

राष्ट्रीय प्रौद्योगिकी संस्थान, मिजोरम
NATIONAL INSTITUTE OF TECHNOLOGY, MIZORAM

(An Institute of National Importance under Ministry of HRD, Govt. of India)

CHALTLANG, AIZAWL: MIZORAM – 796012,

Phone No. 0389- 2341236/ 2341699

Fax: 0389-2341774

Web: www.nitmz.ac.in

Email: nit_mizoram@nitmz.ac.in

Ref. No.: NIT-MZ/TENDER/01-A/2014

Date: 29th January 2014

**NOTICE INVITING TENDER FOR SUPPLY & INSTALATION OF
LABORATORY EQUIPMENTS FOR MECHANICAL ENGINEERING
DEPARTMENT**

Theory of machine

Last date for receiving Tender documents: **25th February 2014 before 3:00 PM**

Date/Time for Opening of Tech. Bids: **25th February 2014 at 3.30 PM**

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Ref. No.: NIT-MZ/TENDER/02-A/2013

Date: 20th May 2013

NOTICE INVITING TENDER (NIT)

National Institute of Technology-Mizoram is one of the ten new NITs established by Ministry of Human Recourse Development, Government of India, New Delhi in the year 2010 at Aizawl, Mizoram to impart education, training and research in Science, Technology and Management leading to award of B. Tech., M. Tech., MBA and Ph.D degrees. This institute is fully financed and governed by Ministry of Human Recourse Development, Government of India.

Sealed Tenders are invited from eligible Manufacturers/Developers or their Authorized Dealers for supply & Installation of Machines as per details at **ANNEXURE-IV, in Two Bids** to reach the undersigned on or before **25th February 2014 before 3:00 PM**. Date/Time for Opening of Tech. Bids: **25th February 2014 at 3.30 PM**. After evaluation of Technical Bids, Financial Bids of the successful bidders will be opened on later date which will be notified in the Institute website. Venue of bid opening: **NIT Mizoram, Aizawl**.

Sl. No.	Reference No.	Items	Qty	EMD (Rs.) in the form of DD only. (Refundable)	Tender Document Fee (Rs.) in the form of DD only. (Non-Refundable)
01.		Supply & Installation of Equipments for Theory of Machine Lab on turnkey basis to be installed at NIT, Mizoram, Aizawl	One Package	@2%	1,000.00

Note: Demand Draft must be in favor of “**Director, NIT Mizoram**” Payable at **Aizawl**.

General Instructions for the Bidders:

01. Quotations will have to be submitted in TWO Bids i.e. **Technical Bid and Financial Bid, in hard copy as well as in soft copy (soft copy must be in MS word 2007 provided in separate CDs for Technical Bid and Financial Bid). Both hard copy and soft copy of Technical Bid should be in one sealed envelope specifically mentioning “Technical Bid” on the cover of the envelope similarly for Financial Bid also, both hard copy and soft copy of must be in one sealed envelope specifically mentioning “Financial Bid” on the cover of the envelope.** Further these two sealed Bids must be kept inside one big sealed envelope before submitting it.

The address of the firm submitting the quotation and the Officer to whom the quotation is addressed must appear distinctly on sealed covers. Further, on sealed cover, the following are to be written:

QUOTATION FOR SUPPLY & INSTALLATION OF **“EQUIPMENT FOR THEORY OF MACHINE LABORATORY OF MECHANICAL ENGINEERING DEPARTMENT AT NIT MIZORAM”**.

02. **Submission of Compliance Certificate:** Duly filled and signed Compliance Certificates (as per formats at **Annexure I (A & B)**) are must with the Technical bid.

03. **Bid not transferable:** The bid documents are not transferable and the seal and signature of the authorized official of the firm must appear on all the papers and envelopes submitted.

QUALIFICATION REQUIREMENTS

01. The Bidder should be a Original Equipment Manufacturer (OEM) Or a firm of reputation having sufficient expertise and experience in the subject tender with sound warranty / service support capability and authorization from Manufacturer/Distributor.

02. **The Bidder has to Quote for all the items in the Theory of Machine Lab, Bidders who do not Quote for all the items are subject to be disqualified.**

TERMS & CONDITIONS:

01. **Rates:** Rates quoted in the **Price Bid** should be **on DOOR DELIVERY NIT Mizoram basis**, as per details below:

Sl. No.	Particulars	Rate
I	Basic Price (per unit) including Packing, Forwarding, Freight, Insurance, Installation & demonstration charges inclusive	
II	Taxes(pl. give break up)	
III	Grand Total for the item on door delivery at NIT Mizoram	

Bidders shall indicate their rates in clear/visible figures as well as in words and shall not alter/overwrite/make cutting in the quotation. In case of a mismatch, the rates written in words will prevail.

