ADMINISTRATION OF UT OF DAMAN & DIU
OFFICE OF THE PRINCIPAL,
GOVERNMENT ENGINEERING COLLEGE,
VARKUND, NANI-DAMAN 396210.

Notice No. 27.1/EQU/GEC/MECH/2019-20/41 **DATED : 03/06/2020.**

E-TENDER

The Principal, Government Engineering College, Daman on behalf of President of India, invites Tender for purchase of following item:

1. Supply of Equipment's for Mechanical Engineering Laboratory of Government Engineering College, Daman through On-line bidding from the website of Gepnic.

* On-line downloading of Tender documents	03.06.2020 to 02.07.2020 -04:30 P.M.
* On-line submission of Tenders	Upto 02.07.2020 – 04:30 P.M. only
* On-line Opening of Technical Bids	On 03.07.2020 at 10:00 A.M.

* Bidders have to submit their PRICE bid in Electronic format only on https://ddtenders.gov.in/nicgep/app till the last date & time for submission. PRICE bid in Physical format shall not be accepted in any case.

Only Tender fees & EMD to be submitted in physical form, all other documents related to Technical Bid shall be uploaded only through e-tender website of NIC i.e. https://ddtenders.gov.in/nicgep/app. [The Tender fees & EMD shall be done by RPAD / Speed post or by hand in Tender Box in Office of the Principal, Govt. Engineering College, Daman upto 02.07.2020 by 04:30 P.M.] However Tender inviting authority will not be responsible in case of Postal or other delay.

The inviting authority reserves the rights to accept or reject any tender without assigning any reason. Tender opening can be postponed depending on the decision of the Tender committee.

In-case bidder needs clarification / training for participating in online tender, they can contact:
National Informatics Centre, Daman
GePNIC Portal, 24x7 Help Desk Nos. 0120-4200462, 4001002, 4001005 and 6277787
Email: support-eproc@nic.in

- Sd -
(Dr. Avinash R. Chaudhari)
I/c. Principal,
Ph No. 9426888068
Email ID: gecdaman@gmail.com

Copy to :

1. The NIC, Daman, with request to put-up on website of Administration of Daman & Diu.
2. The Field Publicity Officer, Daman with a request to publish in newspapers specified in the office letter.

U.T. ADMINISTRATION OF DAMAN AND DIU
OFFICE OF THE PRINCIPAL,
GOVERNMENT ENGINEERING COLLEGE,
VARKUND, NANI DAMAN. 396210.

Terms & Conditions for Supply of Equipment's for Mechanical Engineering Laboratory of Government Engineering College, Daman.

Notice No. 27.1/EQU/GEC/MECH/2019-20/41 **DATED : 03/06/2020**

General terms and Conditions:

1. Tender bids should be submitted duly signed and stamped on every page by the vendor's authorized signatory on or before 02/07/2020 by 4:30 pm. (TENDER Fee Rs. 1000/-) in the form of Demand Draft.
2. The EMD of Rs. 1,07,000/- in the form of F.D.R. in favour of "The Principal, Govt. Engineering College, Daman" should be submitted with the Technical Bid.
3. The EMD FDR must have a due date of at least 06 months.
4. The rates quoted should be valid for 180 days from the date of submission of the Tenders.
5. The Vendor should be the authorized manufacturer / supplier / dealer of the required item.
6. The item should be complied with the specifications / configuration given in the Annexure – III.

6(a) Minor variation/Deviation in the technical specification will be subjected to acceptance by the concerned department and tendering inviting authority.

7. Model, Make and standards of the item should be specified clearly.
8. Technical literature / brochure of item indicating the quoted make and model shall be enclosed.
9. The Committee or a respective member will visit the successful bidder for Demonstration, Inspection & Physical verification of the said items to be purchased.
10. Manufacture / Company should be ISO Certified with valid License of the Model & Make and standards of the item should be specified clearly if available.
11. A "Test Certificate" issued by the "National Laboratories" should be produced for the major Mechanical components used in the Machineries & Equipments, Where applicable or for the products whose such certification is necessary or applicable.

11(a) Clause number 10 & 11 applicable to major / important components (subject to acceptance by technical Expert of the tendering committee that has to be submitted on demand).

12. Items / Machineries / Equipments to be supplied / quoted should be standard make / reputed brand. Sub-standard or made in China items are likely to be rejected from the Bid that has to be submitted on demand.
13. Supply, installation, testing, integration of the item shall be sole responsibility of the selected supplier.
14. The supply and installation of items should be done within 30 days from the date of receipt of supply order.
15. Minimum (01) one-week onsite training shall be given to users on operational modules of the item or as required.
16. Head of Office reserves the right to cancel the order in the event of delay in supply and installation beyond 60 days from the date of Purchase Order resulting in forfeit of the EMD amount.
17. **Delivery: (60 Days from the receipt of Supply Order)**
    - **(a) The Equipments / Items should be ready for inspection within 40 days from the date of supply order.**
    - **(b) The Inspection committee shall inspect respective items of supply, by way of selecting any random piece from the quantity ordered within 35th to 40th day of supply order (any extension for supply and inspection shall not exceed more than 45 days from the date of supply order) failing to which the order shall be liable for cancellation.**
    - (c) **The expense / arrangement for inspection by the inspection committee of respective items at the factory / franchise site award of supply order, will be borne by the bidder.**
18. Penalty: If the suppliers fails to deliver all or any of the Tendered items or perform the service within the specified date, penalty at the rate of 1% per week of the total order value subject to the maximum of 10% of total order value will be deducted, and also be liable to be blacklisted for future participation etc.

