



**TENDER DOCUMENTS**

**MECHANICAL LAB EQUIPMENT**

**NUTECH/SCM/Mech Lab-2019/TD-066**

# NATIONAL UNIVERSITY OF TECHNOLOGY

## TENDER NOTICE

**National University of Technology (NUTECH)**

**NUTECH/SCM/Mech Lab-2019/TD-066**

Sealed bids are invited from Government / FBR Registered Firms for the procurement of Mech laboratory equipment for NUTECH Technology Labs.

1. Tender documents containing terms & conditions and detailed specifications of items can be downloaded from NUTECH website "<https://nutech.edu.pk/d-p.php>" w.e.f **06 May 2019**.
2. Quotations shall be submitted as per requirement of the tender documents.
3. Bidders will be required to submit bank draft/PO equal to 5% of quoted value as Bid Bond in favor of National University of Technology (NUTECH).
4. Sealed bids with detailed specification should reach on the following address latest by **0830 hours on 23 May 2019**. Late submission will not be entertained.
5. Bids will be opened at **0900 hours on 23 May 2019** at SCM Office.
6. Project is to be completed in 60 days from the date of award of contract.
7. Submit Rs 1500/- as Tender fee in favour of NUTECH HBL account: **NUTECH Tendering and contracts, 5037-7000210755**. Please attach bank receipt with technical offer. Offers will not be entertained without payment of processing fee.

**Deputy Director (Supply Chain Management Office)**  
**NATIONAL UNIVERSITY OF TECHNOLOGY (NUTECH) UPROAD, SECI-12,**  
**ISLAMABAD**  
**Tel: 0092-51-5476768, Ext :178**



**NATIONAL UNIVERSITY OF TECHNOLOGY**  
**SUPPLY CHAIN MANAGEMENT OFFICE**

**INVITATION TO TENDER**

**Submission Date/Time** 23 May 2019 at 0830 hours

1. NUTECH desires to procure the list of item(s)/Store(s) as per **Annexure-A**. Interested bidders are requested to send their bids through courier or deliver at NUTECH under two separate sealed envelopes (placed together in third envelope), marked clearly, "Technical Offer" and "Commercial Offer", respectively to the undersigned, latest by or before above mentioned due date. If due to any unforeseen circumstances, NUTECH establishment remains closed, then the last date of submission will be extended to next working day.
2. Please also note that Technical Offer should contain Annexes-A & B duly filled in (supported with relevant technical literature /details/ catalogues etc) and receipt of tender processing fee. Commercial Offer will contain Annexure- C and bid bond. Please ensure no space is left blank in the annexes.
3. Following must be noted for this IT (Invitation to Tender):-
  - a. 2 x copies of technical offer are to be provided.
  - b. Annexes A, B and C must be signed and stamped, Attach only relevant documents.
  - c. Please complete all document as per given format. Do not use any other format or letter head. Offer may be rejected if given format is not followed.
  - d. Validity of offer will be 90 days.
  - e. Delivery period will be 60 days after the date of award of contract.
  - f. Tender(s) must be accompanied with a Bid Bond in agreement of faithful compliance of the conditions of Contract/Purchase Order. This amount will be equivalent to 5% of the total quoted value. In case of non-acceptance of any offer, the Bid Bond will be returned to the bidder by fastest possible means. The Bid Bond amount submitted by the successful bidder will however, be refunded on effective termination of Contract/ Purchase Order. (The Bid Bond will be forfeited in case of default by the bidder from his commitments made through his offer). Submission of Bid Bond is mandatory, otherwise your offer will be rejected.
  - g. 2 years warranty against 5% bank guarantee will be required from the successful bidders

from the date of commissioning.

h. Rates should be quoted on Free Delivery basis at NUTECH Islamabad.

4. We reserve the rights to accept or reject any or all tenders as a whole or in part without assigning any reason whatsoever. The decision in this regard will be firm, final and binding on all bidders.

