TENDER DOCUMENTS

Mechanical Lab Equipment

NUTECH / SCM /Mechanical Lab Eqpt (PSDP) 2020 / TD-109

NATIONAL UNIVERSITY OF TECHNOLOGY

TENDER NOTICE

National University of Technology (NUTECH)

NUTECH / SCM / Mechanical Lab Eqpt (PSDP) 2020 / TD-109

Sealed bids are invited from Government / FBR Registered Firms for the procurement of Mechanical Lab Equipment for NUTECH on **CPT Basis**.

1. Tender documents containing terms, conditions and detailed specifications of items (including draft contract) can be downloaded from NUTECH website "https://nutech.edu.pk" w.e.f **22 Jan 2020**.
2. Quotations shall be submitted as per requirement of the tender documents.
3. Bidders will be required to submit **Bank Draft / CDR** equal to **5%** of quoted value as Bid Bond in favor of National University of Technology (NUTECH).
4. Sealed bids with detailed specifications should reach on the following address latest by **1030 hours on 26 Feb 2020.** Late submission will not be entertained.
5. Bids will be opened at **1100 hours** on **26 Feb 2020 at** SCM Office.
6. Project is to be completed in **120 days** from the date of award of contract.
7. Submit Rs 1500/- as Tender fee in favor 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)
NATIONAL UNIVERSITY OF TECHNOLOGY, IJP ROAD, I-12, ISLAMABAD
Tel: 0092-51-5476768, Ext: 227

NATIONAL UNIVERSITY OF TECHNOLOGY

SUPPLY CHAIN MANAGEMENT

INVITATION TO TENDER

Tender submission time: 1030 hours, 26 Feb 2020

1. NUTECH desires to procure the list of item(s) / Store(s) on **CPT basis**. as per **Annexure-A**. Interested bidders are requested to send their bids through courier or deliver at NUTECH under "Single Stage – Two Envelopes" (two envelopes placed together in third envelope), marked clearly as **"Technical Offer"** and **"Commercial Offer"** respectively to the undersigned, latest by or before above mentioned due date.

2. **Conditions Governing Contracts.** The contract made as result of this IT will be in accordance with the draft contract published on NUTECH University website and other special conditions (Mentioned in this document) that may be added to given contract for the supply of Lab Equipment.

3. **Delivery of Tender.** The offer is to be submitted as under:-

   a. **Technical Offer.** Technical Offer should contain only Annexure-A, Annexure-A-1 & Annexure B duly filled in (supported with relevant technical literature / details / catalogues etc) and receipt of tender processing fee. Copy of bid bond WITHOUT MENTIONING PRICE should be attached with technical offer. Only relevant technical details ie literature/brochures) without mentioning the financial aspect of the offer in DUPLICATE should be enclosed in an envelope. In technical proposal, all items must have the brand names, model number, manufacturer"s name, country of origin, manufacturer's warranty including parts with complete specs and brochures. Re-conditioned and re-furbished equipment shall not be acceptable. Following information will be clearly marked on the envelope:

      (1) Technical Offer
      (2) Original Performa Invoice (without price)
      (3) Tender number

(4) Date/ time of opening

b. **Commercial Offer.** Commercial Offer will contain Annexure-C and bid bond (Dully mentioned and placed in separate envelope. The offer indicating the quoted price FE/Local Currency (in Local Currency for FOR cases & in FE for FOB cases) in figures as well as in words would be enclosed in an envelope. Following information will be clearly marked on the envelope;

(1) Commercial Offer
(2) Original Performa invoice with price
(3) Tender number

c. Both the envelopes i.e. commercial offer and technical offer would be enclosed in yet another properly sealed envelope that will be marked with address of this office only. There should be clear indication that this envelope contains tender documents.

d. The tender duly sealed will be addressed to the following:-

Deputy Director (Supply Chain Management Office)
NATIONAL UNIVERSITY OF TECHNOLOGY (NUTECH)
I J P ROAD, I-12, ISLAMABAD
Tel: 0092-51-5476768, Ext: 227

4. **Date and Time for Receipt of Tender.** Sealed bids with detailed specifications should reach SCM office latest by **1030 hours on 26 Feb 2020.** Delay occurring in post shall not be accepted. Tenders received after the appointed / fixed time will NOT be entertained. The appointed time will, however, fall on next working day in case of closed / forced holiday.

5. **Tender opening.** The offers shall be opened 30 minutes after submission time**.** Commercial offers will be opened at later stage if Technical Offer is found acceptable on examination by technical authorities. Date and time for opening of

commercial offer shall intimated later. Only legitimate / registered representatives of firm will be allowed to attend tender opening.

6. **Validity of Offer.** The validity period of quotations must be indicated and should be 90 days from the date of opening of financial offer.

7. **Documents.** Following information / copy of documents must be provided / attached with offer:-

a. A copy of letter showing firm's financial capability.
b. NTN/GST number be mentioned on the offer and copy of registration Certificate issued by Sales Tax Department, attached.
c. Foreign supplier to provide its Registration Number issued by respective Department of Commerce authorizing export of subject stores **(in FOB cases).**
d. Annexes A, A-1, B and C and special conditions must be signed and stamped. ATTACH ONLY RELEVANT DOCUMENTS.
e. Complete all Annexes as per given format. Do not use your format or letter head. Offer may be rejected if given format is not followed.
f. OEM/principal agency agreement must be provided.

8. **Disqualification.** Offers are liable to be rejected if:-

a. Validity of offer is not quoted as required in IT documents.
b. Any deviation from the General/ Special / Technical Instructions.
c. Offers are found conditional or incomplete in any respect.
d. Copy of EM/Bid Bond & Tender processing fee (with tech offer) and original EM/Bid Bond (with fin offer) are NOT attached.
e. Multiple rates are quoted against one item.
f. Manufacturer's relevant brochures and technical details on major equipment assemblies are not attached in support of specifications.
g. Offer received later than appointed / fixed date and time.
h. Subject to restriction of export license.

i. Offers (Commercial / technical) containing non-initialled / unauthenticated amendments / corrections / overwriting. If the validity of the agency agreement has expired. The commercial offer against FOB / CIF / C&F tender quoted in local currency.

j. If the offer is found to be based on cartel action in connivance with other sources/participants of the tender.

9. **Earnest Money / Bid Bond.** Commercial Offer must be accompanied with a Bid Bond (CDR/Pay Order/Bank Draft) in agreement of faithful compliance of the conditions of Contract. This amount will be equivalent to 5% of the total quoted value. The Bid Bond amount submitted by the successful bidder will however be refunded on effective termination of Contract. (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. Bid Bond will be used as performance guarantee till the delivery of stores, otherwise separate performance guarantee valued at 5 % of contract will be submitted by successful firm till stores are delivered and inspected.

10. **Return of Earnest Money/Bid Bond.**

a. Bid Bond to the unsuccessful bidders will be returned on finalization of the lowest evaluated bidder.

b. Bid Bond of the successful bidder/bidders will be returned on submission of Bank Guarantee/Bid bond against warranty period OR Bid bond retained for the warranty period as the case may be.

11. **Terms of Payment/ LC Charges**

a. **In FOB cases** (all categories) payment will be made through letter of credit (LC). LC opening charges in Pakistan are to be borne by NUTECH. Payment will be made through irrevocable LC in favour of Manufacturer.

b. **In FOR cases** 50% advance payment will be made to the Seller on provision of unconditional Bank Guarantee/ CDR/ DD/ Pay order. 50% payment will made to the Seller after receipt and confirming the correctness of ordered specifications, installation, commissioning OR as the case may be.

12. **Bank Guarantee (BG)**.In case where equipment is backed by warranty, the BG submitted equal to 05% of FOB/FOR/CPT etc value shall remain valid for up to 60 days beyond completion of warranty period.

13. **Taxes/ Duties/ Custom clearance** All taxes /duties /import Licenses Fee as applicable under government laws in Pakistan as well as country of supplier shall be on firm **(in FOR Case).** NUTECH will provide applicable exemption certificates and documents **(In FOB Cases only)**.

14. **Insurance:-** Insurance will be NUTECH's responsibility through NICL **(in FOB Cases)**.

15. **Freight charges /Misc charges:** All charges such as packing, forwarding, local freight, loading and unloading, installation and commissioning, custom clearance, orientations, on job training or any other will be part of quoted price. Delivery till NUTECH will be firm's responsibility and all associated costs will be part of quotation as well.

16. **Warranty**. All goods /store offered would be brand new, from current year of production and will be governed as per warranty clause. The warranty period may be covered by BG as depending on the value /criticality of the tender equipment.

17. **Delivery Schedule.** Store will be delivered within 120 days from contract signing date.

18. **Force Majeure.** If non-compliance with the period of delivery or services can be proved to be due to Force Majeure, such as but not limited to mobilization, war, riot, strike, lockout or the occurrence of unforeseen events, the period shall be reasonably extended.

