राष्ट्रीय प्रौद्योगिकी संस्थान नागालैंड
NATIONAL INSTITUTE OF TECHNOLOGY NAGALAND
Chumukedima, Dimapur
Nagaland - 797 103

Ref: 0212/NIT-N/Mech/2017/05-03 **Date: 31.05.2017**

NOTICE INVITING TENDER (NIT) TWO BID SYSTEM FOR SUPPLY & INSTALLATION OF EQUIPEMNTS & MACHINES FOR STRENGTH OF MATERIAL LAB, DYNAMIC LAB AND HEAT & TRANSFER LAB AT NIT NAGALAND, DIMAPUR

National Institute of Technology Nagaland invites sealed quotation for supply & Installation of Equipments as per details at **ANNEXURE- V**, **in Two Bids** to reach the Registrar, NIT Nagaland on or before 28.06.2017.

Sl No.	Specifications at Annexure	Items	Qty	EMD (Rs.) in the form of DD	Tender Document Fee (Rs.) in the form of DD only.
01.	IV	Supply & Installation of Equipments & Machines for Strength of Material Lab, Dynamic Lab and Heat & Transfer Lab on turnkey basis to be installed at NIT Nagaland, Dimapur	As per in Annexure – V As a Package	6,00,000.00	5,000.00

1) Notice Inviting Tender No. : 0212/NIT-N/Mech/2017/05-03 Date: 31.05.2017

2) Tender Document Issue Date : 31-05-2017

3) Pre-Bid Meeting : 12-06-2017 (14.00 P.M)

4) Last Date of Submission : 28-06-2017 (14.00 P.M)

5) Technical Bid Opening Date & Time : 28-06-2017 (15.00 P.M)

6) Financial Bid Opening Date & Time : 29-06-2017 (11.00 A.M)

7) Venue of Bid Opening : NIT NAGALAND, DIMAPUR

BID INSTRUCTION:

01. Quotations will have to be submitted in TWO Bids. 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 EQUIPMENTS & MACHINES FOR STRENGTH OF MATERIAL LAB, DYNAMIC LAB AND HEAT & TRANSFER LAB AT NIT NAGALAND, DIMAPUR ,NIQ REF NO. ……., DATE:

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's must appear on all the papers and envelopes submitted.

QUALIFICATION REQUIREMENTS

1) **The Bidder should be an Original Equipment Manufacturer (OEM) or an authorized dealer/Distributor & a firm of reputation having sufficient expertise and experience in the subject tender with sound warranty / service support capability and authorization from Manufacturer/Distributor.**

2) **Average Annual Turn Over for the last 3 years should be at least Rs.500 lakhs**

3) **The Bidder should have experience of executing at least 2(Two) Purchase Orders of Equipments/Machines of value of Rupee 100 Lacs or Higher within the last 3 Years from any IITs /NITs/ Central Govt. Institutions or Educational & Research Institutions of National Repute**

4) **The Bidder has to quote for all the items in the Tender as a package. Bidders who do not quote for all the items as per the given Tender Specification are subject to be disqualified.**

5) **The Bidder should clearly state the available nearest after sales & service address in Nagaland/Assam, without which the offer will be rejected. Supporting Documentary evidence should be provided along with the Technical bid**

NIT TERMS & CONDITIONS:

01. **Validity of Quotation:** Quoted rates must be valid for **90 days** from the date of quotation.

02. **Warranty:** The quoted equipment and components must be warranted for a minimum of 2(Two) Years or period specified against the item.

03. **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.

04. **After Sales Service:** Vendors should clearly state the available nearest after sales service facilities in the region, without which their offers will be rejected.

05. **Dealership Certificate:** Dealers or Agents quoting on behalf of Manufacturer/Distributor must enclose valid dealership certificate.

06. **Quality Certificates:** Valid certificate to prove that the products are genuine and of International standard, as mentioned below, must be enclosed:
(a) Manufacturer's certificate. (b) ISO/ISI certificate

07. **Earnest Money:**
Refundable earnest money deposit (EMD) of Rs. 6,00,000.00 of the Quoted Value through demand draft drawn in favour of "The Director, National Institute of Technology Nagaland", payable at Dimapur, 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 Bank Guarantee. Offers received without Earnest Money 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 Dimapur. 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 16-20 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 tempered 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 Nagaland.

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 Nagaland reserves the right not to accept delivery in part or full.

10. **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 Nagaland.

11. **Road Permit:** NIT Nagaland will provide Road Permit to the Vendors of outside Nagaland.

12. **VAT deduction at source:** In case of supply within Nagaland, VAT deduction at source, as per Order/ notification of the Govt. of Nagaland will be applicable.

13. **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.

14. **Payment**:

The payment of 70 percent of the order value shall be released after receipt of item(s) in good condition and after inspection of the goods jointly by representative from Bidder & NIT Nagaland, 20 percent shall be released after successful installation and commissioning of the equipment's with expected requirements and proper wiring / cabling and 10 percent shall be released after completion of total project with proper training.

15. **PENALTY FOR DELAYED DELIVERY**:

In case of supply order for the scientific equipments/ apparatus, the date of delivery should be strictly adhered to. In the event of delayed delivery, installation & commissioning i.e. after the expiry of the period as agreed by both the parties, the vendor shall be liable for a penalty deduction at a percentage of the value of the undelivered equipment subject to a maximum of 10% (ten percent) as detailed below:

@1% up to one week;
@2.5% up to two weeks;
@5% up to three weeks;
@10% for four weeks and above

For the purpose of this clause, part of the week is considered as a full week. In case of delayed delivery, the Director, NIT Nagaland reserves the right not to accept the subject consignment.

16**. Excise Duty & Custom Duty Exemption Certificate:** Excise duty & Custom Duty exemption certificate will be issued from NIT NAGALAND

17. **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.

18. The acceptance of the quotation will rest solely with the Director, NIT Nagaland, 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.

19. **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.

20. Termination for default: Default is said to have occurred
    (a) If the equipment or any of its component is found having poor workmanship, faulty designs, poor performance and bad quality of materials used.
    (b) If the supplier fails to deliver any or all of the services within the time period(s) specified in the purchase order or any extension thereof granted by NIT,Nagaland.
    (c) If the supplier fails to perform any other obligation(s) under the contract.
    (d) Under the above circumstances NIT may terminate the contract / purchase order in whole or in part and forfeit the EMD/PBG as applicable. In addition to above, NIT may at its discretion also take the following actions: NIT may procure, upon such terms and in such manner, as it deems appropriate, goods similar to the undelivered items/products and the defaulting supplier shall be liable to compensate NIT for any extra expenditure involved towards goods and services obtained.

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 Dimapur / India only.

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

REGISTRAR

ANNEXURE –I

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	**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- V	**Quoted Item Specs.***	**Complied (Yes/No)**

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.**

ANNEXURE -II

PERFORMANCE BANK GUARANTEE

To:
The Registrar
National Institute of Technology Nagaland
Chumukedima, Dimapur-797103, Nagaland

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 the .....day of.....20.....