DD (Supply Chain Management)



**NATIONAL UNIVERSITY OF TECHNOLOGY**  
**SUPPLY CHAIN MANGEMENT OFFICE**  
**TECHNICAL OFFER**

**Annex A**

User Reference No **Mech Lab Eqpt-004**      Date: **02-05-2019**

**Technical Specification**

Ser	Part No	Item Name/Size	Specification	A/U	Country of Origin	Qty Req	Bidder Compliance			Tech Scrutiny to be done by user	
							Yes	No	Alternate Offer	Accepted	Rejected
										Reason of Rejection	
1.		<b>Vibrations Trainer with DAQ</b>	Vibration trainer with experiments on damping, resonance, dual-mass system and vibration absorption 6 pendulum oscillators 2 bar-type oscillators 1 spring-mass oscillator Electrical imbalance exciter control unit for the imbalance exciter with a digital frequency display and a TTL output for triggering external devices Tune able absorber with a leaf spring adjustable oil damper Electrically operated drum recorder for recording free vibrations Polar chart recorder for determining the amplitude and phase of forced vibrations	Nos	North America, Europe, Japan	1					

			<p>Technical data          Beam, rigid: LxWxH:          700x25x12mm, 1.6kg          Beam, elastic: LxWxH:          700x25x4mm, 0.6kg          Tension-pressure springs          0.75N/mm          1.5N/mm          3.0N/mm          Imbalance exciter          0 to 50Hz          100cmg          Oil damper: 5 to 15Ns/m          Absorber leaf spring: -          WxH: 20x1.5mm          total mass: approx. 1.1kg          Tune able: 5 to 50Hz          Drum recorder: - 20mm/s, width          100mm          Polar chart recorder: - Ø          100mm  <b>Experimental Capabilities: -</b>          Experiments with            a. Pendulums            b. Spring-mass system            c. Bar-type oscillator            d. Undamped oscillation            e. Damped oscillation            f. Forced vibration            g. Damped and un damped            resonance            h. Absorber effect in multi-            mass oscillators.</p>							
2.		<b>Moment of Inertia with DAQ</b>	<p>Rotating bar          Length: 550mm          Masses: 2x 0.1kg, 2x 0.2kg, 2x          0.4kg</p>	Nos	North America, Europe, Japan	1				

			<p>Solid cylinder Diameter: 120mm Mass: 0.9kg Hollow cylinder Outer diameter: 120mm Inner diameter: 110mm Mass: 0.9kg Weight for the drive 1N <b>Experimental Capabilities:</b> - Investigation of the inertia of various bodies in rotational motion hollow cylinder, solid cylinder or rotating bar with masses as a rotating body.</p>						
3.		<b>Transducers, Instrumentation &amp; Control Teaching Set with DAQ</b>	<p>Input Transducers: Carbon track. Wire wound &amp; precision rotary potentiometers. Slide potentiometers. NTC thermistors. Type 'K' thermocouples. I.C. temperature sensor. Photoconductive cell. Photovoltaic cell. Phototransistor. PIN diode. Linear variable differential transformer. Linear variable capacitor. Strain gauge. Air-flow sensor. Air pressure sensor. Slotted opto-sensor. Reflective opto-sensor. Inductive Proximity Sensor. Hall Effect sensor. Precision servo-potentiometer. Tachogenerator. Humidity sensor. Dynamic microphone. Ultrasonic receiver. Output Devices: Heater. Filament</p>	Nos	North America, Europe, Japan	1			

			<p>Lamp. DC Motor. Solenoid Air Valve. Ultrasonic transmitter. Buzzer. Loudspeaker. Relay. Solenoid. Counter/timer unit with LED display. Bar graph voltage indicator. Analog 10V center-zero meter. Signal Conditioning Circuits: Buffers. Inverters. Comparator with switchable hysteresis. Amplifiers with gain and offset control. Current amplifier. Summing amplifier. Differential amplifier. Instrumentation amplifiers. AC amplifier. Oscillator 40kHz. Filter 40kHz. Low-pass filter with switchable time constant. Precision full-wave rectifier. Sample and hold circuit. Integrator with switchable time constant. Differentiator with switchable time constant. V/F and F/V converters. V/I and I/V converters. Alarm oscillator with switchable latching. Power amplifier. Electronic switch. Internal Power Supplies: -5V, +5V 1A precision supply. -12V, +12V 1A regulated supply. Pneumatic Supply: Internal Pneumatic pump. D.C. motor, tachogenerator, slotted and reflective opto-sensors for incremental and absolute position, and a 360 degree precision potentiometer with</p>							
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			<p>indicator dial for closed-loop position control experiments. System Includes: Trainer. Accessory and Lead Kit. Mains Lead. Curriculum Manual. Student Manual. Instructors Manual. Technical Manual. All Manuals in PDF Format on CDROM. Function Generator. Auto-ranging Digital Millimeter (Qty: 2). Digital Storage Oscilloscope.</p>							
4.		<p><b>Methods to determine the elastic line</b>  <b>Mohrs Analogy with DAQ</b></p>	<p>Beam Length: 1000 mm  cross-section: 20x4mm  material: steel  Weights  7x 1N (hanger)  28x 1N  21x 5N  Measuring ranges  force: <math>\pm 50\text{N}</math>, graduation: 1N  travel: 0 to 20mm, graduation: 0.01mm  <b>Experimental Capabilities: -</b></p> <ol style="list-style-type: none"> <li>a. Elastic lines for statically determinate or indeterminate beams under load</li> <li>b. Determination of the elastic line of a beam by the principle of virtual work (calculation)</li> <li>c. Mohr's analogy (area moment method devised by Mohr; graphical representation)</li> <li>d. Application of the</li> </ol>	Nos	North America, Europe, Japan	1				

