



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

Ref: 0213/NIT-N/Mech/2017/05-04

Date: 31.05.2017

**NOTICE INVITING TENDER (NIT) IN TWO BID SYSTEM  
FOR SUPPLY & INSTALLATION OF EQUIPEMNTS & MACHINES FOR FLUID  
MECHANICS LAB & THERMAL ENGINEERING LAB & PRODUCTION PROCESS  
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 Fluid Mechanics Lab, & Thermal Engineering Lab & Production Process Lab on turnkey basis to be installed at NIT Nagaland, Dimapur	As per in Annexure – V As a Package	4,50,000.00	5,000.00

- 1) Notice Inviting Tender No. : 0213/NIT-N/Mech/2017/05-04
- 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 FLUID MECHANICS LAB & THERMAL ENGINEERING LAB & PRODUCTION PROCESS 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. 4,50,000.00 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 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 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. The 20 percent shall be released after successful installation and commissioning of the equipment's with expected requirements and proper wiring / cabling and remaining 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**

**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.**

**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

MANUFACTURERS'/ DISTRIBUTOR'S AUTHORIZATION FORM

No.

Dated \_\_\_\_\_

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-----

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(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,  
(Name)

(Name of Manufacturer/Distribu



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 (5X6)	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 transportation, unloading and Insurance up to Lab/ Institute (Rs.)	Installation, Commissioning And training Charges, If any (Rs.)	All Total Price (Inclusive of all Taxes, Packing & Forwarding And Charges for Inland Transport And Installation Commissioning ) (5+6+7+8+9)

Price in Words (Rupees \_\_\_\_\_)

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)**

**TECHNICAL SPECIFICATION FOR FLUID MECHANICS LAB & THERMAL  
ENGINEERING LAB & PRODUCTION PROCESS LAB**

SL No	DETAILS TECHNICAL SPECIFICATION	Qty
01.	<p><b><u>HYDRAULIC BENCH</u></b></p> <p><b>Technical Description</b> The hydraulic bench should be suitable for the use of basic fluid mechanics experiments of fluid mechanics. It should supply the water in the closed circuit; the determination of volumetric flow rate and the positioning of the experimental unit on the working surface of the base module and the collection of dripping water. The closed water circuit consists of the sump tank with the submersible pump and the measuring tank arranged above, in which the returning water is collected. The measuring tank is stepped, for large and smaller volumetric flow rates. A measuring cylinder should be provided for very small volumetric flow rates. A stopwatch should also be provided for measuring the flow rate. The top surface should enable the various experimental units to be easily and safely positioned.</p> <p><b>Specification</b></p> <ol style="list-style-type: none"> <li>Hydraulic bench for supplying experimental units in fluid mechanics</li> <li>Closed water circuit with storage tank, submersible pump and measuring tank.</li> <li>Measuring tank divided into two for volumetric flow rate measurement.</li> <li>Measuring cylinder with scale for very small volumetric flow rates..</li> <li>Measurement of volumetric flow rate by using a stopwatch.</li> <li>Work surface with inside edge for safe placement of the accessories and for collecting the dripping water.</li> <li>Storage tank, measuring tank and work surface made of GRP/SS.</li> </ol> <p><b>Technical Data</b></p> <p>Pump - power consumption:250 W - max. flow rate:200-450L/min - max. head: 7-14m Storage tank, contents: 180L Measuring tank -at large volumetric flow rates: 40L -at small volumetric flow rates: 10L Measuring cylinder with scale for very small volumetric flow rates -content: 2L</p> <p><b>Utility Required</b> 230V, 50/60Hz,1 Phase</p>	02
02.	<p><b><u>IMPACT OF JET</u></b></p> <p><b>Technical Description</b> In this apparatus jet forces should be generated and studied with the aid of a water jet that acts on an interchangeable deflector.The experimental unit should include a transparent tank, a nozzle, four interchangeable deflectors with different deflection angles and a weight- loaded scale.A water jet exits a nozzle vertically upwards, hits the deflector and is deflected. The force of water jet is adjusted via the flow rate.Experiments should study the influence of flow velocity and amount of flow rate as well as of different deflection angles. The jet forces generated by the water jet are measured on the weight-loaded scale. The forces are calculated using the momentum equation and compared with the measurements. The experimental unit should be positioned easily and securely on the work surface of the Hydraulic Bench. The water should be supplied and the flow rate should be measured by Hydraulic Bench.</p> <p><b>Experiments</b> -demonstration of the principle of linear momentum</p>	01

	<p>-study of the jet forces          -influence of flow throughput and flow velocity          -influence of different deflection angles</p> <p><b>Specification</b></p> <ol style="list-style-type: none"> <li>1. Investigation of jet forces and demonstration of the principle of linear momentum</li> <li>2. Tank made of transparent material for observing the experiments.</li> <li>3. Nozzle for generating the water jet.</li> <li>4. Jet forces can be adjusted via flow rate.</li> <li>5. Four different shaped deflectors: flat surface, oblique surface, semi-circular surface, conical surface</li> <li>6. Measurement of the jet forces via the weight-loaded scale.</li> <li>7. Flow rate determined by Hydraulic Bench.</li> <li>8. Water supply using Hydraulic bench.</li> </ol> <p><b>Technical Data</b></p> <p>Tank</p> <ul style="list-style-type: none"> <li>- inner diameter: 200mm</li> <li>- height: 340mm</li> </ul> <p>Nozzle</p> <ul style="list-style-type: none"> <li>- Diameter: 10mm</li> </ul> <p>Deflector</p> <ul style="list-style-type: none"> <li>-flat surface: 90°</li> <li>-oblique surface: 45°/135°</li> <li>-semi-circular surface: 180°</li> <li>-conical surface: 135°</li> </ul> <p>Weights: suitable</p> <p><b>Required for Operation</b></p> <p>Hydraulic Bench</p>	
03.	<p><b><u>METHODS OF FLOW MEASUREMENT</u></b></p> <p><b>Technical Description</b></p> <p>With this apparatus students should be able to familiarize themselves with various methods for measuring flow in the pipe system and apply them in practice. The experimental unit should contain different measuring instruments to determine the flow rate. These instruments should be designed with transparent cases in order to visualize how they operate and function. The unit should include rotameter, a Venturi nozzle and orifice plate flow meter. 6 tube manometers is used in order to determine the pressure distribution in the Venturi nozzle or the orifice plate flow meter and measuring nozzle.</p> <p>The experimental unit should be positioned easily and securely on the work surface of the Hydraulic Bench. The water should be supplied and the flow rate should be measured by Hydraulic Bench.</p> <p><b>Experiments</b></p> <ul style="list-style-type: none"> <li>-flow measurement with             <ul style="list-style-type: none"> <li>*orifice plate flow meter and measuring nozzle</li> <li>*Venturi nozzle</li> <li>*rotameter</li> </ul> </li> <li>-comparison of different instrument for flow measurement</li> <li>-determining the corresponding flow coefficients</li> <li>-calibrating measuring instruments</li> </ul> <p><b>Specification</b></p> <ol style="list-style-type: none"> <li>1. Different methods of flow rate measurement</li> <li>2. Measuring instruments: orifice plate flow meter, Venturi nozzle and rotameter</li> <li>3. Flow rate determined by Hydraulic Bench.</li> <li>4. Water supply using Hydraulic bench.</li> </ol> <p><b>Technical Data</b></p> <p>Venturi nozzle: <math>A=84...338\text{mm}^2</math></p> <ul style="list-style-type: none"> <li>- angle at the inlet: 10,5°</li> <li>- angle at the outlet: 4°</li> </ul>	01