Signature and Seal of Guarantors
.....
.....
.....
Date.....20....
Address:.....
.....
.....All correspondence with reference to this guarantee shall be made at the following address:

The Registrar, National Institute of Technology Nagaland,Dimapur-797103, Nagaland

ANNEXURE -III

MANUFACTURERS'/ DISTRIBUTOR'S AUTHORIZATION FORM

No. Dated _____

To,
The Registrar
National Institute of Technology Nagaland
Chumukedima, Dimapur-797103, Nagaland

Dear Sir:
We……. who are established and reputable Manufacturers/distributors of ……having factories/office at----------
---
(address of factory/office) do hereby certify that……
……
…(Name of the Authorised Dealer)is our authorized dealer to quote against your tender enquiry no **…….. ,Last Date of Submission is:**

Yours faithfully,

Signature: _____

_____
(Name of Manufacturer/Distributor)

ANNEXURE- IV

FINANCIAL BID

Name of the Bidder:

TENDER NO. **DATE:**

1	2	3	4	5	6	7	8	09	10
Tender Sl. No.	**Item Description.**	**Qty**	**Rate Per Unit (Rs.)** **Exclusive of all Taxes**	**Total Price (Rs.)** **Exclusive of all Taxes** **(3X4)**	**VAT & other taxes like excise duty payable,if contract is awarded (Rs.)**	**Packing & forwarding up to station of the dispatch , if any** **(Rs.)**	**Charges for inland transport ation, unloading and Insurance up to Lab/ Institute (Rs.)**	**Installation, Commissio ning And training Charges, If any** **(Rs.)**	**All Total Price (Inclusive of all Taxes, Packing & Forwarding And Charges for Inland Transport And Installation Commissioni ng) (5+6+7+8+9)**

In Words Rupess_____

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.

(Signature of the Bidder)

ANNEXURE- V

TECHNICAL SPECIFICATION FOR STRENGTH OF MATERIAL LAB, DYNAMIC LAB AND HEAT & TRANSFER LAB

SL No	DETIALS TECHNICAL SPECIFICATION	Qnty
1.	**Dual Mode (Analogue + Computerized) Combined Universal Testing Machine** Loading Frame :- The base should be Hydraulic Cylinder at its centre and two main screw at both ends. The middle crosshead should be mounted on screws through main nuts. The middle crosshead can be moved up or down through chain transmissions and geared motor to adjust the initial Tensile Compression clearance. On the piston, rest an assembly of upper lower crosshead and two columns. The individually lapped cylinder piston assembly should ensure smooth axial force with minimum friction. Control Panel :- Hydraulic Circuit – it should consist of hydraulic power pack which has a directly driven gear plunger pump which gives a continuous non pulsating flow of oil pressure upto 250 bar. A pressure compensated needle type flow control valve is provided to control the oil flow to cylinder there by achieving a desired piston speed. Loading Rate / Straining rate control :- This should be superfine controlling system which controls loading rate / straining rate as per command from electronic machine control system. With UP / DOWN keys on electronic control system loading rate straining rate can be adjusted. Load Measurement System :- The oil pressure in the main cylinder should also transfer to an electronic pressure transducer which goes proportionate signal to computer electronic unit. The electrical panel is housed in control panel. Displacement measurement is carried out by means of Rack and pinion on rotary encoder. Encoder signal is fed to electronic control system to get displacement. Machines should be calibrated in accordance with procedure laid down in BS – 1610 – 1964 IS – 1828 – 1991. Computerized Universal Testing Machine should comply with grade A of BS 1610-1964and grade 1 of IS 1828 – 1991. An accuracy of ±1% guaranteed from 2% to 100% of capacity of the machine. Computer is an integral part of the entire system in Computerized UTM and not just on ADD on feature. UTM software :- ➢ Menu driven form system with colour graphs to compare sample test results ➢ Test details and reports are stored in database ➢ User programmable master test templates ➢ User can select test from master test Templates and can start similar test ➢ Load and Elongation is continuously displayed on screen ➢ Overload protection for machine by electronic control ➢ Tare Load and Reset Elongation facility available ➢ User selectable sample break detect condition ➢ Load rate and strain rate are also displayed while testing ➢ Unlimited Load rate and strain rate control steps ➢ With Load rate controller, user can hold the load on specimen for unlimited time ➢ With Load rate control, user can specify positive or negative Rate of Loading	1

	➢ User selectable units for load and displacement (kg, kN,N, Ibf, mm, cm, inch etc.) Results and graphs are automatically displayed accordingly ➢ On line display of Load and Displacement (Stress, Extension, Strain) etc. while test is conducted ➢ Provision of auto zeroing of Elongation at preload set by user ➢ User Programmable Reports. User can select Header, Footer, Specimen information, Dimensions, Test information, Test results, Stastical analysis as per his need ➢ Generated reports can be exported to PDF file and can be e-mailed ➢ If electronic extensometer is used then proof stress values from 0.1% to1%can be determined ➢ Software will give alert to user to remove extensometer when load crosses .2% of Gauge length selected then proof load value is calculated. (With extensometer) ➢ Separate graph of extensometer and encoder is displayed ➢ Provision of calculation of Load and Elongation at yield, Peak load and Load at break, Yield stress, Ultimate stress etc ➢ Special software for tensile, compression, bend, TOR steel and other test software as per customer requirements Technical Specification:- Measuring capacity — 1000 Kn Measuring Range — 0 – 1000 Kn Least Count — 0.1 Kn Load Range in Kn with accuracy of measurement ±1% — 20 – 1000 Resolution of Piston movement (mm) — 0.1 Maximum Tensile Clearance at fully descended piston position (mm) — 50 – 850 Maximum Clearance for compression test (mm) — 0 – 850 Distance between columns (mm) — 750 Piston Stroke (mm) — 250 Maximum Straining Speed at no load (mm) — 80 Power supply — 3 Phase, 415 V, 50 Hz, AC HP Total — 4 Accessories Tension Test Jaws for :- Round Specimen dia (mm) — 10 – 25 Round Specimen dia (mm) — 25 – 45 Round Specimen dia (mm) — 45 - 70 Flat Specimen Thickness (mm) — 0 – 22 Flat Specimen Thickness (mm) — 22 – 44 Flat Specimen Thickness (mm) — 44 - 65 Maximum width for Flat Specimen (mm) — 70 For Compression Test :- Pair of Compression Plates dia (mm) — 160 For Transverse Test :- Adjustments Roller supports width (mm) — 160 Diameter (mm) — 50 Maximum adjustable clearance (mm) — 800 Punch Taps of Radius (mm) — 16 Radius (mm) — 22	
2.	**Digital Rockwell Hardness Testing Machine**	1