19. Complete warranty for minimum (01) one years period for the Tendered items from the date of installation.

20. Any required Replacement in part or complete, required services / calibration, Transportation related to such occurrence etc. during the warranty period shall be fully borne by the vendor / supplier.

21. Price of the item should be quoted as per the sample price format given in the (Annexure – III) in Electronic format only through GePNIC.

22. Price of the item quoted in the tender shall be inclusive all charges like tax, freight, installation, activation, integration, documentation, training etc. (if any).

23. Item-wise lowest bids will be accepted for purchase of the respective Mechanical Machinery & equipment's and accordingly the tender awarded to the respective suppliers.

24. The lowest quoted item should be compatible with other purchased items. (Committee reserved the right to choose best compatible supporting equipments to the Primary item.

25. The prices as quoted would be considered as the final prices for evaluation. In any case, upward revision will not be allowed.

26. After the submission of bids, no change in the content of the bid would be allowed. However, the Institute at its discretion may request the vendor to provide additional inputs if required. In case of the vendor not being able to submit the additional input in writing on or before the date specified by the Institute, the bid received from the vendor would be rejected and no explanation would be offered to the vendor for the rejection.

27. The earnest money deposited (EMD) with the bid shall be returned along with the final payment in case of successful bidder. In case of other bidders it will be returned after finishing the codal formalities or after placing the supply order to the eligible bidder.

28. The bidder must be able to service / replace / repair the instruments within 03 to 04 days of the complaint during the warranty period.

29. Tenders will be opened in the presence of the committee member & the representatives of the firms who may like to be / will be present on the date and time of opening of the tenders.

30. The Selected vendor will be required to submit a Security Deposit in the form of FDR, in the favour of "The Principal, Govt. Engineering College, Daman" of **10%** of total order value for a warranty period from the date of supply and installation within one week of receipt of the supply order. (the security deposit shall remain with the principal for the entire warranty period).

31. Payment will be made on submission of bill in duplicate after satisfactory completion of all the formalities of supply, installation, testing and integration of the products at Govt. Engineering College, Daman after obtaining NOC of the concern department or principal.

32. Decision of the Head of the institute will be final and binding in any matters relating to the tender, also the Tender inviting authority reserves the rights to relax T&C related to this tender.

33. In case the vendor requires any further information / clarification related to this tender or specifications, they may contact the undersigned in writing on or before the due date & time of submission of tender, any arguments after the due date will not be acceptable.

The following documents among others must be submitted online ONLY (through GepNIC in the form of PDF duel numbered as per below Sr. No., without which tender will be summarily rejected:

1. Copy of EMD of Rs. 1,07,000/- in the form of F.D.R. valid up to 06 months from a nationalised bank.
2. Copy of Authorised Supplier / Dealer / Distributor of the said items.
3. Copy of Registration Certificate of the firm of a competent authority.
4. List of current two major clients.
5. Copy of "Test Certificate" issued by the "National Laboratories" for the major Mechanical components used in the Machineries & Equipment. (as mentioned at clause no.11)
6. Copy of Manufacturers latest ISO / ISI certification**.** (as mentioned at clause no.10)
7. Copy of VAT / CST and PAN Card.
8. Copy of Income Tax return for last three years A.Y. 2016-17, 2017-18 & 2018-19.
9. Self-certified certificate of assurance to service / repair / replace the complaint in reference of the instruments within one week of intimation.
10. Self-certified certificate of not being a "Black listed company / supplier etc.

NOTE : UPLOAD SINGLE COPY FOR ALL ABOVE DOCUMENTS, THE DEPT. SHALL REQUEST ADDITIONAL INPUTS IF & WHEN FOUND NECESSARY.

(Dr. Avinash R. Chaudhari)
I/c. Principal,
Ph No. 9426888068
Email ID: gecdaman@gmail.com

ANNEXURE - I

TENDER FORM (TECHNICAL BID)

TENDER DOCUMENT FOR
SUPPLY OF EQUIPMENT'S FOR MECHANICAL ENGINEERING LABORATORY OF GOVERNMENT ENGINEERING COLLEGE, DAMAN

Notice No. 27.1/EQU/GEC/MECH/2019-20/41 DATED : 03/06/2020

From:

Date:

To,
The Principal,
Government Engineering College,
Varkund, Nani Daman.