19. **Subletting** Suppliers are not allowed to sublet wholly or part of the contract to any other firm /company without prior permission by NUTECH. Firm found in breach of the clause will be dealt with as per purchaser's right and discretion.

20. **Arbitration.** The dispute shall referred for adjudication to a board comprising of Pro-Rector NUTECH as Chairman and two arbitrators, one to be nominated by each party. The arbitration proceeding shall be held in Pakistan under Pakistan Law. The venue of arbitration shall be the place from which the contract is issued or such other place as the purchaser at his discretion may determine. Arbitration award so given will be firm and final.

21. **Redress Of Grievance.** In case of dispute, case shall be reviewed by 'NUTECH Redress of grievance committee and decision of NUTECH shall be final and binding on both parties.

22. **Export License/Permit /End User Cert.** It shall be the responsibility of the Supplier to obtain from the Government concerned all permits and export licenses, etc required to enable each consignment to be shipped immediately as per the delivery schedule. In case the supplier fails to arrange export license within 30 days of signing the contract the purchaser reserves the right to cancel the contract on the risk and expense of the supplier without prior notice. The purchaser will provide End User Certificate for acquisition of export license to the supplier (format to be provided by the supplier for respective country within 10 day of signing of the contract).

23. **Technical Specification:** The supplier will provide OEM certificate, quality certificate /inspection document to the purchaser confirming the quality of the product being supplied under this contract .Store must bear the manufacturer's identification marking /monogram.

24. **Inspection /Testing of Store**: Inspection testing will be carried out at NUTECH by the concerned inspection team as detailed by the respective department in accordance with the laid down Acceptance Criteria. (Acceptance Test Procedure (ATPs)/Drawing /Test standard and specification). **The supplier will provide ATPs with technical offer**. Mutually agreed/approved ATPs will form part of contract to govern the inspection of store subsequently.

25. **Requirement of Samples.** The requirement of tender sample will be included in the case if required for evaluation by technical authorities'. Beside this advance sample if required will be also made part of the IT as well as the contract.

26. **Change In Specification / Mfr / Model.** No alternation marked/brand and quality of store will be entertained after the tender have been opened.

27. **Checking of Store at Consignee End.** All stores will be checked at Consignee's end in the presence of the supplier's representative. If for some reason, the supplier decides not to nominate his representative for such checking, an advance written notice to this effect will be given by the supplier to the consignee prior to immediately on shipment of store. In such an event the supplier will clearly undertake that decision of consignee with regard to quantities and description of

consignment will be taken as final and discrepancy found will be accordingly made up by supplier. In all other cases the consignee will inform the supplier about arrival of consignment immediately on receipt of store through registered email/letter and telephone. If no response from the supplier is received within 15 days from initiation letter the consignee will have the right to proceed with the checking without supplier's representative .Consignee's report on checking of the stores will be binding on the supplier in such cases.

28. **Packing /Marking.** The supplier shall be responsible for proper packing of the Store in standard export packing worthy of transportation by sea /air /road rail so as to ensure their content being free from lose or damages due to faulty packing on arrival at the ultimate destination. Packing of stores will be done at the expenses of the supplier. All packing cases, containers and other packing material shall become the property of the NUTECH on receipt. Any loss occurred /demurrage paid due to wrong marking will be made good by the supplier

29. **Original Performa Invoice**: Original Performa invoice must have following components incorporated:-

a. HS Code
b. Incoterm
c. Payment Terms
d. Origin of good
e. Port of shipment
f. Address of OEM
g. Seller acceptance (on Performa Invoice)
h. Invoice Date
i. Latest date of shipment
j. Seller complete bank detail

Note: Performa Invoice in the name of NUTECH in case of FOB cases & in the name of local partner in case of FOR cases.

30. **General Instructions:** Following must be noted:-

a. The firm should provide point to point acceptance of each clause of IT and special instructions attached with IT.
b. Firm will render a certificate with technical offer that firm is neither defaulter nor blacklisted by any Government / semi Government

organization directly or indirectly.

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

d. **2 years** warranty against **5% Bank Guarantee** of the store value will be required from the successful bidders from the date of commissioning as performance bond.

e. The stipulated delivery period should be strictly adhered to. Any anticipated delay that is beyond the control of Seller will be informed (in writing) well in advance of the expiry of the due date of the activity along with reasons thereof, requesting for the grant of extension in delivery period. If the Seller fails to do so, or the Buyer is not convinced with the rationale provided by the Seller, Liquidated Damages up to/at 2% per month or part thereof, will be imposed. However, the maximum limit of the Liquidated Damages will not exceed 10% of the delayed store value.

f. If even after applicability of 10% LD, the Seller fails to deliver the required stores, the Buyer will be at liberty to Cancel the contract, and /or procure the stores from an alternate source, on the Seller's "Risk & Cost/Expense". In that case, the Seller will be bound to make payment to the new source through NUTECH. The purchaser’s decision under this clause shall NOT be subjected to arbitration.

g. NUTECH reserves the right to cancel the Contract without assigning any reason whatsoever during its currency / execution / after placement, if the firm is found to be involved in any dubious activity, litigation, lacking to meet contractual obligations with the purchaser or is blacklisted with any other Public procurement agency. No claims / loss /damage of whatsoever nature shall be entertained and NUTECH's decision in this regard will be final / binding on the Seller.

h. An appropriate amount may be paid for mobilization against Bank Guarantee/CDR/Demand Draft/Pay Order.

i. Firms with previous pending/outstanding projects/business with NUTECH may not be considered for award of this tender.

Deputy Director

Supply Chain Management Office

Annex-A

Technical Specifications

NUTECH / SCM / Mechanical Lab Eqpt (PSDP) 2020 / TD-109

Ser	Items	Description	Country of Origin	A/U	Qty Req	Bidder Compliance		Tech Scrutiny to be done by user	
						Yes	No	Accepted	Rejected
								Reason of Rejection	
1.	**Governor Apparatus with DAQ**	• Base unit with safety dome • Unit should be driven with DC motor of approximate power of 30 W, 230V, 50 / 60 Hz, 1 phase, with minimum RPM 300 • Unit should have a Proell governor with minimum of sleeve mass: 3x 100g, and minimum of centrifugal mass: 2x 150g • Unit should have a Porter governor, with minimum of sleeve mass: 3x 100g, and minimum of centrifugal mass: 2x 400g • Unit should have a Hartnell governor, with minimum of centrifugal mass: 2x 400g, and minimum of 2 compression springs, and an adjustable spring preload • Unit measuring range should be from 0 to 700 revolutions per minute • Sensor for measuring position (lift) of each governor • RPM sensor should be mounted to	Europe/ USA	No	1				

		measure the angular speed • Should have at least two springs with following approximate characteristics:- • Spring 1 ○ Outside Diameter 32 mm ○ Length 102 mm ○ Wire Diameter 2.64 mm ○ Spring Rate 1.23 N.mm -1 ○ Mass 70g • Spring 2 ○ Outside Diameter 38 mm ○ Length 102 mm ○ Wire Diameter 3.2 mm ○ Spring Rate 2.07 N.mm-1 ○ Mass 130g • Required Weights of 100 and 200 gram (three each) • Unit connected with data acquisitions system with following characteristics:- • Analogue Inputs • Sample rate up to 25 kHz with 12 bit resolution • Bandwidth/Filter cut-off 3 kHz (nominal) • Data should be exportable as XLSX file and HTML file						

		• LabVIEW software **Experimental Capabilities** •Analysis of the characteristic curves of governor speed vs sleeve lift. •Analysis on governor types with respect to sensitivity, stability and effort. •Calculations and Predictions on Porter and Porell governors of the effects of varying center of sleeve mass over speeds •Analysis on the Hartnell governor of the effect of varying: arm length, spring rate, spring compression, rotating mass Predictions of the design and adjustment of different governors over different speeds and structural changes in terms of masses						
2.	**Determination of Gear Efficiency**	•Three-phase AC motor with variable speed of, power output: 0,20kW, speed: 0…2500 revolutions min-1 •Magnetic particle brake, rated braking torque at exciting current 0…0.2A: 0…8Nm •Two-stage spur gear, transmission ratio should be minimum of 13,5 torque: min, 23.4Nm •Worm gear with minimum of transmission ratio: 15, torque: 10Nm, worm: z=2, worm gear: z=40 •Measuring ranges, speed:	Europe/ USA	No	1			