	Technical Specification :- Test Loads in KGF — 60, 100, 150 Kgf (Rockwell) Initial Load — 10 Kgf Maximum Test Height (mm) — 300 mm Depth of Throat (mm) — 155 mm Size of Base (mm) approx — 640 x 260 mm Machine Height (mm) — 745 mm Net weight (approx) kg — 150 Kg Supply Voltage — 230 V Hz Single Phase Ac Accessories: Rockwell Diamond Indentor — 1 no. Testing Table Φ 50 mm — 1 no. Testing Table Φ 40mm with 'V' Groove for round jobs Φ 6 to 45 mm — 1 no. Steel Ball Indentor Φ 1/16" — 1 no. Test Block HRC — 1 no. Test Block HRB — 1 no. Steel Ball Φ1/16" — 5 no. Allen Spanners — 3 no. Clamping Device — 1 no. PVC Cover for Machine — 1 no. Rubber Bellow — 1 no Instruction Manual — 1 no.	
3.	**Vickers cum Brinell Hardness Testing Machine** Technical Specifications:- Loads (kgf) — 5, 10, 20, 30, 50 (Loads for Vickers) Optical system least count — 0.0005 mm Maximum Test Height — 200 mm Depth & Throat (mm) — 150 mm Weight approx (kg) — 180 Dimension L x W x H — 660 x 180 x 850 mm Connected Load — 0.1 KVA, 1 phase AC, 220 V, 50 Hz Accessories Flat Table 100 mm Dia — 1 no. V table for specimen - 6 to 80 mm dia — 1 no. Vickers Diamond Indentor — 1 no. Vickers Test Block — 1 no. Electrical Cord — 1 no. Instruction Manual — 1 no.	1
4.	**Fatigue Testing Machine** Accuracy & Calibration:- This machine is confirms to requirement of IS : 5075 – 1969 standards. Features:- An interlocking system provided puts off the motor at specimen failure Light weight, Compact size and very simple design Table model no need to foundation Simple lever system and changing load	1

<table>
<tr><td></td><td>Calibration is in Nm
Specification:
Maximum bending moment: 20Nm
Bending moment adjustable: 2.5-20Nm
Ranges: Range I: 2.5-12.5Nm & Range II: 12.5 - 20 Nm
Griping Dia of specimen: 12mm
Testing dia of specimen: 8mm
Rotating speed: 4200rpm
Accuracy of applied bending moment: ±1%
Digital counter: 8 digit
Power required: 0.5 HP
Power supply: 3ph 440v 50hz</td><td></td></tr>
<tr><td>5.</td><td>IMPACT TESTING MACHINE
Technical Specifications :-
<table>
<tr><td></td><td>Charpy</td></tr>
<tr><td>Pendulum Drop Angle (Degree)</td><td>140</td></tr>
<tr><td>Pendulum Effective Weight (Kg.)</td><td>21.300</td></tr>
<tr><td>Striking Velocity of Pendulum (m/ Sec)</td><td>5.308</td></tr>
<tr><td>Pendulum Impact Energy (Joules)</td><td>300</td></tr>
<tr><td>Min. Scale Graduation (Joules)</td><td>1 Joule</td></tr>
<tr><td>Distance between axis of pendulum to centre of strike (length of pendulum in mm)</td><td>813.5</td></tr>
<tr><td>Max. Total friction & Windage losses</td><td>0.5% of max. Impact energy</td></tr>
<tr><td>Striking edge :</td><td></td></tr>
<tr><td>Angle (Degree)</td><td>30°</td></tr>
<tr><td>Radios of Curvature (mm)</td><td>2</td></tr>
<tr><td>Width at tip (mm)</td><td>18</td></tr>
<tr><td>Horizontal relief (Degree)</td><td>--</td></tr>
<tr><td>Vertical relief (Degree)</td><td>--</td></tr>
<tr><td>Specimen Anvils and supports :-</td><td></td></tr>
<tr><td>Suitable for max. specimen cross section(mm)</td><td>10 x 10</td></tr>
<tr><td>Distance between specimen anvils (mm)</td><td>40</td></tr>
<tr><td>Included angle of Anvil tip (degree)</td><td>79</td></tr>
<tr><td>Radius of curvature at Anvil tip (mm)</td><td>1</td></tr>
</table></td><td>1</td></tr>
<tr><td>6.</td><td>DIGITAL TORSION TESTING MACHINE
Suitable for Torsion and Twist tests on various metal rods and flats
Torque measurement by torque cell & angel of twist measurement by rotary encoder
Display of torque & angel of twist on LCD display provided on Data Acquisition system
Torque resolution o,01% of machine capacity for entire range.
Angel of twist resolution is 0.1 degree
Accuracy of Torque measurement ±1% in the range from 4% to 100% of machine capacity
Provisions to conduct test slowly by a handle which facilities finding modulus of rigidity "G"
Facility for connecting to the computer
Various models Maximum Torque Capacity from 100Nm to 300Nm
Machine meet the requirement of IS:5075 1969</td><td>1</td></tr>
</table>

7.	**12" DIFFUSED LIGHT RESEARCH POLARISCOPE** All the optical Elements should be with field 280mm and ½(least count of rotation. Light box with 2 Nos. of 20 watts fluorescent tubes and 55 watts sodium lamp. Table with leveling arrangement and sun mica top. Loading frame any one type from Dead weight or proving ring type, capacity 30 kg with necessary weights with small supports or links for holding small models. Sample model of small size in photo elastic sheet Ring or disc. Light Box: Well-ventilated light box contains white light and monochromatic light. With diffused glass. White light is obtained from fluorescent tube white monochromatic light is obtained from sodium vapor lamp. Which is matching with quarter wave plates used. Universal Loading Frame: Dead Weight Type Universal loading frame is of dead weight & lever system type. Arrangement for both transverse & vertical slow movements of frame is provided. The frame is useful for loading is simple models in tension. Compression and bending one at a time. Space available for model within frame is 30 cm. X 30 cm. Capacity of loading frame is 200 Kg. For specific models the user has to design a fixture suitable for particular loading. 1. All the optical Elements with field 280 mm and ½ least count of rotation. 2. Light box with fluorescent tube and sodium lamp. 3. Table with leveling arrangement. 4. Loading frame of load cell type capacity 200 Kg. Approximate with necessary small supports or links or fixtures for holding small models. 5. Sample models of small size in photo elastic sheet ring & Disc.	1
8.	**STRAIN GAUGE MODULE** Panel provisions: DPM 2volts,Four no. of strain gage with nominal value of 120 Ω/350 Ω are mounted on a cantilever beam which can be loaded with the help of weights in a pan. The system is designed for a maximum of 5-kg load and can be used as a load cell also. Detailed calculations regarding stress and strain in the beam can be performed. Provision is made for two- arm and four-arm operation. Bridge balance controls in terms of coarse control and fine control are provided. An amplifier with variable gain in the range of 0 to 1000 is used for signal processing. Accuracy: ± 1%	1
9.	**Bending Stress in a Beam** A modular structures experiment for study of stress distribution across the section of a beam Experiments • Second moment of area • Converting strains to stresses • Strain gauges • The neutral axis • The bending equation Standard Features • Supplied with comprehensive Lecturer Guide and Student Guide, including theory, experiments and sample results • Made in accordance with the latest European Union directives Specifications • Load: Adjustable 0 to 500N. Ring type load cell with electronic force sensor • Test beam: Aluminium T-section	1

