	each
2	Observe. w glass-coated 10 pcs	1	each
4	Protection foil column 10 pcs	1	each
9	Start plate 210x210	20	each
12	Heatshield 10 sets	2	each

5.0 Site Pack

Site pack should include following items:

Sl No.	Name	Quantity	Unit
1	Thread seal tape	1	each
2	Masking tape	1	each
3	Electric tape	1	each
4	Batteries 4 pack AAA	1	each
5	Diamond sponge, green	1	each
6	Shims kit for build table	1	each
7	Fuse kit for Rack	1	each
8	Oil kit Column Top	1	each
9	Various Screws, nuts and washers	1	each
10	Flat blade connector	2	each
11	O-ring Kit Observation Window	1	each
12	5.5 gauge block	1	each
13	Tube of VAC1 Vacuum Grease	1	each
14	DDL Lamp	1	each
15	Reload tray	1	each
16	Site test equipment	1	each
17	Mechanical Calibration kit	1	each
18	Handle	1	each
19	Locking pliers for grid cup	1	each
20	Tool box complete	1	each
21	HASP Simulation Hardware Key	1	each
22	Calibration plate	1	each
23	Lifting tool HV Unit	1	each

6.0 Vacuum Cleaner

Vacuum cleaner for powder. The vacuum cleaner should be approved by certified agencies for powder safety. Mandatory two units should be supplied, one for the build chamber where the powder is to be recycled and one for waste powder outside the build chamber.

7.0 Water Cooling Chiller
Chiller unit for adequate cooling in EBM
system
Typical Temperature range as supplied chiller specifications: +10°C to
+50°C Humidity: 30-90%
8.0 Software:
Term Software includes slicing software, build processor, and machine control & operation. The software should be able to convert files to STL, repair errors, edits designs, and prepares them for the build platform. Modules for support generation and to create
lightweight structure, lattice structure or functional surfaces should be also included. This should have the following, among others:
a. Option for uploading/import of standard CAD files (.stp file
format). b. There should not be any restriction on file size. c. Software should be able to generate sliced layers
d. Build processor to generate process theme. It should have the option to
change build parameters and create a user-defined build strategy and process theme.
e. Generation of the program and AM operation
f. Software license without any time limit and with all the updates for at least the next 3 years
g. Software should be provided in CD/DVD/Pen drive also (As a backup in case of any failure) OR supplied through cloud sharing platforms/websites

9.0 Materials:
Listed materials with the mentioned quantity should be supplied.
i. Ti-6Al-4V alloy Grade 5 - 100 kg
ii. Ti-6Al-4V ELI alloy Grade 23 - 100 kg
9.1 All powders should have a spherical morphology and Particle Size Distribution (PSD) should be 45-106µm. Supplied material should be suitable for the EBM system as per the quality standard of the EBM system and powders should be suitable to provide build quality specified in the specifications.
9.2 Material data sheet and test report should be enclosed. Ti-6Al-4V alloy should have certification as Aerospace grade. Ti-6Al-4V ELI alloy should have certification as Biomedical grade

10.0 Safety:
10.1 Entire machine should be as per International / European safety standards (EN ISO 12100:2010 and EN60204-1) during the entire operation with respect to radiation safety, powder safety, and electrical safety. It should have necessary protective enclosures, all safety accessories, and safety interlocks. The Supplier should comply with all Safety features and incorporate all safety for controls and operators while in operation from possible damages and injury. Automatic machine shutoff/warnings in the event of malfunctioning beyond pre-set limits.
10.2 X-ray radiation leakage should be well within limits mentioned in international safety standard table 1.0 of AWS C7.1-2004 OR EC Directive 96/29 EurAtom
11.0 Pre dispatch inspection:
11.1 IIT BOMBAY selected components have to be built and submitted as a part of the Technical bid. The generated sample will be used for technical qualification. The samples will be analyzed for geometrical accuracies, surface roughness, and Oxygen content in the build. The sample quality should be on par with the criteria mentioned in section 1.13.