	<p>Orifice plate flow meter: diameter= 14mm  Measuring nozzle: diameter=18,5mm  Rotameter: max. 1600L/h  6 tube manometers: 390mmWC</p> <p><b>Required for Operation</b>  Hydraulic Bench</p>	
04.	<p><b><u>STABILITY OF FLOATING BODIES</u></b></p> <p><b>Technical Description</b>  This apparatus should be used to study the stability of a floating body and to determine the metacenter graphically. In addition, the buoyancy of the floating body can also be determined. The experiment should be easy to set up and is particularly suitable for practical work in small group.  The experiment should be conducted in a tank filled with water. A transparent body with a rectangular frame cross-section should be used as the floating body. Clamped weights that can be moved horizontally and vertically should make it possible to adjust the centre of gravity and the heel. The position of the clamped weight should be read on scale. A clinometer should indicate the heel.  The well-structured instruction manual should be provided along with the apparatus.</p> <p><b>Experiments</b>  Study and determination of  -buoyancy, centre of buoyancy  -centre of gravity, metacenter, stability  -heel</p> <p><b>Specification</b></p> <ol style="list-style-type: none"> <li>1. Investigating the stability of a floating body and determining the metacentre</li> <li>2. Transparent floating body with rectangular frame cross-section</li> <li>3. One horizontal movable clamped weight for adjusting the heel</li> <li>4. One vertically movable clamped weight for adjusting the centre of gravity</li> <li>5. Clinometer with scale for displaying the heel</li> </ol> <p><b>Technical Data</b></p> <p>Floating body  -LxWxH: 300x190x130  - mast height 400mm  Horizontal scale: 180mm  Vertical scale : 400mm  Height scale of the floating body: 120mm  Clinometer scale :+/-35°  Weights: suitable for experiments  Tank for water:50L</p>	01
05.	<p><b><u>LOSSES DUE TO FRICTION IN PIPE LINES , SUDDEN ENLARGEMENT AND CONTRACTION</u></b></p> <p><b>Technical Description</b>  The set-up should consist of 2 pipes of different diameters losses due to friction, which should be connected in parallel. Pressure tapings should be provided on each pipe to measure the pressure losses with the help of a differential manometer. Control valves should be fitted on each pipe, which should enable to use one pipe at a time for experiment.  The set-up should also consist of 1/2" bend and elbow, a sudden expansion and sudden contraction fitting from 15mm to 25 mm, ball valve and gate valve. Pressure tapings should be provided at the inlet and outlet of these fittings under test. A differential manometer fitted in the line should give pressure loss of individual fittings.  The setup should be self-contained water recirculating unit provided with a sump tank and a pump etc. Flow control valve should be fitted in water line to conduct the experiment on different flow rates. Flow rate of water should be measured with the help of rotameter.  The well-structured instruction manual should be provided along with the apparatus.</p> <p><b>Experiments</b>  -To determine the losses due to friction in pipes  -To determine the friction factor for darcy weisback equation  -To determine the losses of head in the fittings at various water flow rates.</p>	01

-To measure the loss coefficient for the pipe fittings.

**Technical Data**

Pipe test section

-Ø<sup>1</sup>/<sub>2</sub>" , Length: 1m, Material: G.I

-Ø<sup>3</sup>/<sub>4</sub>" , Length: 1m, Material: G.I

- Sudden enlargement: from 15mm to 25mm

-Sudden contraction: from 25mm to 15mm

-Bend: ½"

-Elbow: ½"

-Ball valve: ½"

-Gate valve: ½"

**Submersible Pump**

-Power: 0.33HP

-Head: 6-7mtrs

-Flow: 160 LPM

-Pump Body: Stainless Steel AISI 304, with threaded port in compliance with ISO 228/1

- Suction Fliter: Stainless Steel AISI 304

-Suction Plate: Stainless Steel AISI304

Impeller: Stainless Steel AISI304

Motor casing: Stainless Steel AISI 304

Motor casing plate: Stainless steel AISI 304

Motor Shaft: Stainless Steel EN 1008-3-1.9104

Shaft diameter: Ø12mm

Stationary Ring: Ceramic

Rotalionl Ring: Graphite

Electric Motor

-Single phase 230-50Hz with thermal overload protection built in to the winding

-Insulation : F class

-Protection IPX8

Sump tank: Suitable Capacity

Flow measurement: Rotameter

Control Panel comprises of: Standard make on/off switch. Mains Indicator.

Tanks Should be of Stainless Steel

**Utility Required**

230V, 50/60Hz,1 Phase

06. **BERNOULLI'S THEOREM**

**Technical Description**

The set-up should be designed and fabricated to demonstrate the Bernoulli's theorem. It consists of a test section made of acrylic. It should have a convergent and divergent sections. Pressure tapings should be provided at different locations in convergent and divergent sections.

The setup should be self-contained water recirculating unit provided with a sump tank and a centrifugal pump etc. Flow control valve and by-pass valve should be fitted in water line to conduct the experiment on different flow rates. Flow rate of water should be measured with the help of measuring tank and stop watch.

The well-structured instruction manual should be provided along with apparatus.

**Experiments**

-To verify Bernoulli's theorem experimentally.

-To plot total energy vs distance.