	• Beam loading design to give constant bending moment at gauge positions for greater accuracy • Strain measurement: Nine strain gauges (with nine dummy gauges to compensate for temperature variation and balance the strain bridges) and a 16-way digital strain bridge. • Connections from strain gauges to readout via gold plated quick connectors • Gauge Type; 350 Ω type. • Guaranteed gauge Factor of 2.1 ± 0.05 • Accessories included: Vernier • Compatible with the STR1 Structures Test Frame • Compatible with the STR1A Structures Digital Force Display • Compatible with the STR2000 Structures data acquisition system • Compatible with the STRS Structures software with 19 virtual structures experiments	
10.	**Thin Cylinder** Bench-mounted machine to allow students to do stress and strain tests on a thin-walled cylinder Allows students to perform experiments that examine stress and strain in a thin-walled cylinder. The apparatus consists of a thin-walled aluminium cylinder, held in a robust frame. The frame holds the cylinder so that it is free to move along its axis The cylinder contains oil. To stress the cylinder, students use the hydraulic hand pump to pressurise the oil. Strain gauges on the cylinder surface measure strain, while a gauge and electronic sensor measure hydraulic pressure • Ideal for student use and classroom demonstrations • For comprehensive analysis of the stresses and strains in a thin-walled cylinder, under internal pressure • Introduces stress and strain, and how to measure and analyse them • Includes experiments to find Young's modulus and Poisson's ratio • Closed-end and open-end conditions to allow circumferential or biaxial stress tests • High-quality electrical-resistance precision strain gauges measure cylinder strains • Includes built-in microprocessor-controlled display of strain measurements • Mounted on a sturdy base, to form a compact product ideal for use on a workbench • Self-contained, hand-operated hydraulic pressurising system for accurate pressure control • Completely self-contained – needs no other parts Experiments Investigations into stresses and strains in a thin cylinder, to give students an understanding of: • Longitudinal stress, hoop (or circumferential) stress, radial stress and biaxial stress • The behaviour of the cylinder under both open and closed-end conditions • The use of strain gauges • The stress strain relationship and value of Young's modulus for the cylinder material • Indirect strain and stress	1

	• The value of Poisson's ratio for the cylinder material • The use of Mohr's circle to calculate the shear strain at any position in the cylinder • The use of the 'superposition method' to find the principal strains • The effect of the biaxial stress system • Sources of error in their experiments	
11.	**Buckling of Struts** A modular structures experiment to study the relationships between length, end fixing conditions and buckling load of struts Experiments • Euler buckling loads • Relationship between strut length and collapse load • Relationship between various end-fixing conditions and collapse load • Nature of deflection and deflected shapes with various end-fixing conditions Standard Features • Supplied with comprehensive Lecturer Guide and Student Guide, including theory, experiments and sample results • Made in accordance with the latest European Union directives Specifications • To consist of a back plate with a load cell at one end and a device to load the struts at the top. Provision to store 5x test struts in a holder on the back plate. The backplate to include various printed equations and other information for student use. A magnetic linear scale to be provided to monitor the horizontal deflection • A bottom chuck to be fixed to an articulated parallelogram mechanism which prevents rotation but allows movement in the vertical direction against the ring load cell. The mechanism reacts to the side thrust produced by the strut under buckling conditions, while reducing to a minimum friction in the vertical direction • A manually-operated adjustable loading mechanism with a 500 N load cell at the top of the backplate to provide the load to the strut • Test struts: o 5 x aluminum alloy (section 2 mm x 20 mm) o Lengths: 300 mm, 350 mm, 400 mm, 450 mm, 500 mm • Fixing conditions: o Fixed both ends o Pinned both ends o Fixed one end and pinned at the other • Accessories included: o Set of different chucks o Vernier o Tools o Lead to connect to a digital force display • Compatible with the STR1 Structures Test Frame • Compatible with the STR1A Structures Digital Force Display • Compatible with the STR2000 Structures data acquisition system	1

	• Compatible with the STRS Structures software with 19 virtual structures experiments	
12.	**PILLAR DRILL MACHINE** with electric motor & V belt, motor pulley, motor fixing plate adjustable type, belt cover, drill chuck to hold Straight Shank drill bits and drill sleeve sets to hold Taper Shank drill bits. Technical Specifications: Drilling Capacity (In Steel) : 25 mm Column Dia : 87.60 mm Centre of Spindle to Column : 250 mm Max. Spindle to Table: 650 mm Max. Spindle to Base: 1050 mm Taper in Spindle: MT-3 Spindle Travel : 150 mm No. of Speed: 8 Range of Speed: 90 to 1490 RPM Table Size: 345 x 345 mm Base Size: 310 x 320 mm Overall Height with Guard: 1675 mm V-Belt Section : B-52 Elec. Motor – 1 H.P, 1440 RPM Accessories : Drill Chuck 0-1/2" with Arbour, Drill Sleeve (2-3), Drill Vice-100 mm, Elec. Coolant Pump with Tank & Fittings, Machine Lamp	1
13.	**Jig Saw Machine** Throat Depth: 610mm Table size: 350x350mm Cuts Thickness: 45 HP Stroke: as per minute: 650 Motor: 1/2 HP RPM of Machine: 650	1
14.	**Motorized Gyroscope** The apparatus Consists of a rotor mounted in bearings, this rotor is free to rotate about a. Its own axis i.e. axis of spin. b. Axis at precession. c. Axis of gyroscopic couple The rotor is connected to the variable speed motor. The weight of the motor is balanced by another weight which is on either side of the rotor, by putting weights on the weight platform torque can be supplied to rotor, which is also called gyroscopic couple Specifications: • Rotor diameter 250mm free about 3 axis of rotation driven by Variable speed motor. • Dimmer-stat to control the motor speed. • Stopwatch to measure the angular speed about the axis of procession. • Weights: 0.2Kg, 0.5Kg, 1Kg.	1
15.	**Static & Dynamic Balancing Apparatus.** Equipment is designed for carrying out the experiment for balancing 8 rotation mass systems. The apparatus consists of a stainless steel shaft fixed in a rectangular frame. A set of four blocks with a clamping arrangement is provided for static balancing. Each block is individually clamped on shaft and its relative weight is found out using cord and	1

	container system in terms of number of steel bans. For dynamic balancing a moment polygon is drawn using relative weights and angular and axial position of blocks is determined. The block are clamped on shaft is rotated by a motor to check dynamic balance of the system. The system is provided with angular and longitudinal scales and is suspended with chains for dynamic balancing. Experiments: 1. To balance the masses statically and dynamically of a single rotating mass system. 2. To observe the effect of unbalance in a rotating mass system. Technical Specification Drive Motor - FHP Motor, variable speed, with speed controller Balancing Weight - 4 Nos. of Stainless Steel with different sized eccentric Mass for varying unbalance Rotating Shaft – Material Stainless Steel 0.5 kW, 220V, Single Phase	
16.	**Motorized Governor Apparatus** The unit consists of a main spindle driven by a variable speed motor. Three different governor assemblies can be mounted over the spindle. Pointer measures the lift of the governor. Students can calculate characteristic of governor and compare their performance viz. sensitivities, stability, governor effort, etc SPECIFICATIONS Governor assemblies Hartnell, porter& porpel governor assembly one each with rotating weights. Variable speed FHP D.C. motor to drive the main spindle. Sliding weights for porter & proell governor. Scale & a pointer to measure governor lift. Spring & Spring compression adjustment arrangement.	1
17.	**Coriollis Component of Acceleration** This setup is designed to study coriollis co*mponent* of acceleration of a slider crank Mechanism. The apparatus uses Hydraulic analogy to represent the rotating slider. It consists of a rotating block with two arms in opposite direction. These tubes can be rotated at various speeds by using a swinging field motor, which also acts as a dynamometer to measure torque applied to rotating tube. A Perspex window on top cover helps to visualize the process. Rotameter is used to measure water flow rate through tubes. Water is circulated by small mono block pump. Specifications: • Main Tank with fibre glass lining. • Rotating Arms 9*/6* mm dia. 300 mm long. • Motor- Swinging field. D.C. 0.5 HP. • Rotameter • Monoblock Pump • Control Panel comprising of ➢ Speed Control Unit. ➢ Speed Indicator. ➢ Necessary switches. ➢ Rigid support Frame. Range of Experiment: Coriollis Component of acceleration can be determined at various speeds of rotation and water flow rates.	1
18.	**Cam Analysis Machine** The apparatus is designed to study the cam profiles and performance of cam and follower	1