02. **Validity of Quotation:** Quoted rates must be valid for **90 days** from the date of quotation.
03. **Warranty:** The quoted equipment and components must be warranted for a minimum of one Year or period specified against the item from date of Installation.
04. **Literature a must:** All the quotations must be supported by the printed technical leaflet/literature and the specifications mentioned in the quotation must be reflected/ supported by such printed technical leaflet/literature. The model and specifications quoted should **invariably be highlighted** in the leaflet/literature for easy reference.
05. **After Sales Service:** Vendors should clearly state the available nearest after sales service facilities in the region, without which their offers will be rejected.
06. **Dealership Certificate:** Dealers or Agents quoting on behalf of Manufacturer must enclose valid dealership certificate.
07. **Earnest Money Deposit:**

Refundable earnest money deposit (EMD) of @2% of the Quoted Value through demand draft drawn in favor of “The Director, National Institute of Technology Mizoram”, payable at Aizawl, will have to accompany the technical Bid. The EMD of unsuccessful bidders shall be returned after award of contract. EMD of the successful bidder will be released on submission of the Performance Guarantee. Offers received without Earnest Money or valid Certificate shall be summarily rejected.

08. **Performance Bank Guarantee (PBG):** In case of items with order value of Rupees five lakhs (INR 5,00,000/-) and above, the successful bidder shall furnish an unconditional PBG (as per format at **Annexure II**) for 5% of the Purchase Order value from a scheduled Bank of India, after receiving the purchase order. Where the PBG is obtained by a foreign bank, it shall be got confirmed by a Schedule Indian bank and shall be governed by Indian Laws and be subject to the jurisdiction of courts at Aizawl. The PBG shall guarantee that,

- (a) The Vendor guarantees satisfactory operation of the Equipment & components against poor workmanship, bad quality of materials used, faulty designs and poor performance.
- (b) The Vendor shall, at his own cost, rectify the defects/replace the items supplied, for defects identified during the period of guarantee.
- (c) This guarantee shall be operative from the date of installation till 60 days after the warranty period.

09. **Delivery:**

- a) **Time Limit:** Maximum within 12 Weeks from the date of issue of this purchase order.
 - b) **Safe Delivery:** All aspects of safe delivery shall be the exclusive responsibility of the vendor. At the destination site, the package will be opened only in the presence of NIT user/representative and vendor's representative. The intact condition of the package and the seal/indicators for not being tampered with shall form the basis for certifying the receipt in good condition.
 - c) **Insurance:** The supplier is to establish 'All Risk Transit Insurance' coverage till door delivery at NIT Mizoram.
 - d) **Part Delivery:** Acceptance of part delivery shall be a prerogative of the institute.
 - e) **Penalty for delay in delivery:** The date of delivery should be strictly adhered to otherwise the Director, NIT Mizoram reserves the right not to accept delivery in part or full.
10. **Genuine Pricing:** Vendor is to ensure that quoted price for the particular item is not more than the price quoted to any other customer in India, particularly to IITs/NITs and other Government Organization. Copy of the latest price list for the quoted item, applicable in India, must be enclosed with the offer.
11. **Conditional tenders not acceptable:** All the terms and conditions mentioned herein must be strictly adhered to by all the vendors. Conditional tenders shall not be accepted on any ground and shall be rejected straightway. Conditions mentioned in the tender bids submitted by vendors will not be binding on NIT Mizoram.
12. **Road Permit:** NIT, Mizoram will provide Road Permit to the Vendors of outside Mizoram.
13. **VAT deduction at source:** In case of supply within Mizoram, VAT deduction at source, as per Order/ notification of the Govt. of Mizoram will be applicable.
14. **Late and delayed tender:** Late and delayed tender will not be considered. In case any unscheduled holiday occurs on the prescribed closing/opening date the next working day shall be the prescribed date of closing/opening.

15. **Payment:** 100% payment within 30(Thirty) days after receipt of the material in full, satisfactory installation, training and acceptance.

16. **Payment for Imported Goods:** By an irrevocable letter of Credit at CIF/CIP Kolkata value negotiable through any overseas branch of State Bank of India/any Schedule Bank of India.

Note: Please note LoC will not be opened unless and until Letter of Acknowledgement in original is received at NIT, Aizawl, Mizoram, directly from the principal (Even in case of firms having subsidiary office in India).