			<p>principle of superposition</p> <p>e. Determination of the maximum deflection of the beam</p> <p>f. Angle of inclination of the beam</p> <p>g. Comparison between calculated and measured values for angle of inclination and deflection</p>							
5.		<b>Deformation of Straight Beams with DAQ</b>	<p>3 steel beams with different cross-sections</p> <p>1 brass and 1 aluminum beam</p> <p>3 articulated, height-adjustable supports with force gauge</p> <p>1 support with clamp fixing force gauges can be zeroed</p> <p>3 dial gauges to record deformations</p> <p>weights with adjustable hooks</p> <p>anodized aluminum section frame housing the experiment storage system to house the components</p> <p>Beam length: 1000mm</p> <p>Cross-sections: 3x20mm (steel), 4x20mm (steel), 6x20mm (Steel, Brass, Aluminum)</p> <p>Frame opening: 1320x480mm</p> <p>Weights 4x 2.5N (hanger) 4x 2.5N 16x 5N</p> <p>Measuring ranges Force: <math>\pm 50</math>N, graduation: 1N</p>	Nos	North America, Europe, Japan	1				

		<p>Travel: 0 to 20mm, graduation: 0.01mm</p> <p><b>Experimental Capabilities: -</b></p> <ul style="list-style-type: none"> <li>a. Investigation of the deflection for statically determinate and statically indeterminate Straight beams Cantilever beam, Single-span beam, dual- or triple-span beam</li> <li>b. Formulation of the differential equation for the elastic line</li> <li>c. Deflection on a cantilever beam</li> <li>d. Measurement of deflection at the force application point</li> <li>e. Deflection of a dual-span beam on three supports</li> <li>f. Measurement of the support reactions</li> <li>g. Measurement of the deformations</li> <li>h. Influence of the material (modulus of elasticity) and the beam cross-section (geometry) on the elastic line</li> <li>i. Application of the principle of virtual work on statically determinate and indeterminate beam,</li> <li>j. Determination of lines of influence Arithmetically</li> </ul>							
6	<b>Gauge factor</b>	Bending bar with 2 strain	Nos	North	1				

		<p><b>measurement Apparatus of Strain Gauge with DAQ</b></p>	<p>gauges on the compression side and tension side respectively.                  Strain gauge configured as full bridge                  2-point ball bearing mounting of bar permits purely bending load application                  Mechanical load application device.                  Dial gauge with adjustable dial for direct measurement of deflection                  Measuring amplifier with 4-digit digital display.                  Bending bar made of steel: 660x25x12mm                  Strain gauge application full bridge, 350 Ohm                  Two strain gauges on the top and underside of the bar respectively.                  Amplifier measuring range: <math>\pm 2\text{mV/V}</math>                  Resolution: <math>1\mu\text{V/V}</math>                  Zero balancing adjustment range: <math>\pm 1\text{mV}</math>                  Dial gauge 0 to 20mm                  Graduation: 0.01mm  <b>Experimental Capabilities: -</b></p> <ul style="list-style-type: none"> <li>a. Fundamentals of measurement using strain gauges.</li> <li>b. Determination of the gauge factor of strain gauges.</li> </ul>		<p>America, Europe, Japan</p>						
<p>7</p>		<p><b>Hydrostatic</b></p>	<p>All metallic items Stainless steel</p>		<p>USA,</p>	<p>2</p>					