11.1 IIT Bombay researchers shall be witnessing the finished factory acceptance test before the machine is dispatched. As part of the pre-dispatch inspection, supplier shall submit evidence to the build quality and machine capabilities referred in section 1.13

12.0 Installation and commissioning:
12.1 Installation and commissioning of the machine to be done by the supplier at IIT BOMBAY and proving out of the machine and demonstration of all the features is to be carried out by the supplier at IIT BOMBAY
12.2 The layout, pre-installation requirements of the offered machine, and all the peripheral equipment should be provided
12.3 Installation and set-up of the System includes Travel & Living Expenses.

13.0 Inspection:
All the activities mentioned in the Pre-dispatched inspection must be repeated during commissioning.
13 Supplier to demonstrated build as discussed in pre-dispatch inspection as per OEM standards. The sample component must be manufactured in the same machine in presence of IIT BOMBAY researchers. The generated sample will be used for technical qualification. The sample will be analyzed for geometrical accuracies, surface roughness, and Oxygen content in the build. The generated samples will be benchmarked against the sample supplied with the technical bid. The sample quality should be on par with the sample submitted with the technical bid and criteria mentioned in section 1.13.
13.2 Demonstrate the operation of the system as per OEM standards
13.3 Demonstrate functionality of all peripheral equipment as per OEM standards
13.4 Demonstrate the quality of build in the entire build area as per OEM standards
13.5 Safety compliance
13.6 Demonstration of all the safety interlocks as per International safety standard

14.0 Training:
Suitable training to enable safe, efficient operation and maintenance of the machine. The training must include:

➢Machine operation, system handling

➢Application development with design and build rules
➢Build optimizations and process knowledge.
➢Detailed software training for basic and advance operations
➢Preventive maintenance training for unscheduled and specialized maintenance requirements, troubleshooting, etc
➢Process development using non-standard powders
➢Handling of post-processing equipment for powder recovery and other accessories
➢Non-standard alloy Material development training

15. Documentation:
The following documents in the English Language to be provided to IIT BOMBAY:
15.1 User manual, operation manual, and maintenance manual (for mechanical, electrical) of the entire system and sub-systems.
15.2 Maintenance manual- shall cover detailed system configuration with the help of sketches. The safety instructions, maintenance schedule, preventive maintenance schedule with possible errors, and troubleshooting to be provided.
15.3 Standard operating procedure (SOP)

15.4 Original software licenses for all the software included in the supply
15.5 Calibration certificates as per the OEM standard of all the artifacts. The reference standard used for the same shall be provided to IIT BOMBAY.
15.6 All the data and results of testing of the entire system at manufacturer's site as well as at IIT BOMBAY shall be properly documented and supplied to IIT BOMBAY
15.7 Certificate for general compliance with standard, safety, and protection

Sr. No. 160 /Reference No. : 169
Detailed Description of Item :
High-frequency Fatigue system and accessories.

DEPARTMENT OF MECHANICAL ENGINEERING

Technical specification of All-Electric Axial-Torsional Static cum Fatigue UTM with Software

1. Frame	The load frame shall be designed for axial and torsion tests under static and dynamic conditions. The controller shall have the capability to run a dedicated single load frame The load frame must have enough working space for specimen and fixture to accommodate different attachments including bio- chamber/environmental chamber. The loading frame must be equipped with locking mechanism to hold the crosshead in place and it must be indicated The controller must prevent the operation of the pneumatic grips while a test is running or it is under load or strain control. The load frame must feature a frame-mounted Hand set with coarse and fine actuator position adjustment for both linear and rotation axes The Hand set shall control the actuator positioning during specimen loading and removal The load frame shall be configured to allow operation with non- contact strain measurement devices. The frame may be equipped with status indicators enabling current frame status to be visually observed from a distance. The load frame should have integral, corrosion resistant T-slot table attachment of fixturings