17. ADDITIONAL TERM FOR IMPORTED GOODS

Following term besides the fore mentioned terms will be applicable in case of foreign purchases:

Rates: Prices quoted must be for destination including freight and insurance charges inclusive of free delivery up to the door of department/centre NIT, Mizoram premises, as per details below:

Sl. No.	Particulars	Rate
I	Basic Price (per unit) including Packing, Forwarding, Freight, Insurance, Installation & demonstration charges inclusive	
II	Custom Duty (Approximate)	
III	Grand Total for the item on door delivery at NIT Mizoram	

18. **Free Maintenance & Service for 20 Years:** An agreement is to be executed between the Institute & the **Manufacturer/Distributor/Dealer** for providing **Free Maintenance & Service for 20 Years** after expiry of the Warranty Period of the equipment by the Manufacturer/Distributor/Dealer (Preferably from the Manufacturer) within 30 Days from the day of Complain. The cost of the Spare parts required for the service and maintenance will be paid by the Institute along with the To & Fro charges (The cheapest mode of Travel).

18. **Enquiry during the course of evaluation not allowed:** No enquiry from the bidder(s) shall be entertained during the course of evaluation of the tender till final

decision is conveyed to the successful bidder(s). However, the Purchase Committee or its authorized representative may make enquiries/seek clarification from the bidders. In such a case, the bidder must extend full co-operation. The bidders may also be asked to arrange demonstration of the offered items, in a short period of notice.

19. The acceptance of the quotation will rest solely with the Director, NIT Mizoram, who in the interest of the Institute is not bound to accept the lowest quotation and reserves the right to himself to reject or partially accept any or all the quotations received without assigning any reasons.

20. Force Majeure:

If the performance of the obligation of either party is rendered commercially impossible by any of the events hereafter mentioned that party shall be under no obligation to perform the agreement under order after giving notice of 15 days from the date of such an event in writing to the other party, and the events referred to are as follows:

- i. Any law, statute or ordinance, order action or regulations of the Government of India,
- ii. Any kind of natural disaster, and
- iii. Strikes, acts of the Public enemy, war, insurrections, riots, lockouts, sabotage.

21. Applicable Law:

(a) The contract shall be governed by the laws and procedures established by Govt. of India and subject to exclusive jurisdiction of Competent Court and Forum in Aizawl only.

(b) Any dispute arising out of this purchase shall be referred to the Director NIT Mizoram, and if either of the parties hereto is dissatisfied with the decision, the dispute shall be referred to the decision of an Arbitrator to be appointed by the Director of the Institute. The decision of such Arbitrator shall be final and binding on both the parties.

22. **Training:** The vendor will provide free training at NIT Mizoram after Successful installation of the Machines/equipments.

Sd/

Encl.: **ANNEXURE-I, ANNEXURE-II, ANNEXURE-III & ANNEXURE-IV**

A. COMPLIANCE CERTIFICATE FOR NIT TERMS
(To be enclosed in the Technical bid)

Sl. No.	NIT Terms and Conditions	Yes/No
01	Rate quoted as per instruction	
02	AMC rate after warranty provided	
03	Validity of quoted rate for 90 days agreed	
04	EMD submitted (appropriate certificate enclosed)	
05	PBG term agreed	
06	Payment term agreed	
07	Delivery terms agreed	
08	Warranty period agreed	
09	Literature: Printed Literature provided	
10	Dealership / distributorship certificate (in case of dealers/agents) provided	
11	Sales Service: address of after Sales Service centre in India (for imported goods)/ in the region provided	
12	Manufacturer certificate provided	
14	Applicable law terms agreed	

Signature with Seal:.....

Vendor: M/s.....

B. COMPLIANCE CERTIFICATE FOR SPECIFICATIONS
(One for each item must to be enclosed in the Technical bid)

Item Sl. No.			
Specifications as per Annexure-IV		Quoted Item Specs.*	Complied (Yes/No)
Parameter	Specification		

Signature with Seal:.....

Vendor: M/s.....

*** Vendor must quote the parameter specification of the quoted product in this column and not just copy the specification from the tender call document. Failure to do so will lead to rejection of the tender.**

PERFORMANCE BANK GUARANTEE

To:

**The Director
National Institute of Technology Mizoram**

WHEREAS..... (Name of Supplier)

Hereinafter called "the Supplier" has undertaken, in pursuance of Contract No..... dated 20... to supply.....
..... (Description of Goods and Services) hereinafter called "the order".

AND WHEREAS it has been stipulated by you in the said order that the Supplier shall furnish you with a Bank Guarantee by a recognized bank for the sum specified therein as security for compliance with the Supplier's performance obligations in accordance with the order.