		<p><b>Bench with data acquisition system and following Modules and Accessories</b></p>	<p>Diagram in the front panel with distribution of the elements similar to the real one.          Air pump, Water pump          "Alcohol thermometer, range: - 10 – 60 ° C.          Hydrometer (0 – 65 Baumé, 0.600 – 2.000 Sp/gr).          Capillary viscosimeter: 0.5 – 3 cp.          Capillary viscosimeter: 2 – 10 cp.          Capillary viscosimeter: 10 – 55 cp.          Capillary viscosimeter: 55 – 300 cp.          Three graduated cylinders 250 ml glass.          Cylinders graduated 1000 ml plastic.          Two 650 ml glass beakers.          Three glass elements for demonstration of free surface in static conditions.          Bourdon manometer, range: 0 – 3 bar.          Two "U" tube manometers, range: 0 – 450 mm.          Module to study Archimedes' Principle (lever balance with displacement vessel, bucket and cylinder).          Weather Station: Barometer up to 1050 hPa.          Thermometer: -40 – 60° C.          Hygrometer: 0 – 100 %.          Stop clock.</p>		<p>Canada,          Europe,          Japan,</p>						
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			<p>Bleed valves and circuit selection valves.          Module of capillarity in parallel plates.          Module of tubular capillary tubes."          The bench must be capable and should meet operational requirement of the below mentioned modules and accessories.</p> <ul style="list-style-type: none"> <li>a) Dead Weight Calibration Apparatus.</li> <li>b) Flow over Weirs Apparatus.</li> <li>c) Hydrostatic Pressure Apparatus.</li> <li>d) Metacentric Height Calculation Apparatus.</li> </ul> <p><b>Experimental Capabilities:-</b>          Ability to measure          Surface tension,          Capillarity,          Buoyancy force,          Hydrostatic pressure in liquids          Total Pressure and Static Pressure          Density of liquids</p>						
	<b>a</b>	<b>Dead Weight Calibration Apparatus.</b>	<p>Pressure manometer: Bourdon type. 0 – 3 bar.          Set of masses of different weights.          Piston diameter: 18-20 mm.          Piston weight: 0.5 Kg"</p>	USA, Canada, Europe, Japan,	2				

<b>b</b>	<b>Flow over Weirs Apparatus</b>	Scale of the level meter: 0 – 165 mm. Dimensions of the weirs: 170 x 240 x 40 mm. Neckline angle in the V-shape weir: 90°. Dimension of rectangular notch: 30 x 85 mm"		USA, Canada, Europe, Japan	2				
<b>c</b>	<b>Hydrostatic Pressure Apparatus.</b>	Tank capacity: 5.5-6 L. Distance between suspended masses and the support point: 285 mm. Area of the section: 0.007-0.0010 m <sup>2</sup> . Total depth of submerged quadrant: 165 mm Height of support point on the quadrant: 100 mm. Set of masses of different weights		USA, Canada, Europe, Japan	2				
<b>d</b>	<b>Metacentric Height</b>	Maximum angle: +/- 13. Corresponding lineal dimension: +/- 90 mm. Dimension of the float: length = 353 mm, width = 204 mm, total height = 480 mm.		USA, Canada, Europe, Japan,	2				

**Special Instructions**

Description	Bidder			Tech Scrutiny to be done by User		
	Yes	No	Alternate Offer	Accepted	Rejected	Reasons of Rejection
<b>Environment Conditions</b> (a) Temperature range: 05°C to +45°C (b) Relative humidity: 0-70% non-condensing						
<b>Warranty period</b> Two years from the date of commissioning.						
<b>Training Notes</b> Supplier will provide a set of handouts for training on operation and maintenance of the equipment						
<b>Publications</b> Supplier is to provide hard and soft copies (CD) of following manuals. (a) <b>Operational / Maintenance manual:</b> - Qty 01 with Equipment and additional Qty 02 for record purposes and should consist of following sections:- (1) <b>Equipment Description /Operation:-</b> (a)Specifications (b)Description (c)Operation (2) <b>Servicing:-</b> (a)Maintenance Schedule (b )Adjustment / test (c)Removal / Installation procedure (d)Tools Used (3) Trouble shooting guide (4) Cleaning requirements (5) Shipping and receiving (6) Storage requirements (b) <b>IPB</b> (Illustrated Parts Breakdown Manual) should have full parts description along with detailed diagrams (exploded view). (c) <b>Experimental manuals</b> which must contain the list and procedure of the experiments that equipment can perform.						
<b>Spares / Technical Support</b> (a) Supplier to have in-country spares / technical support and						