1.	Full name of the Company / Firm / Supplier (in block letters)	:	
2.	Full address of the Company / Firm / Supplier with telephone number, E-mail number, fax number	:	
3.	Year of incorporation	:	
4.	Name(s) of the Proprietors / Partners / Directors with their full address, Telephone Number, e-mail, fax etc.	:	
5.	Tender Fee Demand Draft No. & Date		
6.	Details of EMD of Rs. 1,07,000/- in the form of F.D.R.		
7.	Name of two major clients with their Address etc.	:	
8.	Details of Registration, Trade License, Labour Licence, other license held / obtained from the various authorities	:	
9.	Copy of Last three years Income-tax return i.e. 2016-17, 2017-18 & 2018-19.	:	
10.	Company / Firm / Supplier Bank Details A. Bank Account No.- B. Bank Name & Branch location -	:	
11.	Copy of "TEST Certificate" from National Laboratories for components mentioned TEST Certificate Necessary	:	
12.	Service tax / VAT / CST No.	:	
13.	PAN No.	:	

I / We certify that I / We read, understood and accept the contents of the broad terms and conditions incorporated in the Tender Form submit this Tender for consideration. I / We certify that the above statements are true.

(Signature of the Owner / Partner / Contractor with SEAL)

Full Name _____

Address _____

ANNEXURE - II

Schedule of Tender

Notice No. 27.1/EQU/GEC/MECH/2019-20/41 **DATED : 03/06/2020**

Sr. No.	Particulars	Details
1.	Name of the Work	Supply of Equipment's for Mechanical Engineering Laboratory of Government Engineering College, Daman
2.	Estimated Cost	Rs. 35,62,083/- (approx.)
3.	Earnest Money Deposit	An EMD amounting to Rs. 1,07,000/- FD from any nationalized bank in favour of "The Principal, Govt. Engineering College, Daman.
4.	Address for issue of Tender Papers	Download from the website i.e. https://ddtenders.gov.in
5.	Last Date/ Time of Submission of Tender	Upto 02/07/2020 – 04:30 P.M. only
6.	Address at which tender to be submitted	Office of the Principal, Govt. Engineering College, Daman.
7.	Venue of Tender Opening	Office of the Principal, Govt. Engineering College, Daman.
8.	Date & Time of opening of Tender	On 03/07/2020 at 10:00 A.M.
NOTE	Tender to remain valid till 60 days from opening the tender. Supply & Installation shall be within 30 days of award of work.	

(Dr. Avinash R. Chaudhari)
I/c. Principal,
Ph No. 9426888068
Email ID: gecdaman@gmail.com

ANNEXURE - III

Schedule for Supply of Equipment's for Mechanical Engineering Laboratory of Government Engineering College, Daman

Notice No. 27.1/EQU/GEC/MECH/2019-20/41 **DATED : 03/06/2020**

Table below must be filled as required and submit in Technical Bid Cover

Sr. No.	Item Particular	Configuration Required	Quantity	Configuration offered with Brand / Make	Whether offer model compiles to configuration on given parameter? (Yes/ No.) with deviation.
1. Mechanics of solid					
1.01	Beam apparatus	Simply supported beam test frame with UDL and Point load arrangement rectangular beam with graduated scale Five sets of iron nickel slotted wets (each set containing nine weights and one hanger of 50 gm cap) Sliding Clamp String Force measurement on supports (spring type)	1		
1.02	Friction set up	Wooden frame with angular inclined setup with angle indicator and pulley 4 different frictional surfaces string set of iron nickel slotted wets (containing nine weights and one hanger of 50 gm cap)	1		
1.03	Hardness testing machine	Capacity: - 3000 kg, Hydraulic Brinell Hardness testing machine with 10 specimens Dead weight type load application system combined with mechanical lever system. Supporting hydraulic system for initial lifting of load before each test and dampening the load application system for smooth application of load. Separate hydraulic power pack, positioned in the bottom part of the machine adding to the machine stability. The machine accuracies confirm to lS: 2281-2005 & BS: 240. Loads (kgf) 500 to 3000 in steps of 250 initial load (kgf) 250 Max. test height x throat (mm) 380 x 200 Max. Depth of elevating screw below base (mm) approx. 180 Machine height (mm) approx. 1150 Size of base (mm) approx. 400 x740 Net weight (kg) approx. 32s Drive Motor (hp) 0.5 Mains Supply 3 Phase,415V, 50Hz With Standard Accessories Testing table dia 200 mm Testing table dia 70 mm with "V" groove for round jobs dia 10 to 80 mm Ball holder dia 5 mm Ball holder dia 10 mm Test Block HBW - 5 /750 Test Block HBW - 10 / 3000 Brinell Microscope (25 X Magnification)	1		