AND WHEREAS we have agreed to give the Supplier a Guarantee:

THEREFORE WE hereby affirm that we are Guarantors and responsible to you, on behalf of the Supplier, up to a total of.....
..... (Amount of the Guarantee in Words and Figures) and we undertake to pay you, upon your first written demand declaring the Supplier to be in default under the order and without cavil or argument, any sum or sums within the limit of (Amount of Guarantee) as aforesaid, without your needing to prove or to show grounds or reasons for your demand or the sum specified therein.

This guarantee is valid until theday of.....20.....

Signature and Seal of Guarantors

.....

Date.....20....

Address:.....

.....

All correspondence with reference to this guarantee shall be made at the following address: **National Institute of Technology Mizoram, Chaltlang, Aizawl, Mizoram, India: 796012**

MANUFACTURERS' AUTHORIZATION FORM

No.

Dated _____

**The Director
National Institute of Technology
Aizawl-796012, Mizoram**

Dear Sir:

We..... who are established and reputable manufacturers ofhaving factories at-----
(address of factory) do hereby certify that(Name of the Authorized Dealer)is our authorized dealer to quote against your tender enquiry no **,Last Date of Submission is:**

No other Company other than
(Name of the Authorized Dealer) is authorized to quote of our products against this Tender Enquiry No.....

Yours faithfully,

(Name)

(Name of manufacturers)

TECHNICAL SPECIFICATION FOR THEORY OF MACHINE LABORATORY

SL NO.	TECHNICAL SPECIFICATION	QTY
1.	<p>APPARATUS OF EQUILIBRIUM OF MOMENTS ON A TWO-ARM LEVER</p> <ol style="list-style-type: none"> 1. The Beam should be -L x W x H:600x300x10mm, centrally ball bearing-mounted 2. The lever length should be of : 2x300mm 3. The equipment should consist weight sets of <ol style="list-style-type: none"> a. 3x1N(hangers) b. 6x5N c. 12x 1N 4. The Investigation of equilibrium moments should consist of two-arm lever. 5. The Ball bearing-mounted beam should have a integrated scale as two-arm lever. 6. It should consist of 3 sets of weights. 7. The equipment should be made of sturdy metal frame. 8. Box to house the components should be provided. 9. It should have the scope to determine the fundamentals of the equilibrium of moments :applied forces, generated moments and equilibrium 10. It should have the scope to measure the action of Forces dependent on the lever 	01(One)
2.	<p>FLYWHEEL APPARATUS</p> <ol style="list-style-type: none"> 1. The Flywheel should be D=300mm, height: 40mm, mass:22.2kg, mass moment of inertia: 0.25kgm² 2. The Pulley should be of Dia=22mm 3. The equipment should consist weight sets of <ol style="list-style-type: none"> a. 1x1N (hangers) b. 4x1N c. 3x 5N 4. The Base Plate of the equipment should be W x H: 250x200mm 5. The hole spacing should be : 230x180mm, D10mm 6. The equipment should be design to demonstrate the experiment on the moment of mass inertia of a flywheel 7. The flywheel should be made of steel 8. The shaft used as drive pulley should be made of steel. 9. It should consist of 3 sets of weights. 10. The shaft should be mounted of Ball bearing. 11. The base plate of the equipment should be made of anodised aluminium. 12. It should have the scope to determine the mass moment of inertia of a metal 	01(One)

	flywheel.	
3.	<p>FUNDAMENTALS OF STATICS APPARATUS</p> <ol style="list-style-type: none"> 1. The Panel should be – <ol style="list-style-type: none"> (i) W x H: 600x700mm,13kg (ii) line grid: 50mm 2. Force gauges for tensile and compressive force <ol style="list-style-type: none"> (i) measuring range: -50...+50N (ii) display diameter: d=110mm (iii) protected against overloading 3. Weight sets should be <ol style="list-style-type: none"> (i) 2x5N(hangers) (ii) 6x5N 4. It should have the scope to determine accumulation and resolution of forces with force parallelogram 5. It should have the scope to determine equilibrium of forces 6. It should have the scope to determine law of levers, determination of moments and equilibrium of moments 7. It should have the scope to determine combined lever systems 8. It should have the scope to determine forces in bearings 9. It should have the scope to determine deflection and resolution of force by fixed and free pulleys 	01(One)
4.	<p>HOOKE'S LAW APPARATUS</p> <ol style="list-style-type: none"> 1. The equipment should have Helical spring short of <ol style="list-style-type: none"> (i) Coils:53 (ii) d=18.3mm (iii) wire diameter: d=1.0mm 2. The equipment should have Helical spring long of <ol style="list-style-type: none"> (i) coils:109 (ii) d=18.3mm (iii) wire diameter: d=1.0mm 3. Scale, graduations: 1mm 4. Set of weights should be <ol style="list-style-type: none"> (i) 10x0.5N (ii) 1x1N(hanger) 5. Experiments relating to Hooke's law and oscillation experiments on a spring-mass system. 6. Metal stand should have integral scale 	01(One)