	<p><b>Technical Data</b></p> <p>Test section: Material acrylic(one piece)  Pizometer tube: Material glass or PU(7 No.)</p> <p><b>Pump</b></p> <ul style="list-style-type: none"> <li>-Power: 0.33HP</li> <li>-Head: 15 mtrs</li> <li>- Flow: 60L/min</li> <li>-Pump body: Cast iron with an Epoxy Electro Coating treatment, with threaded ports in compliance with ISO 228/1</li> <li>- Body Backplate: Stainless steel AISI 304</li> <li>-Shaft diameter: Ø12mm</li> <li>-Stationary Ring: Ceramic</li> <li>-Rotational Ring : Graphite</li> </ul> <p>Sump tank: 70Ltrs  Inlet tank: 20 Ltrs  Flow measurement: using measuring tank with piezometer(25Ltrs)  Stop watch: electronic  Control Panel comprises of: Standard make on/off switch. Mains Indicator.</p> <p>Tanks Should be of Stainless Steel</p> <p><b>Utility Required</b>  230V, 50/60Hz,1 Phase</p>	
07.	<p><b><u>REYNOLDS APPARATUS</u></b></p> <p><b>Technical Description</b></p> <p>The set-up should consist of a glass tube with one end having bell mouth entrance; connected to a constant head water tank, at the other end a valve should be provided to vary the flow rate. The tank should be of sufficient capacity to store water. A capillary tube should be introduced centrally in the bell mouth for feeding dye from a small container placed at the top of tank, through polythene tubing.</p> <p>By varying the rate of flow, the Reynolds's number should be changed. This also changes the type of flow. Visual observation of dye( thread) should indicate the type of flow, which can be confirmed by Reynolds's number computed</p> <p>The setup should be self-contained water recirculating unit provided with a sump tank and a centrifugal pump etc. Flow control valve and by-pass valve should be fitted in water line to conduct the experiment on different flow rates. Flow rate of water should be measured with the help of measuring tank and stop watch.</p> <p>The well-structured instruction manual should be provided along with apparatus.</p> <p><b>Experiments</b></p> <ul style="list-style-type: none"> <li>-To determine the Reynold's and hence the type of flow either laminar or turbulent.</li> <li>-To study transition zone.</li> </ul> <p><b>Technical Data</b></p> <ul style="list-style-type: none"> <li>Tube : material borosilicate glass(ID 14mm 14rompto. , Length: 600mm)</li> <li>Dye vessel: suitable capacity, material Stainless Steel</li> <li>Capillary tube: material Copper/Stainless Steel</li> <li>Constant head water tank: 40Ltrs</li> <li>Sump tank: 60 Ltrs</li> <li><b>Pump</b></li> <li>-FHP</li> </ul> <p>Sump tank: 70Ltrs  Inlet tank: 20 Ltrs  Flow measurement: using measuring cylinder with electronic stopwatch  Control Panel comprises of: Standard make on/off switch. Mains Indicator.</p> <p>Tanks Should be of Stainless Steel</p> <p><b>Utility Required</b></p>	01

	230V, 50/60Hz,1 Phase	
08.	<p><b><u>DISCHARGE OVER NOTCHES</u></b></p> <p><b>Technical Description</b>  The set-up should consist of a channel having sufficient length and width in which water should be supplied from the bottom. Required notch should be fitted at one end of channel. A pointer gauge with vernier scale should be fitted to measure the height of fluid in flow channel. Arrangement for fixing interchangeable notch should be provided. Set of three notches, i.e rectangular notch, 60<sup>0</sup> notch &amp; 45<sup>0</sup> notch should be provided along with the setup.  The setup should be self-contained water recirculating unit provided with a sump tank and a centrifugal pump etc. Flow control valve and by-pass valve should be fitted in water line to conduct the experiment on different flow rates. Flow rate of water should be measured with the help of measuring tank and stop watch.  The well-structured instruction manual should be provided along with apparatus.</p> <p><b>Experiments</b>  To determine co-efficient of discharge(cd) through:  -V Notch 45<sup>0</sup>  -V Notch 60<sup>0</sup>  -Rectangular Notch</p> <p><b>Technical Data</b></p> <p>Channel Test Section: 600x250x180mm  Notch: Material Brass  -Rectangular Notch  -45<sup>0</sup> V Notch  -60<sup>0</sup> V Notch  Pointer Gauge: vernier Scale  Sump tank: 50 Ltrs  Pump  -FHP  - make : 15rompton  Flow Measurement: Using measuring tank(25Ltrs)and electronic stopwatch  Stop watch: electronic  Control Panel comprises of: Standard make on/off switch. Mains Indicator.  Tanks Should be of Stainless Steel</p> <p><b>Utility Required</b></p> <p>230V, 50/60Hz,1 Phase</p>	01
09.	<p><b><u>CENTRIFUGAL PUMP TEST RIG(VARIABLE SPEED WITH DC MOTOR)</u></b></p> <p><b>Technical Description</b>  The apparatus should be a self-contained unit operated on close circuit basis containing a sump tank. The setup should consist of a centrifugal pump coupled with a DC motor. Power input to the DC motor should varied by means of thyristor controlled DC drive to vary the RPM of motor. A RPM indicator with proximity sensor indicates the RPM of pump. Flow of water should be measured by using measuring tank and stop watch. Vaccum gauge should be fitted on suction line and pressure gauge should be fitted on delivery line to measure the pressure.</p> <p><b>Experiments</b>  -To determine total head, pump output, overall efficiency and pump efficiency of the centrifugal pump  -To plot head vs discharge, pump efficiency vs discharge , pump output vs discharge</p> <p><b>Technical Data</b></p> <p>Pump: Kirloskar make(1HP) speed 2800 RPM(max),Head:12 mtr  Medium Flow: water  Drive : 1HP Dc motor with thyristor controlled DC drive for variable speed</p>	01

	<p>Sump tank: 110 Ltrs  Flow Measurement: Using measuring tank with piezometer(70Ltrs)  Stopwatch: electronic  Pressure Gauge: Bourdon type  RPM Measurement: Digital RPM indicator with Proximity sensor  Energy measurement: Electronic energy meter.  Control Panel comprises of: Standard make on/off switch. Mains Indicator  Tanks Should be of Stainless Steel</p> <p><b>Utility Required</b></p> <p>230V, 50/60Hz,1 Phase</p>	
10.	<p><b><u>RECIPROCATING PUMP TEST RIG(VARIABLE SPEED WITH DC MOTOR)</u></b></p> <p><b>Technical Description</b>  The apparatus should be a self-contained unit operated on close circuit basis containing a sump tank. The setup should consist of a double acting, single cylinder reciprocating pump coupled with a DC motor. Power input to the DC motor should varied by means of thyristor controlled DC drive to vary the RPM of motor. A RPM indicator with proximity sensor indicates the RPM of pump. Flow of water should be measured by using measuring tank and stop watch. Vacuum gauge should be fitted on suction line and pressure gauge should be fitted on delivery line to measure the pressure.</p> <p><b>Experiments</b>  -To determine total head, overall efficiency and pump efficiency and volumetric efficiency of the reciprocating pump  -To plot head vs discharge, pump efficiency vs discharge</p> <p><b>Technical Data</b></p> <p>Pump: Double acting single cylinder (1HP) speed 250 RPM(max),Head:5kg/cm<sup>2</sup> max.  Medium Flow: Clear water  Drive : 1HP Dc motor with thyristor controlled DC drive for variable speed  Sump tank: 65 Ltrs  Flow Measurement: Using measuring tank with piezometer(40Ltrs)  Stopwatch: electronic  Pressure Gauge: Bourdon type  RPM Measurement: Digital RPM indicator with Proximity sensor  Energy measurement: Electronic energy meter.  Control Panel comprises of: Standard make on/off switch. Mains Indicator  Tanks Should be of Stainless Steel</p> <p><b>Utility Required</b></p> <p>230V, 50/60Hz,1 Phase</p>	01
11.	<p><b><u>PELTON WHEEL TURBINE ALONG WITH HYDRAULIC BENCH</u></b></p> <p><b>DESCRIPTION</b>  Pelton Wheel should be consists of a Pelton Wheel mounted on a base plate and fitted with a friction dynamometer as illustrated overleaf.  The design of the Pelton Wheel follows typical industrial practice with a horizontal shaft, single horizontal jets produced by a single nozzle fitted with a needle or spear regulator, and a wheel fitted with multiple (16) elliptical ridged buckets at a mean diameter of 100 mm.  The nozzle should positioned in the same plane as the wheel and arranged so that the jet of water impinges tangentially on to the buckets.  After flowing round the inner surface of the bucket, the fluid leaves with a relative velocity almost opposite in direction to the original jet. The desired maximum deflection of the jet (180°) cannot be achieved without the fluid leaving one bucket striking the following one, and so in practice the deflection is limited to approximately 155°.  The bottom of the casing should open to allow the water leaving the buckets to drain away. The front face of the casing is transparent Perspex allowing easy observation of the behavior of the water jet and assessment of exit angles.</p>	01