		Allen Key set Tungsten carbide ball dia 5 mm Tungsten carbide ball dia 10 mm Instruction Manual			
1.04	Impact testing machine	Capacity: -300 Joules /168 J (30 kg), Digital Izod/Charpy Impact testing machine with 10 specimens **Technical Specification**: - The pendulum Impact Tester, it should be designed for conducting Izod, Charpy test. The test methods confirm to BS: 131: PART 4-1972 (Amended 15Aug. 1993) BSEN: 10045-2: 1993. It should be read on digital readout in case of electronic machines. There are two strikers and one combined support anvil available for fitting in to the pendulum and on the base of the machine for the Izod, Charpy test respectively. Changing from one striker to another is achieved simply by fixing the new striker into its position. **CHARPY TEST: -** The Charpy test piece rests on alloy steel support anvils, fitted on the base of the machine rigidly held in position by Allen screws. End stopper is provided for quickly and accurately locating the test piece centrally between the supports. **IZOD TEST: -** The Izod test piece is clamped vertically in Izod support fitted on the base of the machine. The support is provided with a machined vertical groove to suit the test piece size. The front clamp piece and the Allen screw enable clamping of the test piece in correct height with the help of Izod setting gauge supplied.	1		
2. Material Sc. & Metallurgy					
2.01	Metallurgical microscope with computerized image analysis system	TRINOCULAR MICROSCOPE WITH COMPUTERIZED ATTACHMENT **Upright Trinocular Metallurgical Microscope 'CE Marked' with Pro Cam 5MP CMOS Color Camera with ProCAM Capture Software and Calibration Slide 1/100mm slide.** It should be Rigid and stable body fitted with Trinocular observation tube, inclined at 45°. Bright field, incident light through epi-illuminator with centring provision, iris diaphragm and a slot for dropping filters. It should be having precise quadruple revolving nosepiece with positive click stop Co-axial mechanical stage of x-y movement of specimens up to thickness 65mm. Built-in base transformer. Halogen Bulb 6V 20W controlled by a variable intensity control knob. Supplied with daylight blue and green filters in metal mount, a spare bulb, operating manual and vinyl cover in a thermocol box with following optical combination. **Objectives**: M5x, M10x, M40x **Eyepieces**: WF 10x (Paired) **Magnification**: 40x to 400x. **ProCam 5MP CMOS Color Camera with Radical ProCAM Capture Software and**	1		

		Calibration Slide 1/100mm slide. Specifications: - CMOS Sensor Type: MT9P006(C) Pixel: 5.0MP CMOS Sensor Size: 1/2.5" Pixels size: 2.2µm x 2.2µm Resolution/Frame rate: 2592x1944 (full resolution): 7FPS 1280 x 960: 27FPS 640 x 480: 90FPS Binning: 1x1, 2x2, 4x4 Shutter: Electronic Rolling Shutter Exposure Time: 0.2ms~2000ms Sensitivity: 0.53V/Lux-sec SNR: 40.5 dB Dynamic Range: 67 dB Spectral Range : 380-650nm (with IR-filter) White Balance : ROI White Balance/ Manual Temp-Tint Adjustment Image data Format : 10bit RAW photo format : JPEG/BMP/PNG/RAW Date interface : USB2.0 (B type interface) Operating Temperature : 10°C~ 50°C Storage Temperature : -20°C~ 60°C Operating Humidity : 30~80%RH Storage Humidity : 10~60%RH Power Supply : DC 5V over PC USB Port **ProCam Capture & Measurement Software:-** Image Capture, Time Lapse Imaging, Video Capture, Features: * Multi-fluorescence mode * Exposure control * 2D Measurement capabilities * Multi-Camera operation * Image annotation * Programmable resolution * Individual user profiles * Time-lapse * Multi-focus (Z-stacking) Measurements: Line, Rectangle, 2&3point Circle, polygon, Angle, point, Distance b/w two parallel lines, Dee Hand line area/Ellipses, 3 point, Center to center distance, Measurement on live & Captured Images, Text Stamping, Annotations. Tools: Exposure control(A/M), White balance (A/M), Counting, Annotations, Cross, & Angle dividing rulers on live & captured images Reference scale, time lapse imaging, Video Capturing, Edge detection, Image stitching, Z-stacking, Calibration , Reports in MS Word & MS Excel. Image Process & Enhancement, Image format (JPEG/BMP/RAW/PNG), Dead pixel Correction, ETC.			
2.02	Standard specimen set of various steel, cast iron and non- ferrous metals and alloys (metallurgical microstructure set)	Set of 23 Standard Metallurgical Specimens for Microscope Can be used in Labs for Comparison, For Teaching etc, Covering nearly Entire range of Metallurgy, Including booklet with Images of samples through a Microscope Information on Chemical composition, Mechanical Treatment, Heat Treatment & Etchant. 1. Dead Mild Steel 2. Low Carbon Steel 3. Medium Carbon Steel (Annealing) 4. Medium Carbon Steel (Normalizing)	1		

		5. Decarburised High Carbon Steel 6. Inclusion in Steel 7. Hardened Steel 8. Tempered Steel 9. Carburised Steel 10. Tool Steel 11. Grey Cast Iron 12. White Cast Iron 13. Mottled Cast Iron 14. Ductile Cast Iron 15. Cartridge Brass 16. Muntz Metal 17. Tin Bronze 18. Electroplated Component 19. Anodised Aluminium 20. Fusion Welded Mild Steel 21. Friction Welded Steel 22. Powder Metallurgy Component 23. Deformed Mild Steel. Booklet of Complete information including chemical composition, mechanical treatment, details of heat treatment, type of Etchant with description of Microstructure along with their coloured photographs. Set supplied in a wooden storing box with silica			
2.03	Disc polishing machine	Grinding/Lapping Machine designed keeping in mind the needs & requirements of the metallographers. The Double Disc driven by high-end torque motor. The speed varying continuously and indicated on the front fascia. The water faucet arrangement & paper holding band, permitting the discs from wet/ dry grinding and final lapping. Should be corrosion resistant. **Technical Data:** 0.5 HP high torque AC Motor. Imported AC Drive. 8”-disc dia. Standard. LCD display. **RPM**: **50 to 1400 rpm.** **Size**: 71 cm. x45 cm x 42 cm. **Description:** Polishing Machine is used for polishing the Metallographic Samples for Microscopic observation to study various metal structures. **Polishing:** Polishing is the final stage in producing a surface that is flat, smooth, scratch- free and mirror like in appearance. Such a surface is necessary for subsequent accurate metallographic interpretation, both qualitative & quantitative. In this Machine the drive is given the motor spindle, which is mounted on the motor shaft through friction mechanism. Polishing discs are fitted on the shaft and locked by nut. Shaft has two bearings, which are fitted into bearing holder for smooth working.	1		
2.04	Grinding machine (belt	**<u>SPECIFICATION:</u>** Motor – ½ HP – Single Phase with Dust	1		