	<ol style="list-style-type: none"> 7. 2 helical spring as tension springs 8. Tension springs configured in series or singly 9. Load applied to tension spring by a set of weights 10. Box to house the component 11. It should have the scope to determine the Investigation of the proportionality of active force and the spring deflection. 12. It should have the scope to determination of the spring constant 13. It should have the scope to determine the Series configuration of two tension springs 14. It should have the scope to determine the investigation of influence of the spring constant on the frequency of a spring-mass system. 	
5.	<p>BENDING MOMENT DIAGRAM APPARATUS WITH BEAM ON TWO SUPPORTS</p> <ol style="list-style-type: none"> 1. The length of the Beam should be 1000mm, span:800mm 2. Bending moment measuring range should be 10...+10Nm 3. Weight set should be <ol style="list-style-type: none"> (i) 3x 1N(hangers), 12x 1N, 9x 5N (ii) Max. Weight load per hanger: 20N 4. Investigation of bending moment on beam mounted on 2 supports 5. Indication of bending moment in beam should be by low-friction hinge with 1 degree of freedom. 6. Position of hinge at 1/3 span 7. 2 bearing supports 8. Loading of beam should be by 1 to 3 point loads 9. Force gauge and lever arm to indicate bending moment 10. Adjuster nut should be for horizontal alignment of beam 11. Storage system to house the components 12. It should have the scope to determine the calculation of reaction arising from the static conditions of equilibrium. 13. It should have the scope to determine the application of method of section to calculate the internal moments <ol style="list-style-type: none"> i. under a point load ii. under multiple point loads 14. It should have the scope to determine the calculation of bending moment curve 15. It should have the scope to determine the comparison of calculated and measured bending moment values 	01(One)
6.	<p>SHEAR FORCE DIAGRAM APPARATUS WITH BEAM ON TWO SUPPORTS</p> <ol style="list-style-type: none"> 1. The Beam should be - <ol style="list-style-type: none"> (i) Total length: 1000mm, span:800mm (ii) Shear force measuring range: -50...+50N 2. Weight set <ol style="list-style-type: none"> (i) 3x 1N(hangers), 12x 1N, 9x 5N 3. Investigation of shear force on beam mounted on 2 supports. 4. Measurement of shear force in beam by low-friction hinge with 1 degree of 	01(One)

	<p>freedom.</p> <ol style="list-style-type: none"> 5. Position of hinge at 1/3 span. 6. 2 bearing supports 7. Loading of beam by 1 to 3 point loads 8. Force gauge to indicate shear force 9. Adjuster nut for horizontal alignment of beam 10. Storage system to house the component 11. It should have the scope to determine the calculation of reactions arising from the static conditioning of equilibrium. 12. It should have the scope to determine the application of method of section to calculate the internal forces <ol style="list-style-type: none"> (ii) under a point load (iii) under multiple point loads 13. It should have the scope to determine the calculation of shear force diagram 14. It should have the scope to determine the comparison of calculated and measured shear force values 15. It should have the scope to determine the Max. Weight load per hanger: 20N 	
7.	<p>CAM ANALYSIS APPARATUS WITH DIGITAL TACHOMETER AND DIGITAL STROBOSCOPE</p> <ol style="list-style-type: none"> 1. Cam Shaft should be material Stainless Steel 2. Cams should be Tangent, Eccentric, Circular Arc, made of hardened alloy – steel 3. Followers should be: Roller, Knife edge, Mushroom, made of hardened alloy – steel. 4. Compression Spring should be provided 5. Weights should be 1 kg., 500gm, 200 gm & 100gm 6. Motor should be Variable speed DC Motor with speed controller 7. Dial Gauge should be Maker & Mercer/Standard Make. 8. The equipment should be motorized unit consisting of a camshaft driven by a variable speed motor. 9. The free end of the camshaft should have a facility to mount the cam easily. 10. The follower should properly guide in gunmetal bushes and the type of follower should be changed according to the cam under test. 11. Graduated circular protractor should be fitted co-axial with the shaft and dial gauge fitted on the follower shaft, is used to note the follower displacement for the angle of cam rotation. 12. A spring should be used to provide controlling force to the follower system. Weights on the follower shaft could be adjusted as per the requirement. 13. An arrangement should be provided to regulate the speed. 14. The apparatus should be very useful for testing the cam performance for jump phenomenon during operation and the effect of change of inertia forces on jump action of cam-follower during operation could be observed. 15. Three sets of cams and followers should be supplied with the apparatus. 16. It should have the scope to plot the n-(Follower displacement Vs Angle of rotation) curves for different cam follower pairs 17. The follower bounce should be observed by using a stroboscope (Optional) & effect of follower weight on bounce can be studied 18. It should have the scope to study the effect of follower weight on bounce 19. It should have the scope to study the effect of spring compression on bounce. 	01(One)