<p>ensure spares and technical support / assistance for next 10 years</p> <p>(b) Comprehensive list of spares required for scheduled maintenance of Equipment is to be provided</p> <p>(c) Any software provided must have its license</p> <p>(d) Software upgrade support must be provided free of cost for 10 x years with renewed license at every upgrade</p> <p>(e) Supplier must also provide calibration service for at least 5 x years after commissioning</p>						
<p><b>Additional Spare / Replaceable parts.</b></p> <p>(a) Replaceable spare / parts during scheduled inspections are to be identified and provided as per requirement along with equipment sufficient to cater five years consumption.</p> <p>(b) All specialized / standard tools required for inspection / repair / servicing must be supplied along with equipment.</p>						
<p><b>Physical Inspection Criteria:</b> 100% physical inspection of store will be carried out before commissioning of the equipment for following details:-</p> <p>(a) For physical damage, scratches and deformity.</p> <p>(b) Accessories /components as per contractual specifications.</p> <p>(c) Technical Manuals (Operation manual, user guide, IPBs).</p> <p>(d) Quality certificate and calibration certificate by the OEM</p> <p>(e) OEM certificate and verifiable documents by the supplier that store has been procured from certified source and is factory new and from latest production.</p> <p>(f) Brand name and country of origin.</p>						
<p><b>Commissioning</b></p> <p>(a) Commissioning by OEM rep at his own cost and risk at designated place at NUTECH.</p> <p>(b) Any special requirement for installation, operation and commissioning must be specified in the</p>						

offer by the supplier.						
<b>Training</b> 01 week OEM operational/ maintenance training at NUTECH						
<b>Improvement and Safety Measures</b> Any improvement and safety measures suggested by NUTECH during commissioning are to be resolved by the supplier / manufacturer at no extra cost.						
<b>Liability of Supplier</b> (a) OEM certificate of authorized dealership Supplier is to provide original OEM certificate of subject equipment bought directly from the manufacturer and being an authorized dealer. (b) In case the equipment supplied is not compatible with specifications, the supplier will be obliged to call his representatives at his own cost for consultation and corrective action						
<b>Special Notes</b> (a) Additional requirements for the maintenance of equipment (if any) must be intimated by the supplier in technical offer. (b) Supplier must provide the list of organizations using same equipment in Pakistan (if any). (c) Equipment must be a standard product of OEM available at web address of OEM. (d) In case of premature failure of the equipment, OEM has to replace / rectify the item free of cost. Required transportation charges would be borne by the supplier.						

Instl/Assy/Commissioning Req	✓		Contract with OEM/Supplier	✓			
Performance Bond Req	✓		Offer Req for Package Deal	X			
<b>Note:</b> (If any)			Warranty req and Duration	✓ (Min 2 yrs)			
List of "Additional Req may be" sent to procurement office, immediately							
Maint Spare Req	✓		Essentially Running spare req	✓			
Pub/Lit Req	✓		Req of Cert for test data results	✓			
Trg Req	<b>Local by OEM rep</b>		Req of Calibration	✓			
<b>Note:</b> Tick relevant box							

Firm Name_____
Signature_____
Name_____
Designation_____



**NATIONAL UNIVERSITY OF TECHNOLOGY**  
**SUPPLY CHAIN MANAGEMENT OFFICE**

**TECHNICAL OFFER**

**Annex B**

User Reference No **Mech Lab Eqpt-004** Date: **02-05-2019**

**Please fill in the following essential parameters:**

1. Validity of Offer: \_\_\_\_\_ Days (Should not be less than 90 days)
2. Delivery Period: \_\_\_\_\_ Days (After Placement of order)
3. Country of Origin: \_\_\_\_\_
4. Warranty/Guarantee: \_\_\_\_\_ Months from the date of final acceptance of the stores.