	system. The apparatus consists of a shaft supported by ball bearings upon which three different types of cams be mounted. The push rod for follower is supported vertically, which can adopt three different types of followers. Cams and followers can be changed easily. A variable speed motor rotates the cam. A dial gauge permits plotting of follower displacement with respect to cam position. By operating the system at different Speeds, jump speed can be found and also the effect of weight and spring force on jump speed can be studied. Jump can be visualized also with the help of an optional stroboscope. Specifications: • Cam-Eccentric, tangent and circular ARC type- one each • Follower- mushroom, flat faced end roller type- one each • Cams and followers are hardened to reduce wear of the surfaces. • Variable speed motor coupled to cam shaft of suitable range and Variac • A dial gauge to note the follower displacement.	
19.	**Vibration Apparatus** The VIBLAB is designed to help in conducting various experiments to illustrate and verify the principles and relations involved in the study of vibrations. This apparatus enables a comprehensive range of Vibration Experiments to be conducted on single basic framework. The frame is robustly constructed from channel section. The experiments are specially designed for quick and easy assembly on to the framework using minimum amount of common Engineering tools. To reduce changeover lime on tube, more advanced free and forced vibration experiments, large knurled knobs ere used to clamp components on the frame and many components are common to several experiments. Specifications: • Forced and Free Vibrations. • Damped and Undamped vibrations. • Arrangements of vibration for damping. • Sturdy storage cabinet. List of Experiments: 1. Pendulum Experiment: • Simple Pendulum. • Compound Pendulum. • Bi-filler suspension. 2. Longitudinal Vibration Experiment: • Verification of Dukerleys Rule. • Forced rotor with viscous damping along with frictional HP Motor Strip chart recorder & control unit. 3. Torsional Vibration Experiment: • Single rotor System • Two rotor System. • Single rotor with viscous damping. 4. Damped Vibration Experiment: • Verification of Dukerleys Rule Forced rotor with viscous damping along with frictional HP motor strip chain recorder & control unit.	1
20.	**Whirling of Shaft Apparatus.** The unit consists of a base upon which the bearing holders and driving motor and bearing can be fitted in a holders to end conditions of test shafts. A variac provides control of driving motor. The unit demonstrates the phenomenon of	1

	whirling of shafts with single rotor as the test is destructive after the test same shaft cannot be used again, hence the unit only demonstrates the principle. Specifications: • Test shaft: 4.75 mm, 6.35 mm and 7.9 mm- 2 each. • Bearing to provided end conditions, (a) Both ends fixed, (b) One end fixed and one end free. • Drive motor 1/8 HP. 1500 rpm with control Arrangement. • The whole unit is mounted on a sturdy base. • Rotor for each shaft of suitable size.	
21.	**Influence of Moment of Inertia upon Velocity and Acceleration** Moment of Inertia with fly wheel apparatus	1
22.	**Journal Bearing Apparatus** The apparatus consists of a plain steel shaft encased in a bearing and directly driven by a small electric motor. The bearing is freely supported on the shaft and sealed at motor end. The motor speed is precisely controlled by control unit and sealed at motor end. The motor speed is precisely controlled by control unit and can be run in both directions. The bearing contains twelve equivalently spaced pressure tapping around circumference and four along the axis. All are connected by light flexible plastic tube to the manometer so that the pressure head of all sixteen point can be observed at a time. The bearing can be loaded by attaching weight to the arm supported beneath it. Specifications: • Journal: 50mm. dia. (nominal) • Bearing: 55 mm dia. • Weights: 4 adjustable weights • Motor: D.C. shunt motor 3,000 RPM. • Control panel: For speed control of motor • Manometer panel: 16 tube Manometer • Oil recommended: SAE 10	1
23.	**Epicyclic Gear Train and Torque Holding Apparatus** It is a motorized unit consisting of SUN gear mounted on input shaft. These planet gears are mounted on a common arm to which output shaft is fitted. Loading arrangement is provided for loading the system and to measure Holding Torque. SPECIFICATIONS External type Epicyclic Gear Train: Bearing blocks for Input & output shafts A gear train with Holding drum and holding Internal Typo Epicyclic Gear Train: A compact Gear Train. Variable speed D.C. Motor Rope brake arrangement to measure output torque and holding torque. Control Panel comprising of : Digital Ammeter and Voltmeter.	1

	RPM Indicator. Speed Controller.	
24.	**Generation of involute gear tooth profile** This board illustrates the process of cutting of involutes Gear Tooth, by use of tack type cutter It consists of 3 white acrylic discs A, B, C. having pitch circle diameter of 450 mm, 300 mm & 200 mm respectively. A gear tooth profile with module 25mm can be traced out on a piece of paper placed between disc and cutter. An effect of Interference and Undercutting on correct profile of gear tooth can be studied from the profiles traced.	1
25.	**Interference and undercutting** The board shows the demonstration of this phenomenon of Interface and Undercutting. When we rotate the teeth in anticlockwise direction. As the teeth is undercut it gives us smooth working. When we give a rotation in clockwise direction we can observe that the rack tip will be resisted by the tooth flank thus giving interference.	1
26.	**Slip & creep measurement apparatus** The apparatus consists of a variable speed D.C. Motor, Driving pulley and Driven pulley of equal diameter. The pulleys ore mounted on input shaft (Motor Shaft) and output shaft. The driven pulleys can slide on the base with bearing block to change initial tension in belt. Brake drum mounted on output shaft helps to measure power output. The motor speed is varied by dimmer stat. A two channel RPM Indicator is provided to measure speeds of driven and driving pullies respectively.\ Specifications: • D.C. Motor:1 HP 1500 RPM, variable speed. • Driving & Driven pullies of equal diameters. • Brake drum along with spring balance. • Flat Belt of fixed length of following materials: Fabric Belt , Rubber Belt tightening arrangement, Speed Controller Unit, Two Channel digital APM Indicator Stroboscope. Range of Experiment: • To measure co-efficient of friction between pulley material and different Belt materials. • To measure power transmitted with varied belt tensions and plotting graph of (T1-T2). Tension Characteristics. • To measure percentage slip at fixed belt tension by varying load on brake drum and plot graph of (T1-T2) vs percentage slip Le. Slip Characteristics. Finding a creep zone from graph. To measure belt slip speed and observe the limiting value float at constant Speed when the slip just starts.	1
27.	**Dead weight pressure gauge tester** It is used for calibration of pressure gauges. Relationship between pressure acting on the known area of vertically free floating piston producing a force balanced by known dead weight is made use in the Dead Weight Pressure Gauge Tester. Range: 0.5 to 25 KG /cm	1