	grinder)	Tray. Working Window – 4” X 7” Emery Belt Size – 100mm X 915mm			
2.05	Standard specimens of heat treated steel & cast iron before & after heat treatment to view under Metallurgical Microscope	Standard Specimen size for heat treated steel before and after heat Treatment. 1. Dead Mild Steel 2. Low Carbon Steel 3. Medium Carbon Steel (Annealing) 4. Medium Carbon Steel (Normalizing) 5. Decarburised High Carbon Steel 6. Grey Cast Iron 7. White Cast Iron 8. Mottled Cast Iron 9. Ductile Cast Iron Booklet of Complete information including chemical composition, mechanical treatment, details of heat treatment, description of Microstructure along with their coloured photographs.	1		
3. Metrology and instrumentation					
3.01	Inside micrometers	Inside Micrometer: Interchangeable Rod Type with Ratchet Stop. Extension rods up to 150 mm. • Measuring Range: 0-25 mm and 25-50 mm. • Scale: Metric, Accuracy: 0.01 mm. • Material: High Grade Steel & Measuring Faces- Carbide. • Travel of Micrometer Head: Minimum 7 mm. • Total Number of Extension Rods: Minimum 02. • Standards Setting with Calibration certificate of inspection. • Packing –In Carry Wooden Box/ Hard Plastic Box with Product Catalogue.	1		
3.02	Telescopic gauge	Gauge: telescopic type used to measure internal dimensions of work pieces. • Capacity to Measure: Minimum 8-150mm depth. • Size: 8-12.7mm, 12.7-19mm, 19-32mm, 32-54mm, 54-90mm,90-150mm up to 150mm. • Packing: In Wooden Box, foam inside package	1		
3.03	Depth gauge	Range (mm) :200 mm Least count: 0.01mm Scale : Metric With Ratchet Stop, Rod Pieces Carry Box, setting Standards , certificate of inspection Equivalent to Mitutoyo or Higher brands	1		
3.04	Bevel protector	Measuring Range (mm): 0-150, Range: 0-360 Degree, Least Count: 5 Min, Material: Stainless steel, Accurately machined surface for precise readings With Magnifying glass and acute angle attachment, Two Blades 150mm and 300mm	1		
3.05	Slip gauge box	Slip Gauge set of 112 Pieces, Grade-0 standard Slip gage or Johnsons gage block made of steel with calibration Certificate. Size 0.5 – 100MM	1		
3.06	Sine bar	Size - 150mm, 200 mm. Universal Sine. Distance between the rolls: 150-250 mm; Diameter of rolls: 25-30 mm, Accuracy of length: ± 0.002 mm	1 each		

3.07	Straight edge	Made from high quality spring steel. Straight & Knife Edges should be fully ground and hand scraped for a perfectly flat surface. Retain shape & accuracy. Knife Edges Type are flat on one side and have a bevel on the other. Length at least 200mm, Thickness 4mm(5/16Inch). Flatness of Edges should be within 12Microns, Parallelism of Faces not less than 24 Microns	1		
3.08	Feeler gauge	Feeler/Thickness Gauge 0.05 – 1.0MM with 28 Leaves, Graduations 0.05 – 0.15 MM by 0.01MM & 0.2 – 1.0 MM by 0.05MM	1		
3.09	Radius gauge	Range (mm) 1-7- & 7.5-15-mm Gages 14 Increments 0.5mm Material Steel	1		
3.10	Thread pitch gauge	Material Steel (corrosion resistant) Accuracy 0.25 ~ 1.3 （± 0.03mm） 1.4 ~ 7.0 （± 0.05mm） 7.5 ~ 11.5 （± 0.07mm）	1		
3.11	V blocks	Made from close grained cast iron. Blocks should be precisely ground and machined square and parallel. Vee's: 90° centred in true. Squareness and Parallelism of Vee Groves with respect to base Within 0.0012" (30 microns). 50 x 150 x 45 & 70 x 200 x 55	1		
3.12	Samples of various surface textures and different surface roughness	Set of Sample size 3 x 3 inch Crossed lay Parallel lay Perpendicular lay Multi directional lay Circular lay Radial lay Particulate/non-directional/protuberant lay	1		
3.13	Profile Projector	Compact, Light Weight, Table Top with easy operations. 250 mm diameter screen with 90° cross line and chart holders. Screen Graduated to 360° with Vernier reading 6 minutes. Projection Light Source with 24v / 150w Halogen Lamp. Double Oblige **LED Light Source** for Surface Illumination. Focusing can be adjusted manually by hand wheel. Optical Distortion below 0.15%. **Objective Lens Magnification: 10x, 25x and 50x.** View Field diameter (Contour & surface illumination): 25mm Working distance: 60 mm Cooling by built-in-noiseless and vibration free fan. Input Voltage 220v through low voltage transformers. Supplied complete with operating instructions manual. **Specifications :** **Table Type & Size** : Al. 125 X 125mm **Effective Table Area** : 110 x 110mm **X-Y Range** : 25 x 25 mm. **Measuring Unit** : Standard Micrometer	1		