		0…3000min-1, force: 0…100N • Unit should be compatible with the following electric combinations 230V, 50Hz, 1 phase 230V, 60Hz, 1 phase; 120V, 60Hz, 1 phase • Efficiency of the unit should be displayed in digital form **Experimental Capabilities** Determination of the mechanical efficiency of gears by comparing the mechanical driving and braking power for a) Spur gears b) Worm gears c) Helical gears • Determine the speed ratios over gears teeth ratios • Determine the torque variations over the applied loading conditions • Determine of the backlash over a) spur gears b) helical gears c) worm gears • Predictions of transmission ratios • Predictions of torque transmissions						
3.	**Clutches and Brakes Apparatus**	• Leading (primary) and trailing (secondary) shoe brakes with minimum of 15 mm diameter, • Primary and secondary disc brakes with minimum of 15 mm diameter • Pulleys for hanging the masses with minimum of 15 mm diameter • Handles connected with pulleys to apply the load on brakes	Europe/ USA	No	1			

		• Bench/wall mounted base unit • Hanging weights of minimum of 10 grams • Springs for Pressure Applying on clutch plates • Clutch plate with minimum of 5 mm diameter • Clutch Rings • Measuring ranges, speed: Approximately 0…100 revolutions per min, torque: ±15Nm **<u>Experimental Capabilities</u>** • Demonstration/Analysis of clutch engagement and disengagement • To investigate the relationship between the normal pressure applied to the friction surfaces, the mean radius of the friction rings and the torque at which slip occurs • To investigate the relationship between the forces involved in vehicle braking system • Determination of friction forces over clutch plates • Determination of applied pressures to drive the plates • Plotting of characteristics curves over friction forces and applied torques • Plotting of disc applied pressures and friction forces						

4.	**Epicyclic Gear Train Apparatus**	• Bench-top unit with adjustable legs. • Min 3 sets of epicyclic gear train: • Each gear train consists of a sun gear in the center, three planet gears, a planet linkage and an internal or ring gear. • Two graduated discs located at the input and output shafts. • Secondary Output Drive shaft mounted with helical gears • Primary helical gears minimum of three mounted with input shaft • Bearings should be mounted to reduce the frictional losses • Pin for applying the external load on outer shaft • Outer shaft with inner helical gears teeth's • Measuring ranges, speed: Approximately 0…600 revolutions per min • Hooks for hanging the masses to apply load on the shafts as in the form of torque • Three forward speeds and a one reverse speed. • Torque reaction kit to be used with above system **<u>Experimental Capabilities</u>** • To demonstrate the operation and	Europe/ USA	No	1			

		function of an epicyclic gears system • To determine and verify the speed and torque ratio between input and output shafts. • Calculate and experimentally observe the angular velocity ratios of gear trains • Experimentally obtain the torque ratios of gear trains, gear ratios, efficiencies and velocity ratios • Calculate the mechanical advantage and efficiencies of gear trains and draw efficiency curve • To determine the minimum effort required at the input to raise a load at the output.						
5.	**Computerized Vibration Analyzer**	• Acceleration sensors for measuring the acceleration of rotating/displaced/vibratory shafts/beams • Optical sensors to record speed • Channel amplifier with adjustable gains • Oscilloscope to measure the amplitude of vibration • Fast Fourier transform analyzer • Displacement sensors for measuring the angular/linear displacements of vibrational producing equipment • Velocity measuring sensors • Input unit for the generation of vibrations	Europe/USA	No	1			

		• SCADA should be there to measure and adjust the vibrational amplitudes • Measuring amplifier with adjustable gain • Bearings should be mounted for reducing the friction and smooth flow of vibration producing unit • RPM meter to measure the revolutions in case of rotating parts • Deflection measurement sensors in case of measuring the vibrations in beams/columns • Unit should be compatible with at least windows 10 **<u>Experimental Capabilities</u>** • Demonstration of vibration signal calibration and processing • Analysis of Fast Fourier Transform over vibrational apparatus • Calculation of vibration amplitude, speed, velocity and acceleration and plotting of their characteristics curves • Calculation/Prediction of vibration state of vibrational producing equipment • Damage analysis of roller bearings and gears by means of envelope spectra • Detection of cracks in shafts by						

		means of run-up curves and order analysis • Measurement of imbalance vibrations and field balancing of rigid rotors in 1 and 2 planes • Characteristics curves of vibration displacement, velocity and acceleration • Behavioral effects of damped, critically damped and undamped systems						
6.	**Static and Dynamic Balancing Machine,**	• Self-contained bench or desktop mounting unit, • Includes four removable rotating masses (balance blocks) with different inserts for a range of moments • Protractor, horizontal scale and sliding indicator • Flexible mountings • Selection of discs with eccentric holes of different diameters • Nominal Moment Values of the blocks to be approximately 0.025 Nm to 0.040 Nm • Extension shaft and pulley for static balancing, using a weight hanger and masses • Includes minimum 20 x 10 g masses and 10 x 1 g masses • Electric motor and belt drive for dynamic balancing	Europe/USA	No	1			

		Experimental Capabilities • Demonstration of simple static and dynamic balancing of two, three and four rotating masses • Dynamic balancing of rotating mass systems by calculation and vector diagrams (triangle and polygon) • Demonstrates balancing of a horizontal shaft with two, three or four rotating masses • Independent analysis of static and dynamic balancing						
7.	**Torsional Oscillations Apparatus**	• Bench-top unit with adjustable legs • Vibrational Exciters • Adjustable bars lengths to generate the oscillations • Bars can be supported minimum of five different points to make the visual loops • Oscillation amplitude measuring sensors • Velocity measuring sensors • Optical sensors to visualize the loops of oscillations • SCADA to change and measure the amplitude of oscillations and to plot the oscillational behaviours of testing unit over time and length parameters • Unit should be able to measure	Europe/USA	No	1			

		the oscillations under minimum of five types of damping conditions • Input drive unit to generate the oscillations • At least 9 Test rods three each of steel, brass and aluminium. • Diameter 8 mm and 350 mm in length. • A Dynamometer up to 10 Kg, with a 50 g accuracy, to apply the forces on the test rod **<u>Experimental Capabilities</u>** • Demonstration of damped, undamped and critically damped oscillations in a beam • Verification of the elastic torsion equation of circular rods • Measurement of vibrational oscillations amplitude, velocity and accelerations • Acquiring and plotting of free and forced vibrational oscillations • Demonstration and calculations of viscous damping • Demonstration of the behaviour of vibration oscillation absorber • Demonstration and calculations of the resonance phenomenon Demonstration of frictional damping						

8.	**Whirling of Shafts**	• Bench top unit with adjustable legs • Anodized aluminium frame and panels made of painted steel. • Main metal elements made of stainless steel. • Three-phase motor controlled by a variable – frequency drive to make the test shaft rotate to different frequencies. Power of the motor is 0.5 kW and speed range 0 – 10000 r.p.m • Three rotor shafts made of steel of different diameters like 3 mm, 6 mm, 7 mm and approximate length as 950 mm • Rotor disc made of stainless steel with clamping mandrel to load the shaft in a concentrated point. The diameter should be approximately 100 mm and its weight should be approximately 1 Kg. • Speed sensors for measuring the rotational velocity and accelerations, inductive type would be preferred. • Elastic coupling for binding the shafts with the drive motors, • self-aligning bearings for adjustment of shaft during	Europe/USA/UK	No.	1			

		experimentation, • rotor shaft for conducting the whirling made up of metals and fiber based materials • catch bearings for producing the multiple loops within the shaft, • optical sensors for measuring the amplitude of loops produced as a result of whirling of shaft • rotor mass disc for applying the load on rotor shaft, • SCADA based system to measure and plot the: • angular velocity of rotor shaft over different locations of catch bearings • to measure and plot the amplitude of whirls produced as a result of variational speed • demonstrate the loops produced in a rotor shaft in a computer controlled environment **<u>Experimental Capabilities</u>** • Visualization of different modes of oscillation in a shaft • Demonstration of whirls in a shaft and disk and study of speed of the modes of vibration of a rotor shaft in function of different distances between						

		supports • Speed of the modes of vibration of a rotor shaft in function of different diameters of the shaft. • Speed of the modes of vibration of a rotor shaft in function of different conditions in the ends. • Calculation and plotting of nodes and anti-nodes in a shaft over different pointing schemes along with their amplitudes • Influence of the rotating speed of the shaft. Critical speed and operation speed. • Acquiring data and plotting of whirls phenomenon over different diameters of shaft and lengths • Demonstration and plotting of whirls over free-free, free-fixed, fixed-fixed shafts end conditions • Demonstration of whirling in a disc and its effects on multipoint location of shaft Critical speed of the shaft with concentrated load in function of the position of the mass.						
9.	**Gyroscope with DAQ system**	• Base unit with safety dome and a gimbal frame • The rotor of an electric motor shares a horizontally supported shaft	Europe/USA	No	1			

		with a flywheel, forming the gyroscope. • One drive motor to run the gyro for experimentation process, • Second drive motor to run the base of Gyro to produce the instability for experimentation and demonstration purpose, • Both motors work in clockwise and anticlockwise rotation and with variable velocity. • Sensors for measuring the rotational velocity of the rotor and precession • top flywheel mass for spinning purpose, • sliding weight upon which experiments can be conducted at various locations and check the stability of gyro, • lever made up of metal to support and provide the path of sliding weight, • fine weights to stabilize the complete Gyro assembly, • Software for real time data acquisition, measuring and plotting rotation, spinning and gyro effects along with demonstrations of stability effects in aviation and automobiles applications **<u>Experimental Capabilities</u>**						