**EXPERIMENTAL CAPABILITIES**

Torque and power characteristics plotted against rotor speed may be established.  
Efficiency against rotor speed can be determined.

**ACCESSORIES**

- Digital Tachometer
- Pump Speed Display (optional)

**DIMENSIONS AND WEIGHTS**

Length: 580mm  
 Width: 230mm  
 Height: 500mm  
 Gross weight: 12kg  
 Nett weight: 9kg  
 Case size: 0.078m<sup>3</sup>

**HYDRAULICS BENCH**

- [1] Service module for pumping and volumetric measurement of water supply required to operate accessories and experiments.
- [2] This bench should be equipped with a fixed speed electric motor driving a centrifugal pump.
- [3] Working surface is moulded in fiberglass and provides a recessed area on which to mount experiments.
- [4] An integral weir tank should be provided along with a volumetric measuring tank which is stepped to afford accurate measurement of both high and low flow rates.
- [5] The measuring tank discharges into a fiberglass sump tank by means of a quick acting PVC ball valve.
- [6] High Flow Volumetric Tank, 40 litres.
- [7] Low Flow Volumetric Tank, 10 litres.
- [8] Fixed electric motors drive which deliver water to the outlet at the working surface for connection to the individual experiments.
- [9] Pressure tapping points at pump suction, delivery and immediately prior to experiment.
- [10] The flow is regulated by a brass valve.
- [11] Pressure tapping points enable the pressure at pump suction, delivery, and at a point immediately prior to the experiment to be measured.
- [12] A pressure gauge scaled 0-4 bar coupled to a rotary selector switch mounted on the panel together with a pump suction gauge are provided for these measurements.
- [13] Supported on a robust stove enameled steel frame mounted on castors.
- [14] Self-contained water recirculating system
- [15] Direct indication of flow rate given by calibrated weir.
- [16] Fibre glass Sump tank. Capacity of tank - 120L
- [17] Pump: Centrifugal Pump Centrifugal Pump close coupled to an standard induction motor. Flow range 10L/min @ 15m head to 60L/min @7m head.
- [18] Induction motor 0.37 kW, 1.64/0.95A, 3 phase.
- [19] Pump casing: Brass with 3/4 " BSP connections
- [20] Gland: Carbon ring working on ceramic counterface
- [21] Rating: 4 hours in any 24 hour period. Not more than 10 starts per hour
- [22] Speed controller: ABB 3 phase standard induction motor.
- [23] Motor speed 2800r/min at 50Hz, 3400r/min at 60Hz
- [24] Experimental Section dimensions 730mm(L), 170mm(W), 150mm(H),
- [25] Electrical requirements: 240 volt (alternatively 110V). Single phase 50/60 Hz supply

12. **FRANCIS TURBINE ALONG WITH HYDRAULIC BENCH**

**EXPERIMENTAL CAPABILITY**

- Turbine power output versus speed and flow rate at various heads.
- Effect of guide vane setting on turbine performance.

**DESCRIPTION**

Francis Turbine should be designed to be used with Hydraulics Bench.  
 The Francis (reaction) turbine assembly should be mounted on a fixing plate located on the hydraulics' bench dowels.  
 Water should be pumped by the hydraulics bench and the flow rate should be controlled, and measured, by the bench

	<p>equipment. Water enters the turbine via the flexible hose, and a pressure gauge should be provided to measure the turbine inlet head. The water drains into the bench volumetric tank.</p> <p>The turbine case should be made in aluminium featuring a plexiglass, full diameter end cover providing an observation window through which the student can see the guide vane mechanism in operation.</p> <p>The power generated should be absorbed by a drum brake system and measured by a 0-10N spring force balance. The flow of water to the turbine runner should be contorted by a ring mechanism which operates guide vanes, the relative position of which determines the amount of water passing to the runner.</p> <p><b>SPECIFICATION :</b></p> <p>Typical Head: 8 metres,  Flow rate: 40 litres/min  Maximum efficiency: 65%  Power output: 20W</p> <p>An adjustable paddle should be provided which will initiate cavitation at different flow rates and at different pressures.</p> <p><b>HYDRAULICS BENCH</b></p> <ul style="list-style-type: none"> <li>[1] Service module for pumping and volumetric measurement of water supply required to operate accessories and experiments.</li> <li>[2] This bench should be equipped with a fixed speed electric motor driving a centrifugal pump.</li> <li>[3] Working surface is moulded in fiberglass and provides a recessed area on which to mount experiments.</li> <li>[4] An integral weir tank should be provided along with a volumetric measuring tank which is stepped to afford accurate measurement of both high and low flow rates.</li> <li>[5] The measuring tank discharges into a fiberglass sump tank by means of a quick acting PVC ball valve.</li> <li>[6] High Flow Volumetric Tank, 40 litres.</li> <li>[7] Low Flow Volumetric Tank, 10 litres.</li> <li>[8] Fixed electric motors drive which deliver water to the outlet at the working surface for connection to the individual experiments.</li> <li>[9] Pressure tapping points at pump suction, delivery and immediately prior to experiment.</li> <li>[10] The flow is regulated by a brass valve.</li> <li>[11] Pressure tapping points enable the pressure at pump suction, delivery, and at a point immediately prior to the experiment to be measured.</li> <li>[12] A pressure gauge scaled 0-4 bar coupled to a rotary selector switch mounted on the panel together with a pump suction gauge are provided for these measurements.</li> <li>[13] Supported on a robust stove enameled steel frame mounted on castors.</li> <li>[14] Self-contained water recirculating system</li> <li>[15] Direct indication of flow rate given by calibrated weir.</li> <li>[16] Fibre glass Sump tank. Capacity of tank - 120L</li> <li>[17] Pump: Centrifugal Pump Centrifugal Pump close coupled to an standard induction motor. Flow range 10L/min @ 15m head to 60L/min @7m head.</li> <li>[18] Induction motor 0.37 kW, 1.64/0.95A, 3 phase.</li> <li>[19] Pump casing: Brass with 3/4 " BSP connections</li> <li>[20] Gland: Carbon ring working on ceramic counterface</li> <li>[21] Rating: 4 hours in any 24 hour period. Not more than 10 starts per hour</li> <li>[22] Speed controller: ABB 3 phase standard induction motor.</li> <li>[23] Motor speed 2800r/min at 50Hz, 3400r/min at 60Hz</li> <li>[24] Experimental Section dimensions 730mm(L), 170mm(W), 150mm(H),</li> <li>[25] Electrical requirements: 240 volt (alternatively 110V). Single phase 50/60 Hz supply</li> </ul>	
13.	<p><b>GEAR PUMP TEST RIG - Variable Speed</b></p> <p><b><u>TECHNICAL SPECIFICATION :</u></b></p> <ul style="list-style-type: none"> <li>1. Pump : Speed 1500 RPM (max.) Capacity 1 HP, Head 5kg/cm<sup>2</sup> (max.)</li> <li>2. Medium Flow : Clear Oil.</li> <li>3. Drive : Variable Speed</li> <li>4. Sump Tank : Material Stainless Steel, suitable capacity.</li> <li>5. Flow Measurement : By Using measuring tank</li> <li>6. Pressure Measurement: By Using Pressure <b>gauge</b>, Vacuum Sensor gauge.</li> <li>7. RPM measurement : Digital RPM Indicator with Proximity sensor</li> </ul>	01