		Heads 0-25mm **Resolution** : 0.01mm **Rotary Measuring Stage** : 360° graduated with vernier 6 minutes. **Stage Glass** : Diameter 62mm **Maximum Work piece Height** : 100mm **Dimensions** : 55 x 35 x 86 cms.			
3.14	Gear tooth Vernier	Range mm: 1-25mm, Resolution (mm) : 0.02, Equivalent to Mitutoyo or Higher brands	1		
3.15	Thread Diameter measuring machine with Set of best wires to measure thread dimensions	Range (mm) : 0-25 mm, Least count : 0.01mm, Scale : Metric, With Ratchet Stop, Carry Box, setting Standards , certificate of inspection.	1		
3.16	Thread micrometer	Range (mm) : 0-25 mm, Least count : 0.01mm, Scale : Metric, With Ratchet Stop, Carry Box, setting Standards , certificate of inspection.	1		
3.17	Plane plug gauge (GO & NO GO)	Size : 1 - 25 mm in steps of 1 mm tolerance H7 grade			
3.18	Snap Gauge set	Gauge Type: Snap Type Go and Not Go • Single or Double Ended Gauge and Adjustable Snap Gauge. • Material: Aluminium or Tool Steel • Thickness: 25 mm to 50 mm by 5 mm step • Total no of Piece: Minimum -06 pieces. • Packing: In Wooden Box, foam inside package.	1		
3.19	Sensors, position, proximate, velocity, force/strain. (trainer)	SENSOR TRAINER:- The Trainer should have following Technical Specifications. With Angular position sensor (1k/5k) , linear position sensor (50mm,1k/2k) ,inductive proximity sensor ,diffused proximity sensor ,Air velocity sensor with indicator , Force sensor with indicator ,+5V ,-12V,+12V supply , LED indicators for sensors , measurement terminals , Angular scale with pointer , linear scale with pointer ,MS powder coated box with polycarbonate front panel ,terminals for interfacing with microcontroller ,Inbuilt Microcontroller with 3 channel annunciation system based on sensor .with buzzer, push buttons ,LED indicators	1		
3.20	Temperature measurement using different device (trainer)	The Trainer should have following Technical Specifications. This set up should be designed to enable the student to study the following sensors. 1) Thermocouple: Range 0 to200 degree C. Accuracy: +/- 1.5% of the range. 2) Thermistor: Only characteristics with two ranges (0 to 2000 ohm & 0 to 20 Kohm) selectable by switch.	1		

		3) RTD: using PT 100 with provision for study of temp. versus resistance and temp. (I/P) with indicated temp. Characteristics of this widely used sensor. range 0 to 200 degree C. with an accuracy of +/- 1% of the range. 4) IC Sensor: IC Sensor AD 590 is used to study its application as temp. sensor in the Range 0 to 200 degree C, along with its characteristics. A system with water container, heater with cable & thermometer. Housed in an elegant powder coated MS box with neatly labelled anodized plate with suitable connecting terminals. Box size: 290*145*300 mm approx. Common DPM of 199.9 milli volt to be shared . 4 no of pcbs, PCB-11 , 4 pole 3 way 1 no.			
3.21	Dead weight pressure gauge tester (trainer)	The Trainer should have following Technical Specifications. Range: 0 - 25 Kg/Cm^2. Tester provided with a gauge connector of ½ " BSP of complete with one set of weights, Oil holder , wheel of pressure adjustment with valves to oil holder ,1no of Pressure gauge ,powder coated body with height adjustment bolts below	1		
3.22	Pressure Measurement apparatus (trainer)	The Trainer should have following Technical Specifications. A small storage tank with bourden's tube pressure gauge 0-5 kg/cm^{2,} Bourdon tube visible pressure gauge 1no, reference pressure gauge 1 no , quick connectors, Pu piping ,foot pump, Pressure release valve , Valve for inlet pressure control, 3/8" T junction , with MS powder coated base ,With manual.	1		
3.23	TORQUE MEASUREMENT MODULE	The Trainer should have following Technical Specifications. I. Torque sensing by strain gauges II. Rosset gauges with 15-17 mm MS bar (30 cm) with loading lever attached. Loading lever with loading at 250 mm, 375 mm, 500 mm with 0.5kg 1no ,0.2 kg 1 no ,1 kg 1no. III. 3 ½ digit digital torque indicator with Min pot with course and fine balance with Min pot as 10K, 10 turn, course pot 100k ,1 turn, gain pot 100k ,4 no of Op-07, card , H connectors gold plated , IV. Wheatstone's bridge with good quality instrumentation amplifier ,+5V inbuilt supply V. MS powder coated box with polycarbonate front panel.	1		