		• Experimental verification of the gyroscopic laws • Familiarization with the three gyro axes • Calculation of gyroscopic moments • Study the effect of precession • Direction of gyroscopic couple (in relation to precession and rotor spin directions) • Magnitude of gyroscopic couple (in relation to precession and rotor spin velocities) • Direction of gyroscopic couple (in relation to precession and rotor spin directions) • Magnitude of gyroscopic couple (in relation to precession and rotor spin velocities)						
10.	**Multi-channel Measurement Amplifier with DAQ**	• A 16-channel strain display instrument that connects to industry-standard strain gauges. • Fully programmable display to match the strain gauges and their bridge connections • Two dynamic outputs to connect to suitable instruments, such as an oscilloscope or a chart recorder for measurement of transient strains • Direct connections for half and full strain bridge connections, with	Europe/USA	No	1			

		internal ‘make-up’ resistors • Fully programmable to match most types of strain gauges and connections • Range ± 10,000 με, dynamic strain range ± 2000 με. • Dynamic strain output ranges • 200 με/Volt with full bridge connection • 400 με/Volt with half bridge connection • 800 με/Volt with quarter bridge connection • DAQ System • Strain Gauge Kit should be supplied along with following strain gauges • 10x type PFL-20-11 polyester foil strain gauges. Length 20 mm, rated 120 Ohms ± 0.3 Ohm, Gauge Factor 2.13 • 10x type FLA-10-11 alloy foil strain gauges. Length 10 mm,rated 120 Ohms ± 0.3 Ohm, Gauge Factor 2.10 • 10x type FLA-6-11 alloy foil strain gauges. Length 6 mm,rated 120 Ohms ± 0.3 Ohm, Gauge Factor 2.12 • Required solvents, cleaners, neutralizing cleaners, adhesive rubber strips, sufficient quantity of coloured wires, terminal tags, soldering iron and solders, adhesives etc						

11.	**Modular Servo Workshop**	• Laboratory model of servo system compound with different modules to demonstrate: inertia, backslash, damping, elasticity and friction • Linear Damping Module consists of a paramagnetic disc which runs between the poles of the permanent magnet • Inertia Module contains a solid metal roll • Encoder Module is used to measure the rotational angle. A steel baseplate provides firm • Input Motor that should be Analogue or PWM controlled. PWM based would be preferred • Methods use for controls should be from PID to LQ regulator and time-optimal based controls • Position sensor, • Speed sensor, • Incremental encoder, • Techno-generator, • Mounting rail for supporting the complete unit made up of metals, i.e. of steel would be preferred, • Power supply of variable ranges for driving the MSW • Pre-Amplifier Unit • Servo Amplifier • Input & Output Potentiometers • Loading Unit: Complete with	Europe/USA	No	1			

		Brake disc • Reduction Gear Tacho Unit • Digital Encoder • Software: The software for the Modular Servo Workshop should operate under Windows preferably of WIN10 and requires MATLAB®/SIMULINK®, available from The MathWorks Inc. The software should consist of a Real-Time Kernel (RTK), the RTK External Interface and a Modular Servo Workshop Toolbox. **<u>Experimental Capabilities</u>** • PID position control • PID velocity control • Multivariable control design • Pole-placement method • Deadbeat controller • Optimal design method: LQ controller • Demonstration of the continuous case • Demonstration of the discrete case • Steady state characteristics of the DC servo • Time domain identification • Identification task by the surface method • Time domain identification						

		experiment • Demonstration of testing and troubleshooting procedures for servo motors based driven systems • Adaptive control system						
12.	**Hydraulics and Electrohydraulic Trainer with DAQ system**	• Trolley (Aluminum Channel) with frame & caster wheels with Brake • A modular unit consisting of variety of optional kits and elements to configure the desired Hydraulic and Electro-Hydraulic circuit • Hydraulic tank with minimum of 20 Litre capacity, • Oil cleanliness: With suction filter and return line filter • Hydraulics kit containing components to understand the fundamentals and advanced concepts of the hydraulic circuits • Pressure control valves and Pressure limiting valve for Pressure regulation from 5 to 50 bars • Flow control valves: • Shut-off valve. • Adjustable flow control valve: • Knob to regulate the flow.. • Manual distribution valves: • Hydraulic actuators: • Double effect cylinder	Europe/USA	No	1			

		made of stainless steel. Diameter: 40 mm and Stroke of 200 mm. • Connection parts and accessories: • Set of 5 hoses with quick-fit connectors: • 0.6 m hose (2 units). • 1 m hose (2 units). • 2 m hose. • Cross-shaped manifold with manometer with range from 0 to 100 bar with damping • Tank to perform volumetric measures with minimum Capacity of 3 litres and overflow protection • Electro-Hydraulics kit containing components to understand the fundamentals and advanced concepts of the electro-hydraulic circuits. • Pressure control valves and Pressure limiting valve for Pressure regulation from 5 to 50 bars • Flow control valves: • Shut-off valve. • Adjustable flow control valve with pressure compensation • Check valve for flow control with bypass. • Hydraulic solenoid valves:						

		• Bistable 4/2 solenoid valve: ○ Electric activation. ○ Maximum flow: 60 l/min. ○ Maximum pressure: 350 bar. ○ LED indicator. • 4/3 solenoid valve with P-T centre linked with Electric activation, Tandem center, P-T linked, Spring return, with Maximum flow: 60 l/min Maximum pressure: 350 bar • 4/2 solenoid valve with spring return (2 units) with Electric activation, Spring return, Maximum flow: 60 l/min and Maximum pressure: 350 bar. • 4/3 solenoid valve with closed center (2 units) with Electric activation, Closed centre, Spring centred, Maximum flow: 60 l/min and Maximum pressure: 350 bar. • Hydraulic actuators like Double effect cylinder with Diameter: 40 mm, Stroke of 200 mm. • Should have Sensors like Pressure switch, Inductive proximity sensor, two Reed effect proximity sensor, Limit switch • Hydraulic Actuators kit for learning the concepts behind the most common hydraulic actuators as						

		hydraulic motors, hydraulic cylinders, etc containg • Pressure control valves, Flow control valves, Manual distribution valves, Double control valve with joystick, Hydraulic actuators, required sensors and connections • Kit for Measurement and Proportional Control, configured to perform the analog signal and the proportional control over the hydraulic actuators to implement a PID control from the computer. • Control Interface box, PID controller, ○ P controller: Kc: -10 to +10. ○ I controller: Ti: 0 to 100 s. ○ D controller: Td: 0 to 100 s. Sample time: 0.1 to 100 ms. • Electric comparator, 4 analog inputs, and 4 analog outputs • SCADA system with PCI Express Data acquisition board (National Instruments) with • Analog input for Number of channels= 16 single-ended or 8 differential. Resolution=16 bits, 1 in 65536 • Sampling rate up to: 250 KS/s (kilo samples per second) • Analog output Number of						

		channels=2. Resolution=16 bits, 1 in 65536. Maximum output rate up to: 900 KS/s • Digital Input / Output Number of channels=24 • Pressure control valves, Flow control valves, Hydraulic Solenoid Valves, Hydraulic actuators, required sensors and connections • Hydrostatic Steering System kit designed to teach the most common components of the steering system with Distribution valves containing, Maximum flow: 5 l/min, Maximum pressure: 350 bar • Hydraulic and Electro-Hydraulic troubleshooting kit containing Pressure control valves, Flow control valves, Distribution valves, Hydraulic actuators, required sensors and connections **<u>Experimental Capabilities</u>** • Hydraulic Pump Troubleshooting • Flow Measurements • Hydraulic actuators troubleshooting's • Cylinder cushions and boosts • Motor troubleshooting						

		• Hydraulic directional control valve troubleshooting • Hydraulic system troubleshooting • System level troubleshooting • Machine sequence troubleshooting • Machine performance troubleshooting • Hydraulic Filter Maintenance and calibration unit • Fitting and seals systems in a hydraulic unit • Flushing of fluid in a hydraulic systems • Adding of hydraulic fluid in a system • Tubing and component installation						
13.	**Industrial Control Trainer**	• The system should have I/O interface and that can be controlled with the PLC • Chain conveyor • Motor with gearbox and slipping clutch • Belt conveyor: • Trainer must include the Sensors of type: Infrared, Inductive, Capacitive and Fibre Optic • Trainer must include the Solenoids of type: rotary, linear, • Switched Faults, • Start and Stop switch in enclosure, • Emergency Stop Switch	Europe/USA	No	1			