	1	The load frame shall feature an integrated linear and rotary fatigue rated electro-dynamic actuators, both mounted in the test frames upper, movable crosshead. Systems with actuator mounted in the test frame base are notacceptable.
	2	The actuator shall be powered electrically, without any requirement for a hydraulic oil supply, compressed air, or water supply for power or forcooling.
	3	The system shall use a linear electric DC servomotor driven actuator. Hydraulic, pneumatic or rotary motor and linear screw driven actuators are notacceptable.
	4	The system shall be supplied with an integrated linear and rotary forcetransducer
	5	The actuator shall have a dynamic rating of at least ±12kNor
		more, fatigue rated for testing in tensile, compressive modes.
	17	The actuator shall have a continuous static rating of at least ±8kN ormore.
	18	The rotary actuator should have a dynamic rating of ±120Nm or More
	19	The rotary actuator should have a static rating of ±80Nm ormore
	20	The dynamic performance under both axial and torsion condition would be 100 Hz.
	21	The actuator must feature bearings able to resist off-centreloads. The should be rated at full linear load with a 50mm off-centre (eccentric) High Stiffness frame
	22	The linear actuator shall have a minimum of 70 mm total stroke (±35mm) orhigher.
	23	The rotary actuator shall have standard options to eitherrotate ±135 degree or more and in multi turn mode giving +/-20 revolutions or more Continuous rotation - 0.001 rpm to 100 rpm
	24	There shall be a mechanical stop option to halt actuator motion automatically on power loss to ensure specimen safety. Systems which either allows the actuator to fall to the end of its stroke or self-centre to mid stroke on power loss are notacceptable.
	25	The linear optical encoder shall have a resolution of at least0.5µm or better on the linear axis
	26	The rotary actuator shall be equipped with an optical, absolute rotary encoder for rotary positioncontrol.
	27	The rotary optical encoder shall have a resolution of atleast 0.5 seconds or better.
	19	The system should provide a method for break detection which should end the test without causing the system to become unstable.
	20	The actuator is capable of producing full force requiredanywhere along the length of itsstroke.
	21	The load cell must have a minimum 200 % or more overload capacity without mechanicaldamage.
	22	The load cell shall be verified according to recog-

	nized national standards to 0.5% or betterlinearity. 23 Non-linearity, Hysteresis and Repeatability of the load cell are required to be met as per ASTMstandards 24 Accuracy of loading: 1% of indicated load and it should meet the ISO/ASTM standard calibrationstandards
	23 The calibration check of the load cell will occur on customer site as part of installation and also in thefactory. **24** System should be compatible with lower force load cells. These load cells should directly connect to the actuator orbase. **25** The system should have the maximum velocity upto 500mm/sec **26** The system should have controlled unloadingoption

3. Electronic Controller	**3**	Data resolution must be up to 24-bit for all channels across the full scale of all transducers (i.e. no ranging) and at least 19-bit (1 part in 524,288) at a 1kHzbandwidth.
	4	Fully digital closed loop control system isrequired.
	5	Communication between controller and computer to be by means of an industry standard extra-high speed interface such as Gigabit Ethernet
	6	The position/rotation, load/torque, and optional channel(e.g. strain) should be available for control and dataacquisition.
	7	The controller should include a waveform generator with a resolution of 32 bit for enhanced waveform fidelity and a frequency range of 0.1mHz to 100 Hz. It should support the following waveform types: Sine, Triangle, Square,Haversine,, Ramp, and Random
	8	Data acquisition for all channels must be included and must feature 19 bit resolution, with a minimum of 1kHz bandwidth, across the full range of thetransducer.
	9	the controller must have at leastone analogue input for an nalogue waveform drive signal and at least two assignable analogue outputs.
	10	The control system must support, and the relevant software ackages should be available to enable, the user to write and run heir own applicationpackages
	11	All transducers shall be automatically recognized by thecontroller.
	12	The controller must prevent any test proceeding with an uncalibrated transducer to prevent incorrect data beinggathered.
	13	The controller must have a minimum of two limit detectors per connected transducer and must have a detection time of 1ms or better.
	14	The controller must incorporate a watchdog protocol to detect loss of communication with the personal computer. In the event of any communications loss, the controller must stop testing and revertto a safe state.