	<p>8. Control Panel Should Comprises of- Energy meter: Electronic, L&amp;T make, Standard make On/Off Switch, Mains Indicator, etc.</p> <p>9. An ENGLISH instruction manual consisting of experimental procedures, block diagram etc. should be provided along with the Apparatus</p> <p>10. The whole set-up should be well designed and arranged on a rigid structure painted with industrial PU Paint</p> <p>11. <b>It Should be Capable :</b></p> <ul style="list-style-type: none"> <li>• To determine total head</li> <li>• To determine pump output</li> <li>• To determine overall efficiency</li> <li>• To determine pump efficiency.</li> </ul>	
14.	<p><b>BOILER MODELS:</b></p> <p><b>01.Model Of Cornish Boiler</b></p> <p><b>02. Model Of Babcock And Wilcox Boiler</b></p> <p><b>03. Model Of Locomotive Boiler</b></p> <p><b>04. Model Of Cochran Boiler</b></p> <p><b>05. Vertical Water Tube Boiler</b></p> <p><b>06. Model of Lamount Boiler</b></p> <p><b>07. Model of Benson Boiler</b></p> <p><b>08. Model of Loeffler Boiler</b></p> <p><b>09. Model of Valox Boiler</b></p> <p><b>10.Model Of Marcet Boiler</b></p> <p><b>11.Model Of Stirling Boiler</b></p> <p><b>12.Model Of Nestlar Boiler</b></p>	01
15.	<p><b>Single Cylinder Engine - Petrol &amp; Diesel Actual Cut Section Working Models</b></p> <p>1. 2 Stroke 1 Cylinder Petrol Engine - Manual Driven Actual Cut Section Model - 01 No.</p> <p>2. 4Stroke 1 Cylinder Petrol Engine - Manual DrivenActual Cut Section Model - 01 No.</p> <p>3. 4 Stroke 1 Cylinder Diesel Engine - Manual Driven Actual Cut Section Model -01 No.</p>	01
16.	<p><b>SINGLE CYLINDER FOUR STROKE PETROL ENGINE TEST RIG With Rope Brake Dynamometer</b></p> <p><b>TECHNICAL SPECIFICATION SHOULD CONSIST OF:</b></p> <ul style="list-style-type: none"> <li>• Type of Engine : Single cylinder, four stroke, air cooled, Hand start, selflubricating, petrol engine, Honda make (Model:GX-200)</li> <li>• Type of Loading : Rope Brake Dynamometer</li> <li>• RPM measurement : RPM Indicator with Proximity sensor.</li> <li>• Fuel measuring system : Fuel measuring system consists of a fuel tank, a burette anda three way cock</li> <li>• Air Intake Measuring : Air tank fitted with orifice and water manometer system.</li> <li>• Exhaust Gas Calorimeter : An Exhaust Gas Calorimeter, made of Stainless Steel will beprovided for calculating heat carried away by exhaust gases. Thebody of the calorimeter is insulated with ceramic wool andcladded by Aluminum foil. Digital Temperature indicator with</li> </ul> <p>Temperature sensors at appropriate position will be provided</p> <ul style="list-style-type: none"> <li>• An ENGLISH instruction manual consisting of experimental procedures, block diagram etc. will be provided along with the Apparatus</li> <li>• The whole set-up should be well designed and arranged on a rigid structure painted with industrial PU Paint.</li> <li>•</li> </ul> <p><b>EXPERIMENTATION:</b></p>	01

	<ul style="list-style-type: none"> <li>To determine specific fuel consumption</li> <li>To determine Brake Horse Power</li> <li>To determine Brake Thermal Efficiency</li> </ul>	
17.	<p><b>SINGLE CYLINDER FOUR STROKE DIESEL ENGINE TEST RIG With Rope Brake Dynamometer</b></p> <p><b>TECHNICAL SPECIFICATION SHOULD CONSIST OF:</b></p> <ul style="list-style-type: none"> <li>Type of Engine : Single cylinder, four stroke, vertical water cooled, crank start,diesel engine developing 5 HP at 1500</li> <li>Type of Loading : Rope Brake Dynamometer</li> <li>Fuel Measuring System : Fuel measuring system consists of a fuel tank, a burette anda three way cock arrangement.</li> <li>Air Intake Measuring System: Air tank fitted with orifice and water manometer.</li> <li>Measurement of Heat Carriedaway by Cooling wate: It consists of inlet outlet piping with flow control valve, waterr meter and temperature sensor.</li> <li>Temperature Measurement : Digital Temperature Indicator with multi-channel switch</li> <li>Temperature Sensors : RTD PT-100 type</li> <li>RPM measurement : RPM Indicator with Proximity sensor.</li> <li>Exhaust Gas Calorimeter : Made of Stainless Steel including the body &amp; the tube for coolingwater circulation and designed to get maximum temperaturedifference. The body of the calorimeter is insulated on all sides toprevent heat losses due to radiation.</li> <li>An ENGLISH instruction manual consisting of experimental procedures, block diagram etc. will be provided along with the Apparatus</li> <li>The whole set-up should be well designed and arranged on a rigid structure painted with industrial PU Paint.</li> </ul> <p><b>EXPERIMENTATION:</b></p> <ul style="list-style-type: none"> <li>To determine specific fuel consumption.</li> <li>To determine Brake Horse Power.</li> <li>To determine Brake Thermal Efficiency.</li> </ul> <p>To determine volumetric efficiency measurement.</p>	01
18.	<p><b>Computerised Variable Compression Ratio Multi-fuel Engine Test Rig with Manifold Gas injection Kit</b></p> <p><b><u>Technical Specifications:</u></b></p> <p>1) <b>Engine Capacity</b> : 552cc</p> <p>2) <b>Compression Ratio:</b></p> <ol style="list-style-type: none"> <li>Variable 5:1 to 20:1</li> <li>Changeover of S.I to C.I Mode to be done, without changing the engine head.</li> <li>Direct reading of compression ratio, the compression ratio graduation marking is spirally engraved on a 170mm Diameter Plate.</li> <li>To change the compression ratio, the engine head along with the bore block is lifted vertically in 90 degrees without changing the combustion geometry and valve timing. (Tilting of the engine head and bore block should not be done, which may cause change in valve timing)</li> </ol> <p>3) <b>Engine Speed</b> : 1500 rpm</p> <p>4) <b>Number of Cylinders</b> : One</p> <p>5) <b>Fuel Type</b> : Diesel: Mechanical injection.</p> <p>6) <b>Petrol:</b> Multi Point fuel injection with programmable map.</p> <p>7) <b>Gas:</b> Manifold Gas injection</p>	01