		• Connections must include the D type connector for input and output, power terminals, power jack socket • Power supply for deriving the unit **<u>Experimental Capabilities</u>** • Demonstration of the Principles of industrial operation as: • The sort area • The assembly chute • The sensing area • The reject area • Fault insertions switches • Provide the diagnostics of industrial issue • PLC for accepted and rejected assemblies over industrial flow processes • Component queue handling • Start/stop programming of industrial flow process • Operation time calculations						
14.	**Robotics Trainer**	• The trainer should be equipped with a minimum of 5 axis laboratory based robotic arm with 360 degree rotations and minimum of 500mm reach distance. The repeatability of process should be made with the acceptable error of 0.1mm. • User interface should be attached	Europe/USA	No	1			

		for programmability/reprogramming of robotic arm • Drilling and cutting tools attachment for such purposes • Encoder • Electric Gripper for demonstration at laboratory • The mean time between two failures should be of minimum 10,000 hours • The standard cycle time for the process should be of 2-3 seconds. **<u>Experimental Capabilities</u>** • Performing of task using robotics arm • Task performance without human physical involvement • Demonstration of tool changing while performing a machining based operation						
15.	**Pneumatics Trainer**	• multi way valves of type pressure, shut-off and flow control valves • electric limit switch, • proximity switches, • solenoid valves, • signal boards • PLC with programming software • integrated power supply unit to supply the electro pneumatics and the PLC • distributor block for simultaneous	Europe/USA	No	1			

		use of both panels • hoses, • cables, • Air Compressor • Air Cylinders with Adjustable Cushions • Three-Position Pneu-Turn Rotary Actuators • Micro-Line 3-Way Air Switches • Original Line Three-Position Cylinder • Air Pilot Valve • Solenoid Valve • Dual Air Manifold • Power Supply • PIV-Pneumatic Isolation Valves • Push Button valve • Toggle Valve • Connecting Pipe roll • Elbow connector pack • Straight connector pack • Manifold connector pack • Pipe Cutter • Bracket for rod less cylinder • T-connectors **Experimental Capabilities** • Pneumatics power systems • Pneumatics circuits • Pressure and flow of air using pneumatics based units • Speed control circuits • Directional control valves						

		• Demonstration of Air logic based system • Pneumatics maintenance • Schematics • Air flow and resistance • Flow control valves • Demonstration of cam valves for pneumatics control systems						

Firm Name: _____

Signature: _____

Name: _____

Designation: _____

Annex A-1

Special Instructions

Description	Bidder			Tech Scrutiny to be done by User		
	Yes	**No**	**Alternate Offer**	**Accepted**	**Rejected**	**Reasons of Rejection**
Environment Conditions (a) Temperature range: 05ºC to +40ºC (b) Relative humidity: 0-70% non-condensing						
Warranty period Two years from the date of commissioning.						
Training Notes Supplier will provide a set of handouts for training on operation and maintenance of the equipment						
Publications Supplier is to provide hard and soft copies (CD) of following manuals. (a) **Operational / Maintenance manual**: - Qty 01 with Equipment and additional Qty 02 for record purposes and should consist of following sections:- (1)**Equipment Description /Operation**:- (a) Specifications (b) Description (c) Operation (2)**Servicing**:- (a) Maintenance Schedule (b) Adjustment / test (c) Removal / Installation procedure (d) Tools Required (3) Trouble shooting guide (4) Cleaning requirements (b) Full parts description along with detailed diagrams (exploded view). (c) **Experimental manuals** which must contain the list and procedure of the experiments that equipment can perform.						

Spares / Technical Support (a) Supplier to have in-country spares / technical support and ensure spares and technical support / assistance for next 10 years (b) Comprehensive list of spares required for scheduled maintenance of Equipment is to be provided (c) Any software provided must have its license (d) Software upgrade support must be provided free of cost for 10 x years with renewed license at every upgrade (e) Supplier must also provide calibration service for at least 5 years after commissioning						
Additional Spare / Replaceable parts. (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. (b) All specialized / standard tools required for inspection / repair / servicing must be supplied along with equipment.						
Physical Inspection Criteria • 100% Physical inspection of store will be carried out before commissioning of the equipment for following details a. For physical damage, scratches and deformity. b. Accessories/ Components as per contractual Specifications c. Technical Manuals (Operation Manual, user guide) d. Quality Certificate and calibration certificate by OEM 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. f. Brand name and country origin.						
Commissioning (a) Commissioning of the equipment will be carried out by OEM rep at his own cost and risk at designated place at NUTECH. (b) Any special requirement for installation, operation and commissioning must be specified in the offer by the supplier.						
Training 01 week OEM operational/ maintenance training at NUTECH						
Improvement and Safety Measures Any improvement and safety measures suggested by NUTECH during commissioning						

are to be resolved by the supplier / manufacturer at no extra cost.						
Liability of Supplier (a) Verifiable 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						
Special Notes (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.						

Firm Name: _____

Signature: _____

Name: _____

Designation: _____

Annex-B

TECHNICAL OFFER

NUTECH / SCM / Mechanical Lab Eqpt (PSDP) 2020 / TD-109

Fill in 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 Period: _____

General

1. GST Number: _____ (Enclose Copy)
2. NTN / CNIC: _____ (if exempted, provide valid exemption certificate)

Payment Terms

Ser	In FOB Cases	In FOR Cases
a.	80 % through LC on sight.	50% advance payment against BG/CDR/Pay Order/DD
b.	20% after delivery, installation / commissioning, user satisfaction certificate.	50% payment after delivery, installation / commissioning / user satisfaction certificate

Details of Foreign Principal Information with account details)

1. Name / Title: _____
2. Address: _____

OEM Name:	Firm Name:	Signature:
OEM Focal Person:	Firm Focal Person:	Official Seal:
OEM Phone Number:	Firm Phone Number:	Name:
OEM Email Id:	Firm Email Id:	Designation:

Annex C

FINANCIAL OFFER

NUTECH / SCM / Mechanical Lab Eqpt (PSDP) 2020 / TD-109

Ser	Item Name/Size	Specification	A/U	Qty Req	Price Per Unit FOB=USD FOR=PKR	Total Price FOB=USD FOR=PKR

1.	**Governor Apparatus with DAQ**	• Base unit with safety dome
		• Unit should be driven with DC motor of approximate power of 30 W, 230V, 50 / 60 Hz, 1 phase, with minimum RPM 300
		• Unit should have a Proell governor with minimum of sleeve mass: 3x 100g, and minimum of centrifugal mass: 2x 150g
		• Unit should have a Porter governor, with minimum of sleeve mass: 3x 100g, and minimum of centrifugal mass: 2x 400g
		• Unit should have a Hartnell governor, with minimum of centrifugal mass: 2x 400g, and minimum of 2 compression springs, and an adjustable spring preload
		• Unit measuring range should be from 0 to 700 revolutions per minute
		• Sensor for measuring position (lift) of each governor
		• RPM sensor should be mounted to measure the angular speed
		• Should have at least two springs with following approximate characteristics:-
		  • Spring 1
		  ○ Outside Diameter 32 mm
		  ○ Length 102 mm
		  ○ Wire Diameter 2.64 mm
		  ○ Spring Rate 1.23 N.mm -1
		  ○ Mass 70g
		  • Spring 2
		  ○ Outside Diameter 38 mm
		  ○ Length 102 mm
		  ○ Wire Diameter 3.2 mm
			No	1		

		○ Spring Rate 2.07 N.mm-1 ○ Mass 130g • Required Weights of 100 and 200 gram (three each) • Unit connected with data acquisitions system with following characteristics:- • Analogue Inputs • Sample rate up to 25 kHz with 12 bit resolution • Bandwidth/Filter cut-off 3 kHz (nominal) • Data should be exportable as XLSX file and HTML file • LabVIEW software **Experimental Capabilities** •Analysis of the characteristic curves of governor speed vs sleeve lift. •Analysis on governor types with respect to sensitivity, stability and effort. •Calculations and Predictions on Porter and Porell governors of the effects of varying center of sleeve mass over speeds •Analysis on the Hartnell governor of the effect of varying: arm length, spring rate, spring compression, rotating mass Predictions of the design and adjustment of different governors over different speeds and structural changes in terms of masses				
2.	**Determination of Gear Efficiency**	•Three-phase AC motor with variable speed of, power output: 0,20kW, speed: 0…2500 revolutions min-1 •Magnetic particle brake, rated braking torque at exciting current 0…0.2A: 0…8Nm •Two-stage spur gear, transmission ratio should be minimum of 13,5 torque: min, 23.4Nm •Worm gear with minimum of transmission ratio: 15, torque: 10Nm, worm: z=2, worm gear: z=40 •Measuring ranges, speed: 0…3000min-1, force: 0…100N • Unit should be compatible with the following electric combinations 230V, 50Hz, 1 phase 230V, 60Hz, 1 phase; 120V, 60Hz, 1 phase • Efficiency of the unit should be displayed in digital form	No	1		