	13 The control system must include an auto tuning function for linear/rotary channels. This function shouldautomatically determine load string stiffness based on a singular tuning value to optimise the control loop for a particular specimen. Systems which rely solely on manual tuning are not acceptable. 14 Tuning should be able to be performed in either Load OR Position Control. 15 A single tuning method should optimise tuning values for all controllable channels on the sameaxis. 16 The system must feature a digital control system capable of controlling actuator in position/rotation, load/torque, and strain modes. 17 Full range calibration shall be provided for each transducer (system load cell and displacementencoder) 18 Each calibration for every transducer shall be traceable to the National Institute of Standards and Technology (NIST). A certificate shall be provided for each transducerrange 19 Each transducer conditioner shall also have a shuntcalibration.This will allow for calibration to be verified.
4. Software & PC Hardware	**4** Personal computer with latest features to run the experiments and analyze the data is required. It shall utilise the Windows operating system and must feature a 22-inch LCD flat panelmonitor. **5** The system should have software as standard with the system for different testing including dynamic testing, Low Cycle Fatigue, Static testing and Fracture mechanicsstudies. **6** The PC user interface should indicate the teststatus, **7** Standard data acquisition module will beprovided **8** The system must have the capability to program by theoperator for real time control of thesystem **9** The main user interface for the system shall be through a personal computer and utilize a windowed user interface and it is integrated with control system and software interface. **10** The control system must include an auto tuning function for linear/rotary channels. This function should automatically determine load string stiffness based on a singular tuning valueto optimise the control loop for a particular specimen. Systems which rely solely on manual tuning are notacceptable. **11** Required software with free updates and advancedcontrol systems during warranty period.
5.Accessories	a. Fatigue Rated pneumatic/mechanical Wedge-Action Grips. Maximum dynamic loading under tensile, and torsion testingFixtures should hold the flat and round Specimen size,Usable within the environmental chamber temperature range (upto 200 ° C)

	If pneumatic option is provided, suitable air supply requirements If pneumatic option is provided, suitable air supply requirements are to be supplied Grips must be designed for tensile and fatigue testing of metals, plastics, composites, and others and the gripping force must not deform the test samples at the grip d. Fatigue Rated 3 Point BendFixture Maximum Dynamic loading Capacity, With 10mm or better Diameter Rollers. Adjustable span length varied from 24 to 140 mm or better Maximum specimen width is 50mm or better Usable within the temperature range of -80 ° C to 125 ° C or better e. BioChamber fatigue studies as per ASTM standards within the given minimum volume 1 lit Axial loading of 2kN or better Suitable to work with all kinds of biological fluids both synthetic and natural Temperature monitoring kit and recirculation unit f. Power requirements 200-230 V 1 Phase AC 50 Hz
6	Power req 200-230 V 1 Phase AC 50 Hz
7. Supplier Experience	The supplier should prove their knowledge of electric direct-drive linear motor technology and reliability of their product by demonstrating at least 5 years of experience and at least 10 references sites worldwide . The equipment should be proven in a variety of academic / research applications. Service must have accessible through telephone number, email support and service engineer within country Vendors must provide a detailed site preparation guide which includes all the required facilities, space, power supply, humidity and others.
8.OPTIONAL ITEMS:	9.Any additional fixtures required for tensile test of round & flat samples, compression, shear and flexural tests for room temperature studies, environmental studies andbiochamber 10. List of any other requirements for sitepreparation 11. Use of existing MTS Video extensometer for static strain measurement integrated with operatingsoftware** 12. Use of the existing MTS Dynamic contact type Extensometer for direct strain measurement should be possible** Installation The installation will include on-site training on the use and operation of the system. A complete set of on-line operation and maintenance manuals in English shall be provided with the system

	• Up gradation on software, if any, should be available at Freeof • cost duringwarranty • Installation and training are mandatory by factory trainedEngineer(s) • 2 years warranty for all parts includingaccessoriessupplied from the date of supply

****** Details of the existing MTS make Accessories which are available with IIT Bombay which should be able to use with the proposed Axial Torsional test system with the specified accuracies . Tenderer has to integrate , demonstrate & calibrate (if applicable) these accessories with suitable Hardware / software required if any.

If these existing accessories are not compatible then tenderer has to quote these accessories with required softwares .