3.24	MEASUREMENT OF SPEED BY MAGNETIC AND INDUCTIVE PICK UP	The Trainer should have following Technical Specifications. 12V ,1A, 1000 RPM dc motor Speed controller (0-900 RPM), Mettalic Disc with hole , LED as light source Photo transistor sensor for PHOTO ELECTRIC METHOD, Magnetic PICK up switch with arrangement to adjust the distance between disc and sensor for Magnetic sensors, both sensors will generate 1 pulse rev , Inbuilt 12V variable power supply for motor , advanced Microcontroller based RPM indicator with 7 segment display . Part-I main unit with indicator , Part- II motor with sensors and light arrangement ,TP1 for CRO wrt ground ,MS powder coated box with polycarbonate front panel , Dedicated switch for motor on/off.	1		
4. Heat Transfer					
4.01	Apparatus to determine thermal conductivity of metal rod	This experiment should have aims at calculating value of thermal conductivity of given Metal rod using a well-engineered experimental setup. A Metal Bar , one end of which is heated while the other end projects inside cooling jacket. The middle potion is surrounded by cylindrical shell filled with insulating powder. Thermocouples are placed on rod, shell and cooling jacket to determine thermal conductivity. Water flow rate is also measured. Technical Specification:- • Test Section mounted at user friendly height of 800 mm • Individual frame structure, no need of laboratory platform • All wetted Parts are corrosion resistant material • Calibration certificate provided all instrumentation and sensor used • High Quality Industrial Grade make instrumentation and sensor such as Selec; Multispan; L&T etc. • Thick 18 Gauge Sheet metal used for control panel • Detailed Instruction Manual containing experimental procedure, observation table, Apparatus Diagram; Wiring diagram; factory settings and sample readings • Test Bar: 300 mm long / 25 mm Dia./ Brass • Shell Dia.: 175 mm • Measuring Flask 1litre • **Control Panel** • Digital Voltmeter (0-230V) • Digital Ammeter (0-2 Amps) • Wattmeter: (400W) • Toggle ON/OFF • **Heater** • 400 Watt • Band Type • Dimmer Controller • **Thermocouples** • K-type (Cr.Al) 8 Nos. • Multi-Channel Temp. Indicator	1		

4.02	Guarded hot plate method apparatus	The apparatus consists of a slab assembly. The main heater and a radial guard heater are sandwiched between copper plates. The specimen in the form of slabs of equal thickness are placed on either sides of heaters and cooling plates through which water is circulated are on the other sides of specimen. Radial guard heaters ensures all heat of main heater passes axially through the specimens, which is collected by cooling plates. By knowing the temperatures and heat input, thermal conductivity of specimen can be calculated. The test set up is enclosed in an enclosure with insulation inside to reduce radiation losses and to provide undisturbed surroundings. Technical Specification:- • Test Section mounted at user friendly height of 800 mm • Individual frame structure, no need of laboratory platform • All wetted Parts are corrosion resistant material • Calibration certificate provided all instrumentation and sensor used • High Quality Industrial Grade make instrumentation and sensor such as Selec; Multispan; L&T etc. • Thick 18 Gauge Sheet metal used for control panel • Detailed Instruction Manual containing experimental procedure, observation table, Apparatus Diagram; Wiring diagram; factory settings and sample readings • Heaters - i) Main Heater plate 110mm. dia. with mica heater sandwiched between copper plates. ii) Radial guard heater plate 120mm. I.D.200mm OD mica heater sandwiched between copper plates. • Water circulated cooling plates- 2nos. • Dimmerstat 2 A, capacity, 2nos to independently control inputs to the heaters Measurements - i) A Voltmeter and an Ameter with selector switches to measure inputs ii) Multichannel digital temperature indicator to measure temperatures at various point	1		
4.03	Composite wall apparatus	The experimental set-up must be consists of test specimen made of different materials aligned together on both sides of the heater unit. The first test disc should be next to a controlled heater. The temperatures at the interface between the heater and the disc must measured by a thermocouple, similarly temperatures at the interface between other discs are measured.	1		