		Experimental Capabilities Determination of the mechanical efficiency of gears by comparing the mechanical driving and braking power for a) Spur gears b) Worm gears c) Helical gears • Determine the speed ratios over gears teeth ratios • Determine the torque variations over the applied loading conditions • Determine of the backlash over a) spur gears b) helical gears c) worm gears • Predictions of transmission ratios • Predictions of torque transmissions				
3.	**Clutches and Brakes Apparatus**	• Leading (primary) and trailing (secondary) shoe brakes with minimum of 15 mm diameter, • Primary and secondary disc brakes with minimum of 15 mm diameter • Pulleys for hanging the masses with minimum of 15 mm diameter • Handles connected with pulleys to apply the load on brakes • Bench/wall mounted base unit • Hanging weights of minimum of 10 grams • Springs for Pressure Applying on clutch plates • Clutch plate with minimum of 5 mm diameter • Clutch Rings • Measuring ranges, speed: Approximately 0…100 revolutions per min, torque: ±15Nm **Experimental Capabilities** • Demonstration/Analysis of clutch engagement and disengagement • To investigate the relationship between the normal pressure applied to the friction surfaces, the mean radius of the friction rings and the torque at which slip occurs • To investigate the relationship between the forces involved in vehicle braking system • Determination of friction forces over clutch plates • Determination of applied pressures to drive the plates	No	1		

		• Plotting of characteristics curves over friction forces and applied torques • Plotting of disc applied pressures and friction forces				
4.	**Epicyclic Gear Train Apparatus**	• Bench-top unit with adjustable legs. • Min 3 sets of epicyclic gear train: • Each gear train consists of a sun gear in the center, three planet gears, a planet linkage and an internal or ring gear. • Two graduated discs located at the input and output shafts. • Secondary Output Drive shaft mounted with helical gears • Primary helical gears minimum of three mounted with input shaft • Bearings should be mounted to reduce the frictional losses • Pin for applying the external load on outer shaft • Outer shaft with inner helical gears teeth's • Measuring ranges, speed: Approximately 0…600 revolutions per min • Hooks for hanging the masses to apply load on the shafts as in the form of torque • Three forward speeds and a one reverse speed. • Torque reaction kit to be used with above system **<u>Experimental Capabilities</u>** • To demonstrate the operation and function of an epicyclic gears system • To determine and verify the speed and torque ratio between input and output shafts. • Calculate and experimentally observe the angular velocity ratios of gear trains • Experimentally obtain the torque ratios of gear trains, gear ratios, efficiencies and velocity ratios • Calculate the mechanical advantage and efficiencies of gear trains and draw efficiency curve • To determine the minimum effort required at the input to raise a load at the output.	No	1		

5.	**Computerized Vibration Analyzer**	• Acceleration sensors for measuring the acceleration of rotating/displaced/vibratory shafts/beams • Optical sensors to record speed • Channel amplifier with adjustable gains • Oscilloscope to measure the amplitude of vibration • Fast Fourier transform analyzer • Displacement sensors for measuring the angular/linear displacements of vibrational producing equipment • Velocity measuring sensors • Input unit for the generation of vibrations • SCADA should be there to measure and adjust the vibrational amplitudes • Measuring amplifier with adjustable gain • Bearings should be mounted for reducing the friction and smooth flow of vibration producing unit • RPM meter to measure the revolutions in case of rotating parts • Deflection measurement sensors in case of measuring the vibrations in beams/columns • Unit should be compatible with at least windows 10 **<u>Experimental Capabilities</u>** • Demonstration of vibration signal calibration and processing • Analysis of Fast Fourier Transform over vibrational apparatus • Calculation of vibration amplitude, speed, velocity and acceleration and plotting of their characteristics curves • Calculation/Prediction of vibration state of vibrational producing equipment • Damage analysis of roller bearings and gears by means of envelope spectra • Detection of cracks in shafts by means of run-up curves and order analysis • Measurement of imbalance vibrations and field balancing of rigid rotors in 1 and 2 planes • Characteristics curves of vibration displacement, velocity and acceleration	No	1		

		• Behavioral effects of damped, critically damped and undamped systems				
6.	**Static and Dynamic Balancing Machine,**	• Self-contained bench or desktop mounting unit, • Includes four removable rotating masses (balance blocks) with different inserts for a range of moments • Protractor, horizontal scale and sliding indicator • Flexible mountings • Selection of discs with eccentric holes of different diameters • Nominal Moment Values of the blocks to be approximately 0.025 Nm to 0.040 Nm • Extension shaft and pulley for static balancing, using a weight hanger and masses • Includes minimum 20 x 10 g masses and 10 x 1 g masses • Electric motor and belt drive for dynamic balancing **<u>Experimental Capabilities</u>** • Demonstration of simple static and dynamic balancing of two, three and four rotating masses • Dynamic balancing of rotating mass systems by calculation and vector diagrams (triangle and polygon) • Demonstrates balancing of a horizontal shaft with two, three or four rotating masses • Independent analysis of static and dynamic balancing	No	1		
7.	**Torsional Oscillations Apparatus**	• Bench-top unit with adjustable legs • Vibrational Exciters • Adjustable bars lengths to generate the oscillations • Bars can be supported minimum of five different points to make the visual loops • Oscillation amplitude measuring sensors • Velocity measuring sensors	No	1		

		• Optical sensors to visualize the loops of oscillations • SCADA to change and measure the amplitude of oscillations and to plot the oscillational behaviours of testing unit over time and length parameters • Unit should be able to measure the oscillations under minimum of five types of damping conditions • Input drive unit to generate the oscillations • At least 9 Test rods three each of steel, brass and aluminum. • Diameter 8 mm and 350 mm in length. • A Dynamometer up to 10 Kg, with a 50 g accuracy, to apply the forces on the test rod **<u>Experimental Capabilities</u>** • Demonstration of damped, undamped and critically damped oscillations in a beam • Verification of the elastic torsion equation of circular rods • Measurement of vibrational oscillations amplitude, velocity and accelerations • Acquiring and plotting of free and forced vibrational oscillations • Demonstration and calculations of viscous damping • Demonstration of the behaviour of vibration oscillation absorber • Demonstration and calculations of the resonance phenomenon Demonstration of frictional damping				
8.	**Whirling of Shafts**	• Bench top unit with adjustable legs • Anodized aluminum frame and panels made of painted steel. • Main metal elements made of stainless steel. • Three-phase motor controlled by a variable – frequency drive to make the test shaft rotate to different frequencies. Power of the motor is 0.5 kW and speed range 0 – 10000 r.p.m	No	1		

		• Three rotor shafts made of steel of different diameters like 3 mm, 6 mm, 7 mm and approximate length as 950 mm
		• Rotor disc made of stainless steel with clamping mandrel to load the shaft in a concentrated point. The diameter should be approximately 100 mm and its weight should be approximately 1 Kg.
		• Speed sensors for measuring the rotational velocity and accelerations, inductive type would be preferred.
		• Elastic coupling for binding the shafts with the drive motors,
		• self-aligning bearings for adjustment of shaft during experimentation,
		• rotor shaft for conducting the whirling made up of metals and fiber based materials
		• catch bearings for producing the multiple loops within the shaft,
		• optical sensors for measuring the amplitude of loops produced as a result of whirling of shaft
		• rotor mass disc for applying the load on rotor shaft,
		• SCADA based system to measure and plot the:
		  • angular velocity of rotor shaft over different locations of catch bearings
		  • to measure and plot the amplitude of whirls produced as a result of variational speed
		  • demonstrate the loops produced in a rotor shaft in a computer controlled environment
		
		<u>Experimental Capabilities</u>
		
		• Visualization of different modes of oscillation in a shaft
		• Demonstration of whirls in a shaft and disk and study of speed of the modes of vibration of a rotor shaft in function of different distances between supports
		• Speed of the modes of vibration of a rotor shaft in function of different diameters of the shaft.				