The operating temp of these accessories is -70 Deg C to +150 Deg C

Extensometers should be capable of meeting Class B-1/B-2 (as per ASTM E-83) &/ or Class 0.5 (as per ISO 9513)

Sr No	**Model**		
11	Model 632.02F-23 Model 632.02F-23Crack Opening Displacement gauge	Gauge length (GL) – 5.00 mm, Travel +3.00/-1.00 mm with TEDS/ Auto recognition	
2	Model 632.03F-23 Model 632.03F-23 Crack Opening Displacement gauge	GL – 12.00 mm, Travel +4.00 mm with TEDS/ Auto recognition	
3	Model 634.12F-55 Axial Extensometer	GL – 25.00 mm, Travel +12.5 mm with TEDS/ Auto recognition	
4	Model 634.31F-25 Axial Extensometer (with various GL) Model 634.31F-25	GL 10,15,20,25,30,35,40,45,50 GL 10,15,20,25,30,35,40,45,50 mm Travel -2 / +4 mm with TEDS/ Auto recognition	

5	Video Extensometer	• Gage Length: 10 mm / Max Tensile Strain:600% • Gage Length: 25 mm / Max Tensile Strain:200% • Gage Length: 50 mm / Max Tensile Strain:60% • Maximum TransverseGage Length (mm): 22mm • Typical ExtensionResolution (µm): 0.3µm • Minimum Specimen Widthfor Axial measurements (mm): 2.3 mm • Minimum Specimen Width for Transverse Measurements:6.4 mm • Maximum Data TrackingSpeed (mm/minute) (@15 Hz): 2500 mm/minute • Includes calibrationvalidation blocks, calibration file, and specimen markingkit	
6	Model 632.80F-04 Axial Torsional Extensometer	Simultaneous measurement and control of axial and angular strain. - Temperature range: -100 to150 °C (-150 to 300 °F) - Averages axial output fromtwo sides of specimen. - Linearity: 0.5%F.S. - Hysteresis: <0.3%F.S. - Crosstalk: <1.0%F.S. - Frequency: 10 Hzmaximum. - 25 mm (1 in) gagelength - Accommodatesspecimen diameters of 10mm, 12.5mm and 25 mm. --angular travel. - +1.20/-0.50 mm) axial travel. With TEDS/ Auto recognition capability	No photo available

7	Fracture Mechanics Clevis Grips; Model 640.20C-03,	• Specimen Width: 25.4 mm (1 in) • PIN Diameter: 12.2 mm (0.48 in) • Mounting: Threaded, M27x 2 mm (1"- 14) • 30 kN Dynamic Forcecapacity	

Sr. No. 161 /Reference No. : 170

Detailed Description of Item:

Transient Absorption Spectrometer System Technical Specifications:

- Fully automated system for transient absorption measurements in nanosecond , microsecond and millisecond time domain
- 200-800 nm Spectral range with appropriate optics and opto-mechanics
- Coupling optics for external Nd:YAG laser (not-required) for second (532 nm), third (355 nm) and fourth (266 nm) harmonics for sample excitation
- High-intensity pulsed 450W Xenon lamp
- Sample chamber with excitation and probe light delivery optics
- Sample holder for standard liquid sample cells, solid samples and thin films
- Monochromator type: Czerny-Turner with Triple Grating Turret (100-200 mm focal length) with ruled grating (1800 groves/mm); Slits 0.1nm to 4 mm (continuously adjustable), Spectral resolution: 0.1-7 nm.
- Detector type: Photomultiplier with 5 stage dynode chain for high current linearity
- Warranty 1 Year

Sr. No. 162 /Reference No. : 171

Detailed Description of Item:

Technical Specifications for Stopped Flow Spectrometer :

An upgradable, automated, double mixing stopped flow spectrometer with configuration for optical modes like absorbance and fluorescence measurements for rapid kinetics applications.

Equipped with independent stepping motors to drive the syringes, motorized monochromator and automatic concentration studies possible by setting a series of concentration in software with an expected dead time < 1ms.

Detailed Minimum expected specifications described as below

Spectrometer Specifications:

Spectrometer	Dedicated Stand Alone Spectrometer with Motorized Monochromator for Absorbance and Fluorescence Measurements Capabilities
Excitation Wavelength range	200-800 nm or better
Wavelength Accuracy	±0.5 nm or better
Light Source	Xe Lamp and XeHg lamp Standard both (one for scanning and one for single wavelength respectively)
Detector	Photomultiplier tube
Sampling rate	10 µs to 1000s
Detection Modes	Absorbance, Fluorescence and 90°light scattering
Detection Channel	Suitable detection Channel to measure absorbance and fluorescence. Future Upgradation of additional Detection Channels Should be available
Number of detection windows	3