8.	<p>UNIVERSAL GOVERNOR APPARATUS</p> <ol style="list-style-type: none"> 1. The Spindle material should be Stainless Steel 2. Governor Mechanism : Four different types of governor mechanism with spring and weights. <ol style="list-style-type: none"> (i) Watt Governor (ii) Porter Governor (iii) Hartnell Governor (iv) Proell Governor 3. Motor should be variable speed, Standard Make, FHP Motor. 4. Control Panel should be present for speed control of motor. 5. The equipment should be designed to study the working of different governors normally used to control the speed. 6. It should consist of a main spindle, mounted vertically on the base plate. 7. This spindle should be driven by a variable speed Motor which is also mounted vertically on the same base plate. 8. One governor assembly out of four should be mounted on spindle. The spindle speed should be controlled by speed control unit. 9. A graduated scale should be fitted to the sleeve to measure the displacement. 10. It should have the scope to determination of characteristic curve of a sleeve position against speed of rotation for all governors. 11. It should have the scope to study the effect of varying the mass of the center sleeve in Porter and Proell Governor. 12. It should have the scope to study the effect of varying the initial spring compression in Hartnell Governor. 13. It should have the scope to study the determination of characteristics curves of radius of rotation against controlling force (Actual & Theoretical) for all governors. 	01(One)
9.	<p>MOTORISED GYROSCOPE APPARATUS</p> <ol style="list-style-type: none"> 1. The Disc Material should be Stainless Steel, Dia 300 mm x 10 mm thick precisely balanced which can be rotated in 3 mutually perpendicular axis. 2. Motor should be variable speed of standard make. 3. Supplied with Speed Control Unit. 4. Weights should be 2 kg, 1 kg, 500 gms. 5. Stop Watch should be Electronic 6. Accurately marked scale & pointer to measure precession rate. 7. The equipment should consist of stainless steel disc mounted on a horizontal shaft, rotated by a variable speed motor. 8. The rotor shaft should be coupled to a motor mounted on a trunion frame having bearings in a yoke frame, which is free to rotate about vertical axis. 9. A weight pan on other side of disc should balance the weight of motor. Rotor disc should be move about three axis. 10. Torque should be applied by calculating the weight and distance of weight from the center of rotor. 11. The gyroscopic couple should be determined. 	01(One)

	<p>12. It should have the scope to determine the experimental justification of the equation $T = I \cdot \omega \cdot \omega_p$ for calculating the gyroscopic couple by observation and measurement of results for independent vibrations in applied couple T and precession ω_p.</p> <p>13. It should have the scope to study the gyroscopic effect of a rotating disc.</p>	
10.	<p>SLIP & CREEP MEASUREMENT APPARATUS IN BELT DRIVE</p> <ol style="list-style-type: none"> 1. Motor should be variable speed motor of 1HP, 1500 RPM. 2. Pulleys should be driving and driven pulleys of equal diameters (flat pulleys) 3. Loading Arrangement should be brake drum along with spring balance and rope arrangement should be provided to load the system. 4. Belts should be flat belts of fixed length of two different belt materials 5. Belt tightening arrangement should be bearing block is sliding and dead weight can be applied to set the initial tension in belt. 6. Speed Indicator should be 2 Channel digital speed indicator with switch to change the channel. 7. This apparatus should be used for measurement of power transmitted for various input power conditions with varied belt tension. Belt slip or creep also should be measured. 8. The apparatus should consist of a variable speed motor, driving pulley and driven pulley of equal diameters. 9. The pulleys should be mounted on input shaft (motor shaft) and output shaft. 10. The driven pulley should slide on the base only with bearing block to change the initial tension in belt. 11. Brake drum should be mounted on the output shaft, which helps to measure power output. 12. The motor speed should be varied by variable speed drive. A double channel digital speed indicator should indicate driving and driven pulley speeds. 13. With the help of Stroboscope (optional) it should be possible to demonstrate the slip of belt on driving and driven pulley. 14. It should have the scope to measure co-efficient of friction between pulley material and different belt materials. 15. It should have the scope to measure power transmitted with varied belt tension. 16. It should have the scope to measure percentage slip at fixed belt tension by varying load on the brake drum and plot the graph of $(T_1 - T_2)$ v/s percentage slip i.e. "Slip Characteristics". 17. It should have the scope to measure belt slip speed and observe the limiting value of load at constant speed when the slip just starts. 18. It should have the scope to study creep of belt. 	01(One)
11.	<p>EPICYCLIC GEAR TRAINING APPARATUS</p> <ol style="list-style-type: none"> 1. Internal Type Epicyclic Gear Train 	01(One)