	The main component of dead Weight Pressure Gauge Tester are: • Screw Pump to generate pressure in the circuit of adequate capacity and operated by turning the spooked handle. Permit easy and accuracy setting of pressure. • Free Piston Assembly of special steel, hardened, tempered, ground and lapped to accurate size and very fine surface finish to provide true floating action. • Set of weights directly marked in convenient values of pressure and easily stacked on the carrier weight Available in either kgf/cm2, bar Cbf/in2 units.	
28.	**Tool dynamometers: Milling, grinding, lathe, drilling Milling Tool:** Mechanical sensing with unit with two octagonal rings and strain gauges. Two channel digital force indicator with balancing potentiometers and polycarbonate front panel Range of force measurement in co-ordinate direction 0-500Kg Grinder Tool: This a simple set up to study the various forces resolved during grinding operation, designed by sharp techno system for demonstration purpose for the students undergoing tool designing study. This unit works on octagonal ring method using strain gauge as a sensor. A two channel digital force indicator facilitates to measure both forces simultaneously. Lathe Tool: This is a strain gauge type two component lathe tool dynamometer designed to measure vertical and horizontal forces on the while Orthogonal cutting process. The unit is in two parts one is mechanical sensing unit or tool holder, which can be mounted on the top of the Ross slide after removing swivel base and compound slide of a lathe and digital force indicator with this dynamometer student can study the change in these forces by varying Speed. Drilling Tool This is an armed wheel type strain gauge drill tool dynamometer designed to measure thrust and torque during drilling operation. This dynamometer is suitable for drilling a hole up to 25mm size in mild steel, with this dynamometer students can study the change in these forces by varying speed	1
29.	**UNSTEADY STATE HEAT TRANSFER UNIT** Two sets of simple shapes (a solid sphere, a rectangular slab, a long solid cylinder) made of brass and stainless steel is to be `supplied. Each of the shapes should be built-in temperature sensor to measure the temperature at the centre of the shape. Measurements taken on a shape of a particular material should be used to confirm the conductivity of a similar shape of a different material. Transient-temperature/heat flow charts to be supplied for each of the shapes. The water bath should have a capacity of 30 litres and is heated by a 3.0 kW electric heating element. The temperature of the water bath should be maintained and predetermined by means of a temperature controller before taking any measurements. The large volume of water in the bath ensures that any change in the temperature of the water, as the measurements are taken, is negligible. A circulation pump mounted alongside the water bath circulates water from the bath to the base of a vertical cylindrical duct which is	1

located at the centre of the water bath. The velocity of the water should be varied by adjusting the control valve. The individual shapes to be conveniently positioned within the vertical duct by means of a holder before measurements are taken. The heat transfer characteristic and also the water temperature surrounding the shape remains constant due to the upward flow of water at constant velocity past the shape.

A temperature sensor mounted on the holder of the solid shapes contacts the hot water at the same instant as the solid shape to give an accurate temperature/time measurement.

EXPERIMENTAL CAPABILITIES

- Monitoring the changes in temperature for bodies of different sizes, shapes and materials which are dropped into the hot water bath.
- Analysis of the results obtained from different solid shapes using analytical temperature/heat flow charts provided.
- Determination of the conductivity of a shape using the results obtained from similar shape made of different material.
- The effect of shape, size and material properties upon unsteady heat flow.

SPECIFICATIONS

Bench

Made of stainless steel frame with high quality phenolic resin backpanel.

Water Bath

30 liters insulated stainless steel tank with top plate and mounting for solid shapes holder. Heating is by a 3.0 kW electric heater with high temperature cut-out protection. Water circulation by a circulation pump.

Solid Shapes

Two sets of solid shapes made of brass and stainless steel complete with shape holder. Three different shapes i.e. solid sphere, rectangular slab and long solid cylinder. Each solid shape has a built-in temperature sensor at the center.

Instrumentations and Controls

i) 3 units of digital indicator
ii) 3 units of RTD sensor with transmitters
iii) 6 units of thermocouple type K with transmitter

OPTIONAL ITEMS

- DAS

SOLDAS Data Acquisition System

i) A PC with latest Pentium Processor
ii) An electronic signal conditioning system
iii) Stand alone data acquisition modules
iv) Windows based software
    - Data Logging
    - Signal Analysis
    - Process Control
    - Real-Time Display
    - Tabulated Results

	□ Graph of Experimental Results ISO 9001:2008 certified manufacturer preferred	
30.	**HEAT CONDUCTION STUDY BENCH** Both test sections should be equipped with an array of fast response high accuracy (0.1°C) temperature sensors. Cooling water should provides a heat sink to maintain steady temperature gradient. A power control circuit should provides a continuously variable electrical output up to 100W. A temperature gradient in a solid material must causes heat to flow. A solid to be chosen for the demonstration of pure conduction since both liquids and gases exhibit excessive convective heat transfer. Heat conduction should occurs in three dimensions, a complexity which often requires extensive computation to analyse. A one-dimensional approach is required in the laboratory to demonstrate the basic law that relates rate of heat flow to temperature gradient and area. The test modules should be designed to minimise errors due to true three-dimensional transfer. The basic principles of conduction can be taught without knowledge of radiation or convection heat transfer. The linear test of area, conductivity and series combinations. Contact resistance may also be investigated and the important features of unsteady state conduction may be demonstrated. The unit may be used to measure the thermal conductivity of various solid materials such as cork and paper by clamping sample of specific dimensions between the hot and cold elements. EXPERIMENTAL CAPABILITIES □Accurate demonstration of conduction laws □ Linear and radial temperature profiles □Conduction through composite materials □Effect of surface contact □Insulation effects □Thermal conductivity determination □ Area effects □Unsteady state profiles Specifications ***a)*** *Bench* Type : Table Top Material : Mild steel c/w epoxy paint ***b)*** *Linear Module* Consists of: <u>Heater Section (Brass)</u>	