	<p>with programmable map.</p> <p>8) <b>Power</b> : 3-5HP</p> <p>9) <b>Spark Timing</b> : The Spark timing of the engine variable from 0 to 360° Crank angle and is easily controlled from computer.</p> <p>10) <b>Starting</b> : Electric start</p> <p>11) <b>Dynamometer</b> : The Engine is coupled with 5 HP Eddy Current Dynamometer <b>Air cooled</b></p> <p>12) <b>Sensors</b> :</p> <ul style="list-style-type: none"> <li>a) Engine Combustion Pressure Sensor : Piezo-electric 0-100 Bar</li> <li>b) Crank angle : Rotary 360 PPR</li> <li>c) Air Measurement : DP Sensor</li> <li>d) Fuel Measurement : Optical constant volume, fully automatic</li> <li>e) Speed : Encoder</li> <li>f) Dynamometer Load : Strain Gauge Loadcell</li> <li>g) Temperature: “k” Type with inline signal conditioner.</li> <li>h) Gas Consumption measurement : Loadcell (loss in weight)</li> </ul> <p>13)<b>Data Acquisition System</b> : High Speed DAC with 1 mega samples/sec</p> <p>14)<b>Controls</b> : Fuel injection System with controls</p> <p>15)<b>Software</b>: Engine Combustion Analysis and performance Software, Fuel injection and control software.</p> <p><b><u>Required Accessories</u></b>  <b>Desktop Computer with i5 Processor 4GB RAM &amp; UPS</b></p>	
19.	<p><b>Computerized Four Stroke Three Cylinder Water Cooled Petrol Engine Test Rig (MPFI Version)</b></p> <p><b><u>Technical Specifications:</u></b></p> <p>1)Engine: Maruti Suzuki Brand New(The Engine Purchase Bill with Engine Number is provided at the time of inspection)</p> <p>2)Bore X Stroke : 68.5 x 72.0mm</p> <p>3)Displacement :796 (cc)</p> <p>4)No of Cylinders:3</p> <p>5)Fuel System:MPFI</p> <p>6)Dynamometer: Hydraulic Dynamometer 10HP</p> <p>7)Engine Base Frame Size:</p> <p>8)Length : 1125mm</p> <p>9)Width :1375mm</p> <p>10) Height :100mm</p>	01

	<p>11)<b>Exhaust Gas Calorimeter:</b></p> <p>12)Type : Shell and Single Tube with inbuilt Silencer</p> <p>13)Material of Construction: Mild Steel</p> <p>14)No of Temp measuring points in test rig :6</p> <p>15)Inlet pipe Size : 1 ½” SCH 40</p> <p>16)Exhaust Pipe Size : 1 ½” SCH 40</p> <p>17)Exhaust Tapping : Exhaust Gas Recirculation System Stage 1, Emission Analyzer Gun Metal Gate Valve for Both the Tapping’s</p> <p>18)Temperature Sensor Tapping Size : M12 (4 Nos)</p> <p>19)Water flow Control Valve : Gate Valve</p> <p>20)Finish : Powder Coat</p> <p>21) <b>Sensors :</b></p> <ul style="list-style-type: none"> <li>a) Engine Combustion Pressure Sensor : Piezo-electric 0-100 Bar</li> <li>b) Crank angle : Rotary 360 PPR</li> <li>c) Air Measurement : DP Sensor</li> <li>d) Fuel Measurement : Optical constant volume, fully automatic</li> <li>e) Speed : Encoder</li> <li>f) Dynamometer Load : Strain Gauge Loadcell</li> <li>g) Temperature: “k” Type with inline signal conditioner.</li> </ul> <p>22)<b>Data Acquisition System</b> : High Speed DAC with 1 mega samples/sec</p> <p>23)<b>Software:</b> Engine Combustion Analysis and performance Software.</p> <p><b><u>Required Accessories</u></b></p> <p><b>Desktop Computer with i5 Processor 4GB RAM &amp; UPS</b></p>	
20.	<p><b>Computerized Four Stroke Four Cylinder Water Cooled Diesel Engine Test Rig (CRDI Version)</b></p> <p><b><u>Technical Specifications:</u></b></p> <ul style="list-style-type: none"> <li>1) <b>Engine:</b> Make : Suzuki Swift Brand New(The Engine Purchase Bill with Engine Number Should be Provided at the time of inspection)</li> <li>2) Fuel System : CRDI</li> <li>3) Bore X Stroke : 69.9mm X 82mm</li> <li>4) Displacement : 1248cc</li> <li>5) No of Cylinder : Four</li> <li>6) Cooling : Water</li> <li>7) Fuel : Diesel</li> <li>8) Speed : 1500-1750RPM</li> <li>9) HP : 10 HP</li> <li>10) Starting :Electric Start</li> <li>11) <b>Dynamometer:</b> The Engine Should be coupled with 10 HP Eddy Current Dynamometer Air cooled</li> <li>12) <b>Engine Base Frame Size:</b></li> <li>13) Length : 1125mm</li> <li>14) Width :1375mm</li> <li>15) Height :100mm</li> <li>16) <b>Exhaust Gas Calorimeter:</b></li> </ul>	01