	<p>(i) A Compact gear train (industrial)</p> <ol style="list-style-type: none"> 2. Motor should be variable speed motor, 1 HP. 3. Speed Control Unit should be variable Speed Drive for varying the speed of motor. Rope brake arrangement to measure output torque and holding torque. 4. RPM Measurement should be digital RPM Indicator with proximity switch 5. Gear Train is any combination of gear wheels by which motion should be transmitted from one shaft to another shaft. 6. In epicyclic gear trains, the axes of shafts on which the gears are mounted should move relative to a fixed axis. 7. It should be a motorized unit consisting of a SUN gear mounted on input shaft. 8. Planet gears meshes with the annular gear. These planet gears should be mounted on a common arm to which output shaft is fitted. 9. Loading arrangement should be provided for loading the system and to measure holding torque. 10. It should have the scope to measure epicyclic gear ratio between input shaft and output shaft (Actual and Theoretical). 11. It should have the scope to measure input torque, holding torque and output torque. 	
12.	<p>CORIOLLI'S COMPONENT OF ACCELERATION APPARATUS WITH DIGITAL RPM INDICATOR:</p> <ol style="list-style-type: none"> 1. The equipment should be used to study Coriolli's Component of Acceleration of a slider crank mechanism. 2. The mechanical slider system should be replaced by a continuous stream of water flowing through a steady rotating pair of tubes. 3. These tubes should be rotated at various speeds by using a swinging field motor which also acts as dynamometer. 4. A Perspex window on top of the tank gives clear view of the process and prevents splash of the water over the side of the tank. 5. The dynamometer should continuously measures torque applied to the rotating tubes. 6. The equipments should be self contained, water re-circulating, provided with its own speed control unit and water circulating pump. 7. It should have the scope to determine Coriolli's Component of Acceleration at various speeds of rotation and water flow rates. 	01(One)
13.	<p>WHIRLING OF SHAFTS DEMONSTRATOR</p> <ol style="list-style-type: none"> 1. The Test Shafts should be of <ol style="list-style-type: none"> (i) Length : 1000 mm each. (ii) Diameter : 3.2, 4.8 & 6.4 mm (approx.) (iii) Quantity : Two each. 2. Kinematic coupling bearing should be for fixed or free ends without restraint. 3. Drive motor should be of 5000 rpm, FHP. 4. Supplied with a speed control unit. 5. The euipment should be designed to study the whirling of shafts. 	01(One)

	<ol style="list-style-type: none"> 6. The equipment should consist of a sturdy frame, bearing holders, variable speed motor etc. to drive the shaft along with speed control unit. 7. Different bearing should be fitted in bearing block to have different end conditions i.e. (i) both end fixed (ii) one end free and one end fixed etc. 8. It should have the scope to determine the display of various modes of whirl for a shaft with : <ol style="list-style-type: none"> (i) Both ends directionally fixed. (ii) One ends fixed and other free (iii) Both ends directionally free. 9. It should have the scope to determine the modes of vibrations can be studied and frequency can be measured in each case. 	
14.	<p>STATIC & DYNAMIC BALANCING APPARATUS</p> <ol style="list-style-type: none"> 1. Drive Motor should be FHP Motor, variable speed, with speed controller. 2. Balancing weight should be 4 Nos. of Stainless Steel with different sized eccentric mass for varying unbalance. 3. Rotating Shaft should be of material Stainless Steel 4. Digital Tachometer 5. This equipment should be designed for carrying out the experiment for balancing a rotation mass system. 6. The apparatus should consist of a stainless steel shaft fixed in a rectangular frame. 7. A set of four blocks with a clamping arrangement should be provided. 8. For static balancing, each block should be individually clamped on shaft. 9. For dynamic balancing, a moment polygon should be drawn using relative weights and angular and axial position of blocks is determined. 10. The block should be clamped on shaft is rotated by a motor to check dynamic balance of the system. 11. The system should be provided with angular scale and is suspended with chains for dynamic balancing. 12. It should have the scope to balance the masses statically and dynamically of a single rotating mass system. 13. It should have the scope to observation of effect of unbalance in a rotating mass system. 	01(One)
15.	<p>JOURNAL BEARING APPARATUS</p> <ol style="list-style-type: none"> 1. Journal should be of diameter 50 mm 2. Bearing should be of diameter 55 mm 3. Weights should be 4 weights. 4. Motor should be variable speed FHP Motor 5. Control Panel should be for speed control of motor. 6. Oil recommended should be SAE 40 	01(One)