Emission Fluorescence with Cut-off filters	One set of 220nm (standard) with spacers/adaptors Additional set of 550 nm should be quoted in main offer
Cuvette	One set of Standard 0.8mm to 2mm path length with dead time <1.2ms
Micro Cuvette Accessory	Additional Micro Cuvette with 1mm to 10mm path length with dead time <0.7ms
Double Mixing Stopped Flow Specifications:	
Number of syringes	3
Syringe Volume	2ml to 10ml Standard
Syringe material	PEEK / Glass
Mixing	Single and Double Mixing Capabilities
Number of mixers	2 Independent T-Mixers/Ball Mixers
Number of Drive Mechanisms/Motors	3 (Independent)
Precision of Drive Mechanisms /Motors	<11 nl per step or better
Sample consumption	Priming volume <100 µl per syringe or better
Mixing ratio	variable from 1:1 to 1:100 with possibility to do all asym-metric ratio

Minimum injection volume	<25 µl or better
Compatibility	Syringes and Cuvettes and all internal parts should be compatible to 100% solvents operations
Anaerobic operation	Loading ports for Anaerobic operations should be provided for each syringes
Data Acquisition and Software Control :	
Software	Suitable Windows Operating System based Data Acquisition software for operation of the instrument. Controlled parameters like loading, Delivery, mixing, flow rate control, data acquisition and data collection should be possible. Single Mixing, Multi-mixing Experiment Protocols. Automatic concentration studies possible by setting a series of concentration in the software. Aging experiments Provision in the software to show estimated dead time value in an experiment. Data processing analysis should be available like Global Fitting. Provisions for data merging and exporting data to text/excel format. Two Copies of Licensed Version Data Acquisition Software should be provided. One copy of User manual should be provided.
Warranty	Standard for One year on electronics and 3 years on Drive Mechanisms for Trouble free operations.
Installation	Installation, Training and Demo on Site for at least Three days. Application Support should be available for consecutive Two Years after the installation (online/offline)
Desktop Computer	Branded Desktop Computer i5, 4GB RAM, 1TB HDD, LED Monitor, Keyboard Mouse and Genuine Windows 10 OS

Necessary *Accessories:*	All necessary accessories should be supplied with the instrument as a package including necessary cables, power cables, modules, kits, tubing, adapters, etc. for complete functioning of the equipment on site

Sr. No. 163 /Reference No. : 172
Detailed Description of Item:

Technical Specifications for Advanced Multi Mode Micro plate Reader Spectrometer :	
Advanced high performance Multimode micro plate reader for measurement of Fluorescence, FP, Luminescence, UV-Vis absorbance and onsite upgradable to and other detection modes	
Detection Modes	Fluorescence Intensity & FRET Luminescence UV/Vis Absorbance with Spectral Scanning Fluorescence Polarization / Anisotropy Should be possible to Upgrade for following modes: • TRF & TR-FRET • Laser based Alpha Screen / Alpha LISA / AlphaPlex • Atmospheric Gas Control Unit for O2/Co2 • 2x Built-in reagent injectors for time critical assays • Low volume (2ul) DNA/RNA measurements using additional adapter
Measurement Modes	Top and Bottom reading Endpoint and Kinetic measurements Spectral Scanning (both in Fluorescence and Luminescence) Well Scanning
Micro plate Formats	6- to 1536-well plates
Shaking	Linear, orbital, and double-orbital with user-definable time and speed
Incubation	+4°C above ambient to 45°C

Read Times	10 sec for 96 well plate & 20 sec for 384 well plate
Focal Height Adjustment	Automated focal height adjustment for optimal position of detector
Fluorescence Intensity, FRET & TRF, TR-FRET Measurement Mode:	
Light Source	High energy xenon flash lamp
Detector	Low noise Photomultiplier Tube (PMT)
Wavelength range	320 – 740 nm (for Monochromator) & 240 – 740nm for filters
Wavelength Selection	LVF Monochromator / Quad Monochromator based & also band pass filters for high sensitivity assays. True Hybrid technology allowing to choose either Monochromators and/or Filters vice versa in any combination for excitation & emission wavelength selection
Dichroic Mirror	Auto-tuning / user selectable Spectral Range: 340 - 740 nm
Bandwidth	User selectable in the range 8 – 80nm
Spectral Scanning	Fluorescence Excitation / Emission Spectral Scanning
Optical Filters	TRF, TR-FRET, FP should be possible to do by specific filters. At least 4 excitation filters, 4 emission filters, and 3 dichroic mirrors