	Diameter : 25 mm Cooler Section (Brass) Diameter : 25 mm Interchangeable Center Section of length 30 mm i) Brass of diameter 25 mm ii) Stainless steel of diameter 25 mm iii) Brass of diameter 13 mm *Radial Module* Material : Brass Diameter : 110 mm Thickness : 3 mm *Instrumentations* Linear module consists of a maximum of 9 temperature sensors at 10 mm interval. For radial module, 6 temperature sensors at 10 mm interval along a radius are fitted. *Control Panel* Allows the heater input power to be set and the temperature at any of the sensors to be shown in °C on the indicator. - EI DIGITAL INSTRUMENTATIONS i) 2 units of digital indicator ii) 1 unit of power transducer OPTIONAL ITEMS - DAS SOLDAS Data Acquisition System i) A PC with latest Pentium Processor ii) An electronic signal conditioning system iii) Stand alone data acquisition modules iv) Windows based software □ Data Logging □ Signal Analysis □ Process Control □ Real-Time Display □ Tabulated Results □Graph of Experimental Results	
31.	**NATURAL CONVECTION AND RADIATION UNIT** The unit should be self-contained mounted on a lockable castor wheels. The pressure vessel should be made from a steel cylinder and in the wall of the vessel are tappings for a vacuum gauge, a pressure transducer, an air-vacuum/pressure and a wall temperature thermocouple. The heater element should be made from a copper tube and finished with a matt black surface. A thermocouple must be attached to its surface to measure the	1

temperature in the vessel. The vessel may be charged with air up to 200kPa (absolute) or evacuated to 5 Pa (absolute). By connecting an air-line from a suitable compressor, pressures above atmospheric are produced and is measured using the pressure transducers. At the same time, pressures belowatmospheric are produced using a vacuum pump and to be measured using the vacuum gauge. Both devices should be displayed the pressure on a combined instrument on the control panel. For safety purpose, a pressure relief valve is installed in the system.

EXPERIMENTAL CAPABILITIES

- Study the phenomena of heat transfer over a range of pressures and vacuum
- Measurements of pressures and temperatures
- Verification and calculation of heat loss, emissivity and Stefan-Boltzman constant

SPECIFICATIONS

Pressure Vessel

Type : Cylinder
Material : Stainless steel
Capacity : Approx. 45 L

Heated Element

Material : Copper tube and finished with a matt black surface
Max. element surface temperature : 200°C
Thermocouple is attached to its surface to measure temperature in vessel

Vacuum Pump

Max. working pressure : Approx. 2 bar
To evacuate the air in the vessel

Control Panel

All instrumentations and displays for element power, temperatures and pressures

OPTIONAL ITEMS

- DAS

SOLDAS Data Acquisition System

i) A PC with latest Pentium Processor
ii) An electronic signal conditioning system
iii) Stand alone data acquisition modules
iv) Windows based software
- Data Logging
- Signal Analysis
- Process Control
- Real-Time Display
- Tabulated Results
- Graph of Experimental Results

32.	**THERMAL CONDUCTIVITY OF BUILDING MATERIALS APPARATUS** This equipment should be designed for students to experimentally determine the thermal conductivities of various building materials. The test materials, in the form of square plate, are placed in between the electrically heated heating plate and the water-cooled cooling plate. Cooling water should provide a heat sink to maintain a steady temperature gradient. Clamping device should be used to facilitate specimens interchanging and to ensure that there is adequate contact pressure and thermal contact between the specimens. Thermal sensor should be used to measure the heat transfer rate. The thermal conductivity to be determined from the heat transfer rate and temperature difference. All measurements should be displayed on digital indicators. EXPERIMENTAL CAPABILITIES The unit allows students to performthe following experiments: ¨ Determination of the thermal conductivity of different materials. ¨ Determination of the thermal conductivity of specimens connected in series. ¨ Determination of thermal resistance. SPECIFICATIONS The Thermal Conductivity of Building Materials Apparatus comes complete with the followings: *Test Materials* The following test materials of various thicknesses are supplied:- Polystyrene, POM, plaster, cork, PMMA, Armaflex, Acrylic, cardboard Size : 300 mm x 300 mm The test materials have a thickness or combined thickness of up to 75 mm *Heating Plate* Heater Power : 500 W *Instrumentations* All the necessary temperature sensors and plate heater controller are provided to conduct the experiments. All readings are digitally displayed on digital indicators.	1
33.	**RADIATION HEAT TRANSFER RIG** Most of the components must be mounted on a horizontal double rail track with adjustable feet supports. At one end of the track is a “plane black body” radiation source consisting of an electrically heated plate mounted in a casing so that its exposed face is in a plane perpendicular to the track. At the other end of the track is a diffused light source mounted in a casing which may be rotated about a vertical axis. Between these sources students may place either a heat radiation meter (radiometer) or a light meter, according to the	1

source in use. These meters indicate the intensity of heat or light received at their locations.

In addition, a number of accessories may be fitted to the track for a variety of experiments. The accessories include:

i) Metal plates with attached thermocouple.
ii) Two metal plates mounted so that the aperture between them can be varied.
iii) Three acrylic filters.

The meter and all accessories should be mounted in suitable carriers which position them about the centre line of the sources and a linear scale on the track assists accurate positioning. Electrical power for either the radiant or light source is supplied from a solid state regulator in the instrument panel.

The panel also includes a digital indicator displaying the temperature sensed by either of the thermocouples, and a digital indicator displaying the intensity of radiation received by the radiometer.

A standard industrial type light meter is supplied with this unit to be used in conjunction with the light source.

EXPERIMENTAL CAPABILITIES

- Demonstration of Inverse Square Law
- Investigation of the relationship between the temperature of a surface and the rate at which heat is radiated
- Demonstration of Kirchhoffs law applied to radiation
- Effect of interconnecting geometry between radiating surfaces
- Demonstration of Lamberts Cosine Law

SPECIFICATIONS

A bench top unit for the demonstration of the fundamental laws governing thermal radiation by using both heat and light sources.

Mounting Track

Parallel rails with adjustable feet and linear scale

Radiant Source

400 W heater embedded in a flat plate to provided a “black body” emitter

Light Source

40 W lamp with glass diffuser

Accessories

Two metal plates with thermocouples
Two aperture plates

	Three acrylic fillers *Instrumentations* Radiometers : Moll type thermopile with digital indicator Range : 0 to 2,000 W/m2 Thermometer : Digital display Range : 20 to 600°C x 1°C Light meter : 0 to 20,000 lux and 0 to 50,0000 lux - EI DIGITAL INSTRUMENTATIONS i) 2 units of digital indicator ii) 1 unit of temperature sensor iii) 1 unit of radiometer OPTIONAL ITEMS - DAS SOLDAS Data Acquisition System i) A PC with latest Pentium Processor ii) An electronic signal conditioning system iii) Stand alone data acquisition modules iv) Windows based software □ Data Logging □ Signal Analysis □ Process Control □ Real-Time Display □ Tabulated Results □ Graph of Experimental Results	
34.	**LIQUID DIFFUSION COEFFICIENT APPARATUS** EXPERIMENTAL CAPABILITIES □ Measurement of mass transfer rates □ Measurement of diffusion coefficients. □ The effect of concentration upon diffusion coefficient □ First order unsteady state process analysis □□□□Familiarisation with laboratory instruments to obtain data for industrial process design DESCRIPTIONS	1