	<ol style="list-style-type: none"> 7. Pressure Gauge : should be of Compound Pressure gauge (-1 to 1) Kg/cm² 8. Digital Tachometer is Optional. 9. The apparatus should consist of a plain steel shaft excavated in a bearing and directly driven by a FHP Motor. 10. The bearing should be freely supported on the shaft and sealed at the motor end. 11. The speed of the motor should be controlled by the speed control unit. 12. One compound pressure gauge should be mounted on Bearing to measure the pressure at different position around the circumference. 13. Bearing should be free to rotate and can be adjusted at any position of circular scale. 14. The bearing should be loaded by attaching weights to the arm supported beneath it. 15. It should have the scope to study the pressure profile of lubricating oil at various conditions of load and speed. 16. It should have the scope to Study plotting the Cartesian polar pressure curves. 	
16.	<p>PROTOTYPE(PORTABLE)OF VARIOUS MECHANISMS MODELS, MECHANICAL TRAINING MODULES</p> <ol style="list-style-type: none"> 1. Models should be with Acrylic Cover 2. Overall Dimensions should be 145X95X60mm 3. The models give an idea to explain the most fundamental and frequently used mechanisms and give a deep understanding of the Theory of machines. 4. All the components should be made with high degree of precision, interchangeability and easy to assemble or disassemble. 5. The models should be assembled on transparent Perspex sheets, so that it is easy to visualize & understand the mechanical motions & functions. 6. All the models should have rotating handles, so that a student can understand the actual mechanisms more deeply by rotating themselves which otherwise is difficult to understand in the real big machines 7. Name of the models <ol style="list-style-type: none"> 1. Single Stage-Spur Gear. 2. Single Stage-Spur Gear with intermediate Gear. 3. Two Stage Spur Gear 4. Three Stage-Spur Gear 5. Three Speed and Reverse Gear 6. Worm Gear 7. Bevel Gear 8. Rack and Quadrant Gear Drive 9. Reversing Gear (Tumbler Type) 10. Epicyclic Gear (Sun and Planet) 11. Cycloidal Motion 12. Internal rolling Gear drive 13. Internal Gear and Pinion drive 14. Helical Gear 15. Spiral Gear 90° 16. Spiral-Gear single stage with intermediate Gear 	01No each

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| | <ol style="list-style-type: none"> 17. Herringbone Gear 18. Crank drive to oscillating link 19. Crankshaft and Slider Mechanism 20. Two crank and linkage drive (Variable velocity) 21. Crank and slotted link drive (Oscillator) 22. Friction Wheel Drive (Circumference) 23. Centrifugal Mechanism and clutch drive 24. Friction Wheel Drive (Variable Speed) 25. Cone clutch drive (Single sided) 26. Cone clutch drive (Two speed) 27. Dog clutch drive (Single sided) 28. Dog clutch drive (Two speed) 29. Flat belt drive (with tensioner) 30. Belt Drive Toothed 31. Belt drive-Single speed 32. Belt drive-two stage 33. Belt drive (Contra-Rotation) 34. Belt drive-Multispeed 35. Chain drive (with tensioner) 36. Geneva Drive (Maltese Cross) 37. Sliding wedge gear with straight line and arcuate output. 38. Cam with straight line and Lever follower 39. Face Cam Drive (Free Follower) 40. Face Cam Drive. (Double sided) Trapped followers. 41. Oldham's Coupling 42. Differential Gear 43. Lathe Screw Cutting 44. Shaper Mechanism Model 45. Crank and connecting rod 46. Four bar link mechanism 47. Bevel Gear type reversing mechanism 48. Scotch Yoke Mechanism 49. Ellipse Tracer 50. Watt Mechanism 51. Peaucellier Linkage drive 52. Pantograph Mechanism 53. Allen Link Motion 54. Hobbing Mechanism Model | |
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