**General**

GST No: \_\_\_\_\_ (Please enclose copy)

NTN/CNIC: \_\_\_\_\_ (if exempted, please provide valid exemption certificate)

**Payment Terms:** (Mandatory to mention) (Please tick/ mention the desired payment term/ mode)

1. 50 % advance payment (Against valid bank Guarantee)
2. 50% Payment after delivery, installation /commissioning, user satisfaction certificate

**Details of Payment Recipient**

(1) Name/Title: \_\_\_\_\_

(2) Address: \_\_\_\_\_

Signature: \_\_\_\_\_

Official Seal: \_\_\_\_\_

Name: \_\_\_\_\_

Designation: \_\_\_\_\_



**NATIONAL UNIVERSITY OF TECHNOLOGY**  
**SUPPLY CHAIN MANAGEMENT OFFICE**

**FINANCIAL OFFER**

**Annex C**

User Reference No **Mech Lab Eqpt-005** Date: **02-05-2019**

Ser	Part No	Nomen/ Experiment	Description	A/U	Qty Req	Unit Price (Rs) (excluding taxes)	All taxes)	Unit price with all taxes (rs)	Total Amount of Total Qty With Tax (Rs)
1.		<b>Vibrations Trainer with DAQ</b>	Vibration trainer with experiments on damping, resonance, dual-mass system and vibration absorption 6 pendulum oscillators 2 bar-type oscillators 1 spring-mass oscillator Electrical imbalance exciter control unit for the imbalance exciter with a digital frequency display and a TTL output for triggering external devices Tune able absorber with a leaf spring adjustable oil damper Electrically operated drum recorder for recording free vibrations Polar chart recorder for determining the amplitude and phase of forced vibrations Technical data Beam, rigid: LxWxH: 700x25x12mm, 1.6kg Beam, elastic: LxWxH: 700x25x4mm, 0.6kg Tension-pressure springs 0.75N/mm	Nos	1				

			<p>1.5N/mm          3.0N/mm          Imbalance exciter          0 to 50Hz          100cmg          Oil damper: 5 to 15Ns/m          Absorber leaf spring: -          WxH: 20x1.5mm          total mass: approx. 1.1kg          Tune able: 5 to 50Hz          Drum recorder: - 20mm/s, width 100mm          Polar chart recorder: - Ø 100mm  <b>Experimental Capabilities: -</b>          Experiments with</p> <ul style="list-style-type: none"> <li>i. Pendulums</li> <li>j. Spring-mass system</li> <li>k. Bar-type oscillator</li> <li>l. Undamped oscillation</li> <li>m. Damped oscillation</li> <li>n. Forced vibration</li> <li>o. Damped and un damped resonance</li> </ul> <p>Absorber effect in multi-mass oscillators.</p>						
2.		<b>Moment of Inertia with DAQ</b>	<p>Rotating bar          Length: 550mm          Masses: 2x 0.1kg, 2x 0.2kg, 2x 0.4kg          Solid cylinder          Diameter: 120mm          Mass: 0.9kg          Hollow cylinder          Outer diameter: 120mm          Inner diameter: 110mm          Mass: 0.9kg          Weight for the drive 1N  <b>Experimental Capabilities: -</b>          Investigation of the inertia of various bodies in rotational motion hollow</p>	Nos	1				

			cylinder, solid cylinder or rotating bar with masses as a rotating body.						
3.		<b>Transducers, Instrumentation &amp; Control Teaching Set with DAQ</b>	<p>Input Transducers: Carbon track. Wire wound &amp; precision rotary potentiometers. Slide potentiometers. NTC thermistors. Type 'K' thermocouples. I.C. temperature sensor. Photoconductive cell. Photovoltaic cell. Phototransistor. PIN diode. Linear variable differential transformer. Linear variable capacitor. Strain gauge. Air-flow sensor. Air pressure sensor. Slotted opto-sensor. Reflective opto-sensor. Inductive Proximity Sensor. Hall Effect sensor. Precision servo-potentiometer. Tachogenerator. Humidity sensor. Dynamic microphone. Ultrasonic receiver. Output Devices: Heater. Filament Lamp. DC Motor. Solenoid Air Valve. Ultrasonic transmitter. Buzzer. Loudspeaker. Relay. Solenoid. Counter/timer unit with LED display. Bar graph voltage indicator. Analog 10V center-zero meter. Signal Conditioning Circuits: Buffers. Inverters. Comparator with switchable hysteresis. Amplifiers with gain and offset control. Current amplifier. Summing amplifier. Differential amplifier. Instrumentation amplifiers. AC amplifier. Oscillator 40kHz. Filter 40kHz. Low-pass filter with switchable time constant. Precision full-wave rectifier. Sample and hold circuit. Integrator with switchable time constant. Differentiator with switchable time constant. V/F and F/V converters. V/I and I/V converters. Alarm oscillator with switchable latching. Power amplifier. Electronic switch. Internal Power Supplies:</p>	Nos	1				