	The diffusion cell, the most important component, should be designed for fast diffusion rates in liquids to minimise long observation period. The cell basically should consists of a honeycomb of accurately dimensioned capillaries, positioned between two liquids of differing concentration of the solute whose diffusion coefficient is to be studied. During the experiment, students shall place a small volume of concentrated solution on one side of the honeycomb. At the beginning, the other side of the honeycomb consists of a large volume of pure solvent (water). The solute diffuses from high concentration side to the low side, causing the concentration within the larger volume to increase. The mixture is continually stirred while the increase in concentration is continuously monitored using a conductivity meter. SPECIFICATIONS *Diffusion Cell* Material : Borosilicate glass O.D. : 10 mm Thickness : 1.5 mm Capillary : 1 mm (bore) x 5 mm x 97 no's (made of PVC) *Diffuser Vessel* Capacity : 1.0 litre Material : Clear acrylic O.D. : 100 mm Thickness : 3.0 mm Height : 200 mm *Conductivity Meter* Range : 0 - 1,999 □S/cm (auto-ranging) Temperature : ATC - PT100 *Magnetic Stirrer* Range : 0 to 1,500 rpm Electricity : 230VAC/1-phase/50-60Hz	
35.	**SOLID-LIQUID EXTRACTION UNIT** EXPERIMENTS □ Determination of the extraction efficiency. □ Effects of solvent flow rate, contact time and solvent feed temperature on the extraction efficiency. □ Batch and continuous extraction.	1

- Semi-continuous extraction using Soxhlet method.
- Mass balance analysis.

TECHNICAL SPECIFICATIONS

Reboiler (B1)

5-L horizontal evaporator made of stainless steel.
2kW electrical heater with temperature control.

Column (K1)

DN50 x 1000 mm column made of borosilicate glass.
Packings: Glass Raschig rings (8mm x 8mm)

Condenser (W2)

Coil heat exchanger made of stainless steel.
Heat transfer area: 0.3 m^2

Pre-Heater (W3)

150W cartridge heater with temperature control.

Product Cooler (W4)

Coil heat exchanger made of stainless steel.
Heat transfer area: 0.03 m^2

Extraction Vessel (B2)

Cylindrical vessel made of borosilicate glass with 4-L solid sample container made of stainless steel with porous support.

Receiver Vessel (B3)

5-L cylindrical vessel made of stainless steel.

Instrumentation and Control

Temperature measurements
Temperature controllers
Flow rate measurements
Pressure measurements

OPTIONAL ITEMS

- EI

DIGITAL INSTRUMENTATIONS

i) 5 units of digital indicator
ii) 1 unit of flowmeter
iii) 3 unit of RTD sensor c/w transmitter
iv) 1 unit of pressure transmitter

	- DAS SOLDAS DATA ACQUISITION SYSTEM i) A PC with latest Pentium Processor ii) An electronic signal conditioning system iii) Stand alone data acquisition modules iv) Windows based software □ Data Logging □ Signal Analysis □ Process Control □ Real-Time Display □ Tabulated Results □ Graph of Experimental Results - CAL SOLCAL COMPUTER AIDED LEARNING SOFTWARE i) Interactive multimedia features ii) Graphical simulation iii) Experiment results samples iv) Full experiment manuals	
36.	**Thermal Image Camera** Specification with 25 Degree Lens IR resolution -320 × 240 pixels MSX resolution - 320 × 240 pixels UltraMax - Yes Thermal sensitivity/NETD - <30 mK @ +30°C (+86°F) Field of view (FOV) -25° × 19° Minimum focus distance - 0.4 m (1.31 ft.) Spatial resolution (IFOV) - 1.36 mrad Image frequency –60 Hz Focus–Automatic (one shot) or manual Digital zoom – 2× and 4× Detector type -Focal plane array (FPA), uncooled microbolometer Spectral range–7.5–13 µm Display –Touch screen, 3.5 in. LCD, 320 × 240 pixels Auto orientation - Automatic landscape or portrait Image adjustment - Auto or manual Image modes - IR image, visual image, MSX, picture in picture, thumbnail gallery Multi Spectral Dynamic Imaging (MSX) - IR image with enhanced detail presentation Picture in Picture - Resizable and movable IR area on visual image Object temperature range - –20°C to +120°C (–4°F to +248°F) &0°C to +650°C (+32°F to +1202°F) Accuracy - ±2°C (±3.6°F) or ±2% of reading	1

	Spotmeter - 5 Area - 5 areas (boxes or circles) with max./min./average Automatic hot/cold detection - Auto hot or cold spotmeter markers within area Measurement presets - No measurements, Center spot, Hot spot, Cold spot, 3 spots, Hotspot-spot, Hotspot-temperature Difference temperature - Delta temperature between measurement functions or reference temperature Reference temperature - Manually set or captured from any measurement function Emissivity correction - Variable from 0.01 to 1.0 or selected from materials list Measurement corrections - Emissivity, reflected temperature, relative humidity, atmospheric temperature, object distance, external IR window compensation Color palettes - Iron, Rainbow, Rainbow HC, White hot, Black hot, Arctic, Lava Color Alarm (isotherm) - Above/below/interval Measurement function alarm - Audible/visual alarms (above/below) on any selected measurement function, 1 Humidity Alarm incl. Dew point alarm, 1 Insulation Alarm. Screening - Difference temperature alarm, audible Image storage- Standard JPEG, including digital photo and measurement data, on memory card Image storage mode - Simultaneous storage of thermal and digital photo in same JPEG file & Optional to store digital photo as a separate JPEG file Voice Annotation - 60 seconds (via Bluetooth) Text Annotation - Add short note (stored in JPEG EXIF tag) METERLiNK - Wireless connection (Bluetooth) to FLIR meters with METERLiNK Report generation – Instant Report (*.pdf file) in camera including IR and visual images & Separate PC software with extensive report generation Compass - Camera direction automatically added to every still image Non-radiometric IR video recording - MPEG-4 to memory card Visual video recording - MPEG-4 to memory card Radiometric IR video streaming - Full dynamic to PC using USB or to mobile devices using Wi-Fi Non-radiometric IR video streaming - MPEG-4 using Wi-Fi &Uncompressed colorized video using USB Visual video streaming - MPEG-4 using Wi-Fi & Uncompressed colorized video using USB Built-in digital camera- 3.1 Mpixels (2048 × 1536 pixels), and one LED light Laser - Activated by dedicated button Wi-Fi - Peer-to-peer (ad hoc) or infrastructure (network) Interfaces - USB-mini, USB-A, Bluetooth, Wi-Fi, composite videocolorized video Video out - Composite Battery type - Rechargeable Li ion battery Battery operating time - Approx. 4 hours at +25°C Charging system - In camera (AC adapter or 12 V from a vehicle) or 2-bay charger Charging time - 4 h to 90% capacity, charging status indicated by LED's Power management - Automatic shutdown and sleep mode (user selectable)	

	AC operation - AC adapter, 90–260 VAC input, 12 V output to camera Start-up time from sleep mode - Instant on Operating temperature range - –15°C to +50°C (+5°F to +122°F) Storage temperature range - –40°C to +70°C (–40°F to +158°F) Humidity (operating and storage) - EC 60068-2-30/24 h 95% relative humidity +25°C to +40°C (+77°F to +104°F) / 2 cycles Magnetic fields - EN 61 000-4-8, Test level 5 for continuous field Encapsulation - IP 54 (IEC 60529) Shock - 25 g (IEC 60068-2-27) Vibration - 2 g (IEC 60068-2-6) Safety - EN/UL/CSA/PSE 60950-1	