		• Speed of the modes of vibration of a rotor shaft in function of different conditions in the ends. • Calculation and plotting of nodes and anti-nodes in a shaft over different pointing schemes along with their amplitudes • Influence of the rotating speed of the shaft. Critical speed and operation speed. • Acquiring data and plotting of whirls phenomenon over different diameters of shaft and lengths • Demonstration and plotting of whirls over free-free, free-fixed, fixed-fixed shafts end conditions • Demonstration of whirling in a disc and its effects on multipoint location of shaft Critical speed of the shaft with concentrated load in function of the position of the mass.				
9.	**Gyroscope with DAQ system**	• Base unit with safety dome and a gimbal frame • The rotor of an electric motor shares a horizontally supported shaft with a flywheel, forming the gyroscope. • One drive motor to run the gyro for experimentation process, • Second drive motor to run the base of Gyro to produce the instability for experimentation and demonstration purpose, • Both motors work in clockwise and anticlockwise rotation and with variable velocity. • Sensors for measuring the rotational velocity of the rotor and precession • top flywheel mass for spinning purpose, • sliding weight upon which experiments can be conducted at various locations and check the stability of gyro, • lever made up of metal to support and provide the path of sliding weight, • fine weights to stabilize the complete Gyro assembly, • Software for real time data acquisition, measuring and plotting rotation, spinning and gyro effects along with demonstrations of stability effects in aviation and automobiles applications	No	1		

		Experimental Capabilities • Experimental verification of the gyroscopic laws • Familiarization with the three gyro axes • Calculation of gyroscopic moments • Study the effect of precession • Direction of gyroscopic couple (in relation to precession and rotor spin directions) • Magnitude of gyroscopic couple (in relation to precession and rotor spin velocities) • Direction of gyroscopic couple (in relation to precession and rotor spin directions) • Magnitude of gyroscopic couple (in relation to precession and rotor spin velocities)				

10.	**Multi-channel Measurement Amplifier with DAQ**	• A 16-channel strain display instrument that connects to industry-standard strain gauges.
		• Fully programmable display to match the strain gauges and their bridge connections
		• Two dynamic outputs to connect to suitable instruments, such as an oscilloscope or a chart recorder for measurement of transient strains
		• Direct connections for half and full strain bridge connections, with internal 'make-up' resistors
		• Fully programmable to match most types of strain gauges and connections
		• Range ± 10,000 με, dynamic strain range ± 2000 με.
		• Dynamic strain output ranges
		  • 200 με/Volt with full bridge connection
		  • 400 με/Volt with half bridge connection
		  • 800 με/Volt with quarter bridge connection
		• DAQ System
		• Strain Gauge Kit should be supplied along with following strain gauges
			No	1		

		• 10x type PFL-20-11 polyester foil strain gauges. Length 20 mm, rated 120 Ohms ± 0.3 Ohm, Gauge Factor 2.13 • 10x type FLA-10-11 alloy foil strain gauges. Length 10 mm,rated 120 Ohms ± 0.3 Ohm, Gauge Factor 2.10 • 10x type FLA-6-11 alloy foil strain gauges. Length 6 mm,rated 120 Ohms ± 0.3 Ohm, Gauge Factor 2.12 • Required solvents, cleaners, neutralizing cleaners, adhesive rubber strips, sufficient quantity of coloured wires, terminal tags, soldering iron and solders, adhesives etc				
11.	**Modular Servo Workshop**	• Laboratory model of servo system compound with different modules to demonstrate: inertia, backslash, damping, elasticity and friction • Linear Damping Module consists of a paramagnetic disc which runs between the poles of the permanent magnet • Inertia Module contains a solid metal roll • Encoder Module is used to measure the rotational angle. A steel baseplate provides firm • Input Motor that should be Analogue or PWM controlled. PWM based would be preferred • Methods use for controls should be from PID to LQ regulator and time-optimal based controls • Position sensor, • Speed sensor, • Incremental encoder, • Techno-generator, • Mounting rail for supporting the complete unit made up of metals, i.e. of steel would be preferred, • Power supply of variable ranges for driving the MSW • Pre-Amplifier Unit • Servo Amplifier • Input & Output Potentiometers • Loading Unit: Complete with Brake disc • Reduction Gear Tacho Unit	No	1		

		• Digital Encoder • Software: The software for the Modular Servo Workshop should operate under Windows preferably of WIN10 and requires MATLAB®/SIMULINK®, available from The MathWorks Inc. The software should consist of a Real-Time Kernel (RTK), the RTK External Interface and a Modular Servo Workshop Toolbox. **<u>Experimental Capabilities</u>** • PID position control • PID velocity control • Multivariable control design • Pole-placement method • Deadbeat controller • Optimal design method: LQ controller • Demonstration of the continuous case • Demonstration of the discrete case • Steady state characteristics of the DC servo • Time domain identification • Identification task by the surface method • Time domain identification experiment • Demonstration of testing and troubleshooting procedures for servo motors based driven systems • Adaptive control system				
12.	**Hydraulics and Electrohydraulic Trainer with DAQ system**	• Trolley (Aluminum Channel) with frame & caster wheels with Brake • A modular unit consisting of variety of optional kits and elements to configure the desired Hydraulic and Electro-Hydraulic circuit • Hydraulic tank with minimum of 20 Litre capacity, • Oil cleanliness: With suction filter and return line filter • Hydraulics kit containing components to understand the fundamentals and advanced concepts of the hydraulic circuits • Pressure control valves and Pressure limiting valve for Pressure	No	1		

		regulation from 5 to 50 bars
		• Flow control valves:
		  • Shut-off valve.
		  • Adjustable flow control valve:
		  • Knob to regulate the flow..
		• Manual distribution valves:
		• Hydraulic actuators:
		  • Double effect cylinder made of stainless steel. Diameter: 40 mm and Stroke of 200 mm.
		• Connection parts and accessories:
		  • Set of 5 hoses with quick-fit connectors:
		  • 0.6 m hose (2 units).
		  • 1 m hose (2 units).
		  • 2 m hose.
		• Cross-shaped manifold with manometer with range from 0 to 100 bar with damping
		• Tank to perform volumetric measures with minimum Capacity of 3 litres and overflow protection
		• Electro-Hydraulics kit containing components to understand the fundamentals and advanced concepts of the electro-hydraulic circuits.
		• Pressure control valves and Pressure limiting valve for Pressure regulation from 5 to 50 bars
		• Flow control valves:
		  • Shut-off valve.
		  • Adjustable flow control valve with pressure compensation
		• Check valve for flow control with bypass.
		• Hydraulic solenoid valves:
		  • Bistable 4/2 solenoid valve:
		  ○ Electric activation.
		  ○ Maximum flow: 60 l/min.
		  ○ Maximum pressure: 350 bar.
		  ○ LED indicator.				

		• 4/3 solenoid valve with P-T centre linked with Electric activation, Tandem center, P-T linked, Spring return, with Maximum flow: 60 l/min Maximum pressure: 350 bar • 4/2 solenoid valve with spring return (2 units) with Electric activation, Spring return, Maximum flow: 60 l/min and Maximum pressure: 350 bar. • 4/3 solenoid valve with closed center (2 units) with Electric activation, Closed centre, Spring centred, Maximum flow: 60 l/min and Maximum pressure: 350 bar. • Hydraulic actuators like Double effect cylinder with Diameter: 40 mm, Stroke of 200 mm. • Should have Sensors like Pressure switch, Inductive proximity sensor, two Reed effect proximity sensor, Limit switch • Hydraulic Actuators kit for learning the concepts behind the most common hydraulic actuators as hydraulic motors, hydraulic cylinders, etc containg • Pressure control valves, Flow control valves, Manual distribution valves, Double control valve with joystick, Hydraulic actuators, required sensors and connections • Kit for Measurement and Proportional Control, configured to perform the analog signal and the proportional control over the hydraulic actuators to implement a PID control from the computer. • Control Interface box, PID controller, ○ P controller: Kc: -10 to +10. ○ I controller: Ti: 0 to 100 s. ○ D controller: Td: 0 to 100 s. Sample time: 0.1 to 100 ms. • Electric comparator, 4 analog inputs, and 4 analog outputs • SCADA system with PCI Express Data acquisition board (National Instruments) with • Analog input for Number of channels= 16 single-ended or 8 differential. Resolution=16 bits, 1 in 65536 • Sampling rate up to: 250 KS/s (kilo samples per second) • Analog output Number of channels=2. Resolution=16 bits, 1 in 65536.				