			-5V, +5V 1A precision supply. -12V, +12V 1A regulated supply. Pneumatic Supply: Internal Pneumatic pump. D.C. motor, tacho-generator, slotted and reflective opto-sensors for incremental and absolute position, and a 360 degree precision potentiometer with indicator dial for closed-loop position control experiments. System Includes: Trainer. Accessory and Lead Kit. Mains Lead. Curriculum Manual. Student Manual. Instructors Manual. Technical Manual. All Manuals in PDF Format on CDROM. Function Generator. Auto-ranging Digital Millimeter (Qty: 2). Digital Storage Oscilloscope.						
4.	<b>Methods to determine the elastic line Mohrs Analogy with DAQ</b>	<p>Beam Length: 1000 mm  cross-section: 20x4mm  material: steel  Weights  7x 1N (hanger)  28x 1N  21x 5N  Measuring ranges  force: <math>\pm 50\text{N}</math>, graduation: 1N  travel: 0 to 20mm, graduation: 0.01mm</p> <p><b>Experimental Capabilities: -</b></p> <ul style="list-style-type: none"> <li>h. Elastic lines for statically determinate or indeterminate beams under load</li> <li>i. Determination of the elastic line of a beam by the principle of virtual work (calculation)</li> <li>j. Mohr's analogy (area moment method devised by Mohr; graphical representation)</li> <li>k. Application of the principle of superposition</li> </ul>	Nos	1					



			<p>l. Determination of the maximum deflection of the beam</p> <p>m. Angle of inclination of the beam</p> <p>Comparison between calculated and measured values for angle of inclination and deflection</p>						
5.	<p><b>Deformation of Straight Beams with DAQ</b></p>	<p>3 steel beams with different cross-sections</p> <p>1 brass and 1 aluminum beam</p> <p>3 articulated, height-adjustable supports with force gauge</p> <p>1 support with clamp fixing</p> <p>force gauges can be zeroed</p> <p>3 dial gauges to record deformations</p> <p>weights with adjustable hooks</p> <p>anodized aluminum section frame housing the experiment</p> <p>storage system to house the components</p> <p>Beam</p> <p>length: 1000mm</p> <p>Cross-sections: 3x20mm (steel), 4x20mm (steel), 6x20mm (Steel, Brass, Aluminum)</p> <p>Frame opening: 1320x480mm</p> <p>Weights</p> <p>4x 2.5N (hanger)</p> <p>4x 2.5N</p> <p>16x 5N</p> <p>Measuring ranges</p> <p>Force: <math>\pm 50\text{N}</math>, graduation: 1N</p> <p>Travel: 0 to 20mm, graduation: 0.01mm</p> <p><b>Experimental Capabilities: -</b></p> <p>k. Investigation of the deflection for statically determinate and statically indeterminate Straight beams</p> <p>Cantilever beam, Single-span beam, dual- or triple-span beam</p> <p>l. Formulation of the differential equation for the elastic line</p>	Nos	1					

			<ul style="list-style-type: none"> <li>m. Deflection on a cantilever beam</li> <li>n. Measurement of deflection at the force application point</li> <li>o. Deflection of a dual-span beam on three supports</li> <li>p. Measurement of the support reactions</li> <li>q. Measurement of the deformations</li> <li>r. Influence of the material (modulus of elasticity) and the beam cross-section (geometry) on the elastic line</li> <li>s. Application of the principle of virtual work on statically determinate and indeterminate beams</li> </ul> <p>Determination of lines of influence Arithmetically</p>						
6		<p><b>Gauge factor measurement Apparatus of Strain Gauge with DAQ</b></p>	<p>Bending bar with 2 strain gauges on the compression side and tension side respectively. Strain gauge configured as full bridge 2-point ball bearing mounting of bar permits purely bending load application Mechanical load application device. Dial gauge with adjustable dial for direct measurement of deflection Measuring amplifier with 4-digit digital display. Bending bar made of steel: 660x25x12mm Strain gauge application full bridge, 350 Ohm Two strain gauges on the top and underside of the bar respectively. Amplifier measuring range: <math>\pm 2\text{mV/V}</math> Resolution: <math>1\mu\text{V/V}</math> Zero balancing adjustment range: <math>\pm 1\text{mV}</math> Dial gauge 0 to 20mm Graduation:</p>	Nos	1				