Sensitivity	Top: < 0.5 pM fluorescein, 384 well plate Bottom: < 1.0 pM fluorescein, 384 well plate FP: < 1 mP SD at 1 nM fluorescein, 384 well plate TRF: < 50 fM Europium, 384 well plate HTRF: > 880 % Delta F for High Calibrator &> 30 % Delta F for Low Calibrator
Gain	Auto gain / Auto focus for each well
Luminescence Measurement Mode:	
Detector	Low noise Photomultiplier Tubes
Wavelength range	320 – 740nm (for Monochromator) & 240 – 740nm for filters
Spectral Scanning	Luminescence Emission Spectral Scanning
Sensitivity	< 10 amol/well of ATP
Dynamic range	8 Logs
Absorbance Measurement Mode :	
Wavelength range	230 – 1000nm
Wavelength Selection	Spectrometer based
Detector	CCD Array / Photodiode

Accuracy	< 1% at 2 OD
Dynamic Range	0 - 4 OD
Scan Speed	Capture a full UV / Vis absorbance spectrum (220 to 1000 nm) in less than 8 second per well
Data Acquisition and Software Control :	
Software	License free Multi-user software package including Reader Control and Data Analysis Software Data Statistics, User defined Formulas, Signal Curve Analysis, Standard Curve with various fit types PARALLEL LINE ASSAY analysis should be included. FDA 21 CFR Part 11 compliant
Device Control / in-terface	Should be supplied with desktop i3 Processor, 4GB RAM, 1TB Hard drive, 18" Monitor, Keyboard, Mouse, (Windows 10)
	Instrument should come with one year warranty

Sr. No. 164 / Reference No. : 173 (Revised)
Technical Specification for: Wedge type Heat Sealing Machine

A Wedge Type Welding machine with mandatory following features

1. Welding Width: 8mm-60 mm
2. Variable Speed, Minimum – 0.1 m/min, Maximum 30 m/min
3. Automatic Temperature Control (Max 650 degrees Celsius)
4. Digitally Regulated Temperature, Roller Pressure and Sealing Speed.
5. Onboard Digital Touchscreen to change Parameters
6. Machine Heating time should be less than 5 seconds.
7. Machine should be ready within 60 seconds of turning on the main switch.
8. Adjustable speed during welding process.

9. Easy Roller and Wedge Calibration.
10. Up to 50% speed difference between Top and Bottom roller for curvature welding.

BMaterials to Join

1. Metallised-PET, LLDPE, LDPE, HDPE, PVC, Mylar, Polyvinyl chloride (PVC), Polyurethane (PU), Polyethylene (PE), and
2. Polypropylene (PP)
3. All above Material thickness-(0.1- 2 mm) and (10-1500 GSM)

c.Weld Type

1. Butt joint, Lap joint, Curvature Joint, Tubular Joints

D Machine Accessories Needed

- 8mm 3D Wedge Bracket Set x 1 unit
- 13 mm 3D Wedge Bracket Set x 1 Unit
- 25 mm 3D Wedge Bracket Set x 1 Unit
- 8 mm Silicone Roller with Hardness 30,50 and 70 Shore.
- 13 mm Silicone Roller with Hardness 30,50 and 70 Shore.
- 25 mm Silicone Roller with Hardness 30,50 and 70 Shore.
- Steel Roller with Knurling (8 mm, 13 mm and 25mm) x 1 set each
- Steel Roller with Flat (8 mm, 13 mm and 25mm) x 1 set each
- Tape Delivery System based attachment for Easier Butt joint x 1 Unit
- Quick Arm x 1 Unit
- Adjustable Overlap Guide (0-64 mm) x 1 unit
- Adjustable Hem/Piping Guide (0-60 mm) x 1 unit
- Open Hem Guide up to 110 mm x 1 unit
- Modular 3D Guide with Holder System
- Overlap Guide for Quick arm x 1 unit
- Connection adaptor for fume extraction x 1 unit