	<p>17) Type : Shell and Single Tube with inbuilt Silencer  18) Material of Construction: Mild Steel  19) No of Temp measuring points in test rig :6  20) Inlet pipe Size : 1 ½” SCH 40  21) Exhaust Pipe Size : 1 ½” SCH 40  22) Exhaust Tapping : Exhaust Gas Recirculation System Stage 1, Emission Analyzer Gun Metal Gate Valve for Both the Tapping’s  23) Temperature Sensor Tapping Size : M12 (4 Nos)  24) Water flow Control Valve : Gate Valve  25) Finish : Powder Coat  <b>26) Sensors :</b>  a) Engine Combustion Pressure Sensor : Piezo-electric 0-100 Bar  b) Crank angle : Rotary 360 PPR  c) Air Measurement : DP Sensor  d) Fuel Measurement : Optical constant volume, fully automatic  e) Speed : Encoder  f) Dynamometer Load : Strain Gauge Load cell  g) Temperature: “k” Type with inline signal conditioner.  27) <b>Data Acquisition System :</b> High Speed DAC with 1 mega samples/sec  <b>Software:</b> Engine Combustion Analysis and performance Software</p>	
21.	<p><b>Abel Flash Point Apparatus</b>  <b>AS Per IP-33 and IS-1448(p-20) Electrically Heated model with voltage Variance for control.</b></p> <ul style="list-style-type: none"> <li>• Pen sky marten flash point tester closed cup as per IP-34,ASTM D 93 &amp; IS 1448(P-21) Electrically heated model with motorized stirrer with digital temperature controller.</li> <li>• Cleveland open cup flash &amp; fire point apparatus as per IP 36, ASTM D 92,IS 1448 (P 69) Electrically heated model with voltage variance or Energy Regulator.</li> </ul>	01
22.	<p><b>Redwood Viscometer with Digital Temperature Controller and with Motorized Stirrer</b>  <b>STANDARD :-</b> Should Conform to the specifications of: IP 70.  <b>FEATURES &amp; BENEFITS :-</b></p> <ol style="list-style-type: none"> <li>1) TYPE OF BATH :- ELECTRICALLY HEATED IMMERSSION HEATER.</li> <li>2) MAX WORKING TEMPERATURE :- 99 DEGREE C</li> <li>3) CONTINOUS WORKING TEMPERATURE :- 95 DEGREE C</li> <li>4) CAPACITY :- 1 SAMPLE AT A TIME.</li> <li>5) HEATER :- SS TUBULAR IMMERSSION HEATER</li> <li>6) ACCURACY :- +/- 3 DEGREE C</li> <li>7) READABILITY :- +/- 0.5 DEGREE C</li> <li>8) TEMPERATURE CONTROLLER :- <ol style="list-style-type: none"> <li>a. BY ENERGY REGULATOR WHICH WILL TURN ON &amp; OFF HEATER AS TIME SWITCH.</li> </ol> </li> <li>9) INPUT POWER SUPPLY : 230 V AC, 50 HZ, 1 PHASE WITH 6 AMP CURRENT RATING.</li> <li>10) HEATING LOAD : 1 KW .</li> <li>11) STIRRER : MANUAL STIRRER WITH STIRRER BLADE FOR MAINTAINING UNIFORMITY THROUGHOUT CHAMBER.</li> <li>12) TOP LID MADE OF STAINLESS STEEL WITH PROVISION OF MOUNTING OF ONE THERMOMETER. .</li> <li>13) CONTROL PANEL/DISPLAY :- <ol style="list-style-type: none"> <li>a. ENERGY REGULATOR .</li> <li>b. HEATER INDICATOR.</li> <li>c. KETTLE PLUG FOR HEATER CONNECTION.</li> </ol> </li> <li>14) CONSTRUCTION :- <ol style="list-style-type: none"> <li>a. DOUBLE WALLED CONSTRUCTION , THERMALLY INSULATED WITH INSIDE BODY MADE OF STAINLESS STEEL OUTSIDE GI.</li> <li>b. POWDER COATED EXTERNAL SURFACE FOR ESTHATIC APPEARANCE.</li> </ol> </li> </ol> <p>Accessories :</p>	01

	<ul style="list-style-type: none"> <li>a) SS lid cover</li> <li>b) Thermometer collar</li> <li>c) Ball lock</li> <li>d) Glass redwood cup</li> <li>e) Thermometer ip8c</li> <li>f) Thermometer ip9c</li> <li>g) Thermometer ip10c</li> <li>h) Digital stopwatch</li> </ul>	
23.	<p><b>Digital Viscometer</b></p> <p><b>Technical Specifications:</b>  Min. Viscosity Range: 200cps, Max. Viscosity Range: 80M cps  Speeds: 0.01-200RPM  Speed Increments: 200  Accuracy: +/-1.0% of range  Repeatability: +/-0.2%</p> <p><b>It Should consists of the following</b></p> <hr/> <ul style="list-style-type: none"> <li>• 1 x Main Viscometer</li> <li>• 1 x Lab Stand</li> <li>• 1 x Spindle Guard Leg</li> <li>• 1 x Spindle Set, (Spindle No. 2 to 7)</li> <li>• 1 x PG Flash Software</li> <li>• 1 x RTD Temperature Probe</li> <li>• 1 x Convenience Pack</li> <li>• 1 x Instruction Manual</li> <li>• 1 x Carrying Case</li> </ul> <p><b>Digital Viscometer Features:</b></p> <hr style="border-top: 1px dashed black;"/> <ul style="list-style-type: none"> <li>- 5 inch Full Colour Touch Screen display</li> <li>- 200 selectable speeds</li> <li>- Built-in test based user instructions</li> <li>- On screen data comparison</li> <li>- Complete computer control with optional Rheocalc T Software</li> <li>- Convenient Bubble Level</li> <li>- Download custom test programs with PG Flash Software</li> </ul>	01
24.	<p><b>COMPUTERISED STEAM POWER PLANT</b></p> <p><b>TECHNICAL SPECIFICATION :</b></p> <ul style="list-style-type: none"> <li>• Automatic Oil Fired Steam Boiler with a design pressure of 8.6 bar g and an output of 200 Kg/hr from and at 100°C.</li> <li>• Fuel Oil Storage Tank 100 litres capacity fitted with hand transfer pump and contents gauge.</li> <li>• Water Treatment System to condition the mains water supply. Boiler water storage tank 500 litres capacity fitted with make up water inlet, condensate return pipe, boiler sample cooling coil, all mounted on common frame with the oil tank. Centrifugal boiler feed pump.</li> <li>• Steam Turbine Set – single stage, single row, single nozzle type. Designed to operate at a nominal 3000 rpm with a steam supply pressure of 7 bar g and producing a maximum power output of 500 Watts. The Turbine is directly coupled to a 1 kW D.C. electric dynamometer connected to the main electrical supply.</li> <li>• Condenser Unit – atmospheric surface condenser sized to condense all the steam discharged from the steam turbine. Condensate extraction pump with provision to return condensate to the feed tank or to drain. Cooling water circulation pump.</li> </ul>	01



- Blowdown Tank to allow the safe discharge of pressurized water with atmospheric vent for the discharge of steam exhaust.

**Instruction Manual**

Self-explanatory operating manuals should be provided with each system. Detailed theory as well as practical exercises is included in the manual.