			<p>0.01mm</p> <p><b>Experimental Capabilities: -</b></p> <p>c. Fundamentals of measurement using strain gauges.</p> <p>Determination of the gauge factor of strain gauges.</p>						
7		<p><b>Hydrostatic Bench with data acquisition system and following Modules and Accessories</b></p>	<p>All metallic items Stainless steel</p> <p>Diagram in the front panel with distribution of the elements similar to the real one.</p> <p>Air pump, Water pump</p> <p>"Alcohol thermometer, range: -10 – 60 ° C.</p> <p>Hydrometer (0 – 65 Baumé, 0.600 – 2.000 Sp/gr).</p> <p>Capillary viscosimeter: 0.5 – 3 cp.</p> <p>Capillary viscosimeter: 2 – 10 cp.</p> <p>Capillary viscosimeter: 10 – 55 cp.</p> <p>Capillary viscosimeter: 55 – 300 cp.</p> <p>Three graduated cylinders 250 ml glass.</p> <p>Cylinders graduated 1000 ml plastic.</p> <p>Two 650 ml glass beakers.</p> <p>Three glass elements for demonstration of free surface in static conditions.</p> <p>Bourdon manometer, range: 0 – 3 bar.</p> <p>Two "U" tube manometers, range: 0 – 450 mm.</p> <p>Module to study Archimedes' Principle (lever balance with displacement vessel, bucket and cylinder).</p> <p>Weather Station: Barometer up to 1050 hPa.</p> <p>Thermometer:-40 – 60° C.</p> <p>Hygrometer: 0 – 100 %.</p> <p>Stop clock.</p> <p>Bleed valves and circuit selection valves.</p> <p>Module of capillarity in parallel plates.</p> <p>Module of tubular capillary tubes."</p> <p>The bench must be capable and should</p>		2				

		<p>meet operational requirement of the below mentioned modules and accessories.</p> <p>e) Dead Weight Calibration Apparatus.  f) Flow over Weirs Apparatus.  g) Hydrostatic Pressure Apparatus.  <b>h) Metacentric Height Calculation Apparatus.</b></p> <p><b>Experimental Capabilities:-</b>  Ability to measure  Surface tension,  Capillarity,  Buoyancy force,  Hydrostatic pressure in liquids  Total Pressure and Static Pressure  Density of liquids</p>						
a	<b>Dead Weight Calibration Apparatus.</b>	<p>Pressure manometer: Bourdon type. 0 – 3 bar.  Set of masses of different weights.  Piston diameter: 18-20 mm.  Piston weight: 0.5 Kg"</p>		2				
b	<b>Flow over Weirs Apparatus</b>	<p>Scale of the level meter: 0 – 165 mm.  Dimensions of the weirs: 170 x 240 x 40 mm.  Neckline angle in the V-shape weir: 90°. Dimension of rectangular notch: 30 x 85 mm"</p>		2				
c	<b>Hydrostatic Pressure Apparatus.</b>	<p>Tank capacity: 5.5-6 L.  Distance between suspended masses and the support point: 285 mm.  Area of the section: 0.007-0.0010 m<sup>2</sup>.  Total depth of submerged quadrant: 165 mm  Height of support point on the quadrant: 100 mm.  Set of masses of different weights</p>		2				
d	<b>Metacentric</b>	<p>Maximum angle: +/- 13.</p>		2				

		<b>Height</b>	Corresponding lineal dimension: +/- 90 mm. Dimension of the float: length = 353 mm, width = 204 mm, total height = 480 mm.						
<b>TOTAL</b>									

Bid Bond Ref \_\_\_\_\_ Taxes \_\_\_\_\_

Total Bid Value \_\_\_\_\_

(Bid Bond be attached with Annex C. Copy of Bid Bond be attached with

Technical offer without showing its value) . Exposure of bid bond in tech offer may result in rejection offer.

Firm Name _____ Signature _____ Name _____ Designation _____
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