		Maximum output rate up to: 900 KS/s • Digital Input / Output Number of channels=24 • Pressure control valves, Flow control valves, Hydraulic Solenoid Valves, Hydraulic actuators, required sensors and connections • Hydrostatic Steering System kit designed to teach the most common components of the steering system with Distribution valves containing, Maximum flow: 5 l/min, Maximum pressure: 350 bar • Hydraulic and Electro-Hydraulic troubleshooting kit containing Pressure control valves, Flow control valves, Distribution valves, Hydraulic actuators, required sensors and connections **<u>Experimental Capabilities</u>** • Hydraulic Pump Troubleshooting • Flow Measurements • Hydraulic actuators troubleshooting's • Cylinder cushions and boosts • Motor troubleshooting • Hydraulic directional control valve troubleshooting • Hydraulic system troubleshooting • System level troubleshooting • Machine sequence troubleshooting • Machine performance troubleshooting • Hydraulic Filter Maintenance and calibration unit • Fitting and seals systems in a hydraulic unit • Flushing of fluid in a hydraulic systems • Adding of hydraulic fluid in a system • Tubing and component installation				
13.	**Industrial Control Trainer**	• The system should have I/O interface and that can be controlled with the PLC • Chain conveyor • Motor with gearbox and slipping clutch	No	1		

		• Belt conveyor: • Trainer must include the Sensors of type: Infrared, Inductive, Capacitive and Fibre Optic • Trainer must include the Solenoids of type: rotary, linear, • Switched Faults, • Start and Stop switch in enclosure, • Emergency Stop Switch • Connections must include the D type connector for input and output, power terminals, power jack socket • Power supply for deriving the unit **<u>Experimental Capabilities</u>** • Demonstration of the Principles of industrial operation as: • The sort area • The assembly chute • The sensing area • The reject area • Fault insertions switches • Provide the diagnostics of industrial issue • PLC for accepted and rejected assemblies over industrial flow processes • Component queue handling • Start/stop programming of industrial flow process • Operation time calculations				
14.	**Robotics Trainer**	• The trainer should be equipped with a minimum of 5 axis laboratory based robotic arm with 360 degree rotations and minimum of 500mm reach distance. The repeatability of process should be made with the acceptable error of 0.1mm. • User interface should be attached for programmability/reprogramming of robotic arm • Drilling and cutting tools attachment for such purposes	No	1		

		• Encoder • Electric Gripper for demonstration at laboratory • The mean time between two failures should be of minimum 10,000 hours • The standard cycle time for the process should be of 2-3 seconds. **Experimental Capabilities** • Performing of task using robotics arm • Task performance without human physical involvement • Demonstration of tool changing while performing a machining based operation				
15.	**Pneumatics Trainer**	• multi way valves of type pressure, shut-off and flow control valves • electric limit switch, • proximity switches, • solenoid valves, • signal boards • PLC with programming software • integrated power supply unit to supply the electro pneumatics and the PLC • distributor block for simultaneous use of both panels • hoses, • cables, • Air Compressor • Air Cylinders with Adjustable Cushions • Three-Position Pneu-Turn Rotary Actuators • Micro-Line 3-Way Air Switches • Original Line Three-Position Cylinder • Air Pilot Valve • Solenoid Valve • Dual Air Manifold • Power Supply • PIV-Pneumatic Isolation Valves • Push Button valve	No	1		

		• Toggle Valve • Connecting Pipe roll • Elbow connector pack • Straight connector pack • Manifold connector pack • Pipe Cutter • Bracket for rod less cylinder • T-connectors **Experimental Capabilities** • Pneumatics power systems • Pneumatics circuits • Pressure and flow of air using pneumatics based units • Speed control circuits • Directional control valves • Demonstration of Air logic based system • Pneumatics maintenance • Schematics • Air flow and resistance • Flow control valves • Demonstration of cam valves for pneumatics control systems				
Total						

Firm Name: _____

Signature: _____

Name: _____

Designation: _____

Tender No_____

Name of the Firm _____

Firm Address_____

Date_____

Telephone No_____

E-Mail_____

To,

DD SCM Office
NUTECH University
I-12, Main IJP Road,
Islamabad.

Dear Sir

1. I / We hereby offer to supply to the NUTECH University the stores detailed in schedule to the tender inquiry or such portion thereof as you may specify in the acceptance of tender at the price offered against the said schedule and further agree that this offer will remain valid up to 90 days after opening of Financial offer and will not be withdrawn or altered in terms of rates quoted and the conditions already stated therein or on before this date. I / we shall be bound by a communication of acceptance to be dispatched within he prescribed time.

2. I / we have understood the instructions to Tenders and General Conditions Governing Contract available at NUTECH website and have thoroughly examined the specifications / drawing and / or patterns quoted in the schedule here to and am/are fully aware of the nature of the stores required and my/ our offer is to supply stores strictly in accordance with the requirements.

Yours Faithfully.

(Signature of Tenderer)
Designation
Date:

Individual signing tender and / or other documents connected with a contract must be signed by principal authorized rep/ OEM rep/ Authorized partner firm rep.

BANK GUARANTEE AGAINST
"ADNVANCE/PERFORMANCE/WARRANTY GUARANTEE
Which ever is applicable

Guarantee No
Date: _____

Amount: _____

Valid upto: _____

In Favour of:
National University of Technology (NUTECH), IJP Road, I-12, Islamabad.

Subject: **In compliance with terms of Advance/Performance/Warranty Guarantee Bank Guarantee**

Contract No: _____
dated_____

Dear Sir,

1. Whereas your good-self have entered into Contract No: _____ dated _____ with M/s [Firm Name] Located at [Firm Address], Herein after referred to as our customer and that one of the conditions of the Contract is submission of Bank Guarantee by our customer to your good-self for a sum of [Amount].

2. Incompliance with this stipulation of subj contract, we hereby agree and undertake as under:-

   a. To pay to you unconditionally on demand and / or without any reference to our Customer an amount not exceeding the sum of [Amount] as would be mentioned in your written Demand Notice.
   b. To keep this Guarantee in force till [Validity Date].
   c. That the validity of this Bank guarantee shall be kept two clear year ahead of the original / extended delivery period or the warrantee of the stores which so ever is later in duration on receipt of information from your office. Our liability under this Bank Guarantee shall cease on the closing of banking hours on the last date of validity of this Bank Guarantee. Claim received there after shall not been entertained by us whether you suffer a loss or not. On receipt of payment under this Guarantee, this

documents i.e., Bank Guarantee must be clearly cancelled, discharged and returned to us.

d. That we shall inform your office regarding termination of the validity of this bank Guarantee on clear month before the actual expiry date of this Bank Guarantee.

e. That with the consent of our customer you may amend / alter any term / cause of the contractor add / delete any term / clause to / from this contract without making any reference to us. We do not reserve any right to receive any such amendment / alternation or addition / deletion provided such like actions do not increase our monetary liability under this Bank Guarantee which shall be limited only [Amount……..].

f. That the bank guarantee herein before given shall not be affected by any change in the constitution of the Bank or Customer / Supplier or Vendor.

g. That this is an unconditional Bank guarantee, which shall been cashed on sight on presentation without any reference to our Customer / Supplier or Vendor.

Signature_____

Name_____

Desig_____

Bank Stamp_____

Note: No changes in the above given BG format shall be accepted.

"SELLER'S WARRANTY"

(To be provided on stamp paper)

Contract No: _____ Dated: _____

Validity 2 years from the date of final acceptance of the Stores.

1. We hereby guarantee that we are the genuine and original Source of provisioning the Stores to our Buyer. We also undertake that nothing in the manufacturing of these Stores has been obtained through unauthorized means.
2. We hereby warrant and undertake that the Stores and all the associated spares/ accessories supplied under the terms and conditions of the above Contract, are:
    a. brand new, complete in all respects, possessing good quality and standard workmanship; and
    b. liable for replacement/rectification free of charge, if during the Warranty period the same are found defective before or under normal use or these do not remain within the limits and tolerances stated under the specifications or in any way not in accordance with the terms of this Contract. All expenses incurred in removal, re-provisioning and reinstallation of such defective Stores or their parts shall also be borne by us.
3. The Warranty shall remain valid for a period of 2 years from the date of final acceptance of the Stores.

Signature_____

Name_____

Desig_____

Stamp_____

Date_____

CHECK LIST

(This checked list must be attached with your technical offer, duly filled and Signed by authorized signatory)

Tender No_____ **Date**_____

1	Tender Processing Fee	a. Tender processing fee ref no_____ b. Bank_____ c. Amount_____	
2	EM/ Bid Bond	a. EM/ Bid Bond ref no_____ b. Bank _____	
3	Form Annex A, A-1, B and C signed by Authorized Signatory	**Yes**	**No**
4	Offering specification of items as per IT	**Yes**	**No**
5	Quoted Currency as per IT	**Yes**	**No**
6	Accounting unit/Qty as per IT	**Yes**	**No**
7	Delivery Schedule as per IT	**Yes**	**No**
8	Country of origin of store_____		
9	Name of OEM:-_____		
10	Original Performa invoice (Mandatory)	**Yes**	**No**
11	Certified that there is no Deviation from IT conditions/ there is deviation from IT condition as per fol details	**Yes**	**No**
12	Blacklisting certificate.	**Yes**	**No**
13	Verifiable OEM Certificate	**Yes**	**No**
14	Warranty Period as per IT	**Yes**	**No**
15	ATPs provided	**Yes**	**No**

Note: Fill and/or mark Yes/No where required

_____

Signature of Firm Auth Signatory