<b>Steam Turbine</b>	
Turbine	Single Stage, Single Row, Single Nozzle Type
Capacity	500 Watts
Speed	1000 – 3000 RPM
<b>Dynamometer</b>	
Type:	D.C. Generator
Cooling	Air
Load Measurement method	Lamp Loading
Max Speed	3000 rev/m
Capacity	750 Watts
Coupling Type	Direct Tyre
<b>Loading</b>	
Type/Description	Lamp Loading
Capacity	750 Watts

Measurement of Temperatures at different points

Type	“K”
Range	0-1500°C
Signal conditioning/transmitter	Standalone
Location	Ambient Air
Type	“K”
Range	0-1500°C
Signal conditioning/transmitter	Standalone
Location	Boiler Feed Water
Type	“K”
Range	0-1500°C
Signal conditioning/transmitter	Standalone
Location	Fuel Oil
Type	“K”
Range	0-1500°C
Signal conditioning/transmitter	Standalone
Location	Boiler Steam Outlet
Type	“K”
Range	0-300°C
Signal conditioning/transmitter	Standalone
Location	Turbine Nozzle Inlet

All the measured parameters from the sensor should be connected to the computer.

[Measurement of Pressure at different points](#)

Type	Piezo-resistive
Range	0-200 Bars
Signal conditioning/transmitter	Standalone
Location	Boiler Steam
Type	Piezo-resistive
Range	0-200 Bars
Signal conditioning/transmitter	Standalone
Location	Steam Orifice Differential
Type	Piezo-resistive
Range	0-200 Bars
Signal conditioning/transmitter	Standalone
Location	Turbine Steam Inlet
Type	Piezo-resistive
Range	0-200 Bars
Signal conditioning/transmitter	Standalone
Location	Turbine Steam Exhaust

All the measured parameters from the sensor should be connected to the computer

#### Turbine Speed

Type/Description	A non-contact PNP sensor is used to measure the engine RPM. A PNP sensor gives a pulse output for each revolution of the Turbine. The data is connected to the computer
Range	0-9999 RPM
Display	Digital Indicator

#### Data Acquisition Card

Resolution	12 bit
Specification	Operating 45 MHz 12 bit 8 channel ADC 12 bit 2 channel DAC 4 digital input 4 digital output USB Controller operating 24MHz.
Software	Windows based
Type	Run Time
Operating System	Windows XP

All the above measuring instruments, sensors, transducer and transmitters listed above should be routed to the computer.

Computer : i3 with 4GB RAM and 500GB Hard Disk.

UPS : 500VA

## **TECHNICAL SPECIFICATIONS (MM)**

- Centre distance : 1500
- Centre height : 250
- Swing over bed : 502
- Swing over gap : 700
- Gap length in front of face plate : 160
- Bed width : 300
- Swing over carriage : 440
- Swing over cross slide : 310
- Cross slide travel : 250
- Tool post slide travel : 130
- Maximum tool dimensions : 25 X 25
- **Headstock** Main spindle bore : 58
- Main Spindle Nose: A2 -6/Camlock-6
- Main Spindle morse taper : 4(MT)
- Speed Range : 40- 2300 rpm
- No. of Speed Range : 3
- Speed Range 1 : 40-310 rpm
- Speed Range 2 : 310-840 mm
- Speed Range 2 : 840-2300 mm
- Pitch diametral threads/diametral pitch : 44
- Longitudinal Feeds : 0.044 -0.662
- Cross feeds : 0.020 – 0.296
- Metric threads : 0.5 -7.5
- Whitworth threads in T.P.I : 60 -4
- Modular threads : 0.25 -3.75
- Pitch diametral threads : 120-8
- Ø35 lead screw rod pitch : 6
- **Tail stock** barrel diameter : 68
- Tail stock barrel travel : 200
- Tail stock morse taper : 4 (MT)
- **Fixed Steady** capacity : 145
- **Follow Rest** capacity : 95
- **Main Motor** Power : 5.5 kw
- **Pump Motor** Power : 0.1 kw
- 

## **STANDARD ACCESSORIES**

- 1) Spindle brake
- 2) Reducing bush
- 3) Levelling plates
- 4) 2-Fixed Centers
- 5) Square Tool post and key
- 6) Chip collecting tray
- 7) Instruction manual
- 8) Coolant Equipment
- 9) Centralized lubrication of carriage and cross slide and chariot
- 10) Emergency stop
- 11) Main Switch
- 12) Low Voltage lighting
- 13) Rigid Lead Screw guard
- 14) Top slide guard

	<p>15) Thread dial indicator 16) Rear splash guard chuck guard</p> <p><b>OPTIONAL ACCESSORIES</b></p> <ul style="list-style-type: none"> <li>• UNIVERSAL 3 JAW WITH HARD JAWS-CI CHUCK- 250 mm</li> <li>• FIXED STEADY REST</li> <li>• FOLLOW REST</li> <li>• BORING ATTACHMENT WITH LATHE</li> </ul>	
26.	<p><b>ALL GEARED UNIVERSAL MILLING MACHINE WITH LONGITUDINAL FEED AUTOMATIC</b></p> <p><b>Technical Specifications:</b></p> <p><b>TABLE :</b></p> <ul style="list-style-type: none"> <li>• Working Surface: 1100 x 280 mm</li> <li>• No. of T-Slot &amp; Size: 3/M – 12</li> <li>• Distance between T-Slots: 75 mm</li> <li>• Table Swivel: 45°</li> </ul> <p><b>RANGE:</b></p> <ul style="list-style-type: none"> <li>• Longitudinal feed (Automatic): 580 mm</li> <li>• Longitudinal feed by hand: 650 mm</li> <li>• Cross feed by hand: 225 mm</li> <li>• Vertical feed by hand: 400 mm</li> <li>• Max. Safe Wt. on Table: 300 Kg</li> </ul> <p><b>SPINDLE :</b></p> <ul style="list-style-type: none"> <li>• Spindle Arbour: 25.4 mm</li> <li>• Spindle Nose Taper: ISO 40</li> <li>• Distance from Spindle to Table Min. - Max.: 0-275 mm</li> <li>• Throat Distance with Vertical Head : 275 mm</li> <li>• No. of Spindle Speeds: 9</li> <li>• Range of Spindle Speeds: 60 to 1000 RPM</li> <li>• Spindle Bearing Front: 32211</li> <li>• Spindle Bearing Rear: 32208</li> </ul> <p><b>FEEDS :</b></p> <ul style="list-style-type: none"> <li>• No. of Feeds: 6</li> <li>• Longitudinal Feed: 10, 16, 25, 46, 71, 111 mm / min</li> </ul> <p><b>DRIVE :</b></p> <ul style="list-style-type: none"> <li>• Spindle Motor: 2 HP</li> <li>• Table Feed Motor: 0.5 HP</li> <li>• Coolant Pump Motor: 0.1 HP</li> </ul> <p><b>ACCESSORIES:</b></p> <p>1) SWIVEL BASE MILLING MACHINE VICE 100 MM</p> <p>2) UNIVERSAL DIVIDING HEAD WITH INDEXING ATTACHMENT 100 MM WITH TRUE CHUCK</p> <p>3) ROTARY INDEXING TABLE</p>	01

4) RACK MILLING ATTACHMENT GRIP TYPE	
5) SLOTTING ATTACHMENT GRIP TYPE	
6) ISO – 40 MILLING ADOPTOR	
7) SET OF 8 COLLETS RANGING FROM 4 TO 25.4 MM	
8) CLAMPING KIT	
9) MACHINE LAMP	