		Technical Specification:- • Test Section mounted at user friendly height of 800 mm • Individual frame structure, no need of laboratory platform • All wetted Parts are corrosion resistant material • Calibration certificate provided all instrumentation and sensor used • High Quality Industrial Grade make instrumentation and sensor such as Selec; Multispan; L&T etc. • Thick 18 Gauge Sheet metal used for control panel • Detailed Instruction Manual containing experimental procedure, observation table, Apparatus Diagram; Wiring diagram; factory settings and sample readings • Wall : Dia: 200 mm • MS : 16 mm Thk • Bakelite : 12 mm Thk • Wood : 8 mm Thk • **Control Panel** • Digital Voltmeter (0-230V) • Digital Ammeter (0-2 Amps) • Wattmeter: (400W) • Toggle ON/OFF • **Heater** • 400 Watt • Band Type • Dimmer Controller • **Thermocouples** • K-type (Cr.Al) 8 Nos. • Multi-Channel Temp. Indicator			
4.04	Double pipe heat exchanger setup	The apparatus must allow heat exchange between hot and cold water in both parallel flow and counter flow fashion. This must be made possible with the help of simple valve arrangement. Temperature indicators must be placed to measure hot water inlet and outlet as well as cold water inlet and outlet temperature. Effectiveness and LMTD values of the heat exchanger must be determined. Technical Specification:- • Test Section mounted at user friendly height of 800 mm • Individual frame structure, no need of laboratory platform • All wetted Parts are corrosion resistant material • Calibration certificate provided all instrumentation and sensor used • High Quality Industrial Grade make instrumentation and sensor such as Selec; Multispan; L&T etc. • Thick 18 Gauge Sheet metal used for control panel • Detailed Instruction Manual containing experimental procedure, observation table, Apparatus Diagram; Wiring diagram; factory settings and sample readings • Inner tube: GI/21 mm Dia • Outer Tube: GI/60 mm Dia	1		

		• Effective Length: 750 mm • Valve arrangement for Parallel and **Counter Flow** • 1 ltr. Measuring Jar • Stopwatch • **Control Panel** •Multi-Channel •Temp. Indicator • Toggle ON/OF • **Heater** •2 Litre •Water •Geyser • **Thermocouples** •K-type (Cr.Al) 6 Nos.			
4.05	Shell and tube heat exchanger setup	Apparatus should be Straight Tube Single Pass type Shell type heat exchanger Shell must be made of clear Perspex and Tubes are copper. There must be Arrangement for Counter and Parallel Flow. Temperature indicators must be placed to measure hot water inlet and outlet as well as cold water inlet and outlet temperature. Effectiveness and LMTD values of the heat exchanger must be determined. Technical Specification:- • Test Section mounted at user friendly height of 800 mm • Individual frame structure, no need of laboratory platform • All wetted Parts are corrosion resistant material • Calibration certificate provided all instrumentation and sensor used • High Quality Industrial Grade make instrumentation and sensor such as Selec; Multispan; L&T etc. • Thick 18 Gauge Sheet metal used for control panel • Detailed Instruction Manual containing experimental procedure, observation table, Apparatus Diagram; Wiring diagram; factory settings and sample readings • Shell Dia. 100 mm • Shell Length: 300 mm • No. of Baffle: 3 Nos. • No. of tubes: 17 • **Control Panel** •Multi-Channel Temp. •Indicator • Toggle ON/OF • **Heater** •2 Litre Water •Geyser • **Thermocouples** •PT-100(RTD) 4 Nos.	1		
4.06	Pin fin apparatus setup	Apparatus aims at studying heat transfer rate from the fin & the fin effectiveness in natural & forced conviction. Technical Specification:- • Test Section mounted at user friendly height of 800 mm • Individual frame structure, no need of laboratory platform • All wetted Parts are corrosion resistant material • Calibration certificate provided all	1		

		instrumentation and sensor used • High Quality Industrial Grade make instrumentation and sensor such as Selec; Multispan; L&T etc. • Thick 18 Gauge Sheet metal used for control panel • Detailed Instruction Manual containing experimental procedure, observation table, Apparatus Diagram; Wiring diagram; factory settings and sample readings •Pin Fin MOC: Brass • Pin Fin Dia: 12 mm • Duct Length: 150 mm • Centrifugal Blower • Orifice meter and Manometer arrangement to measure flow rate • **Control Panel** •Digital Voltmeter (0-230V) • Digital Ammeter (0-2Amps) • Wattmeter:(400W) • Toggle ON/OFF • Blower Speed Regulator • **Heater** •400 Watt • Band Type • Dimmer Controller • **Thermocouples** •K-type (Cr.Al)• 6 nos. • Multi-Channel Temp. Indicator			
4.07	Emissivity measurement apparatus	Experimental setup consists of two circular plates identical in size and are provided with heating coils. The plates are kept in an enclosure and heat input can be varied by regulators and is measured by an ammeter and voltmeter. Each plate has thermocouple and one to read the chamber temperature. One plate is blackened by a layer of enamel black paint to form the idealized black surface whereas the other plate is the test plate. The aim is to measure the emissivity of the test plate surface. Technical Specification:- • Test Section mounted at user friendly height of 800 mm • Individual frame structure, no need of laboratory platform • All wetted Parts are corrosion resistant material • Calibration certificate provided all instrumentation and sensor used • High Quality Industrial Grade make instrumentation and sensor such as Selec; Multispan; L&T etc. • Thick 18 Gauge Sheet metal used for control panel • Detailed Instruction Manual containing experimental procedure, observation table, Apparatus Diagram; Wiring diagram; factory settings and sample readings • Test and Black Plates: 150 mm Dia • **Control Panel** •Digital Voltmeter (0-230V) • Digital Ammeter (0-2Amps)	1		

		• Wattmeter:(400W) • Toggle ON/OFF • Blower Speed Regulator • **Heater** •400 Watt • Band Type • Dimmer Controller • **Thermocouples** •K-type (Cr.Al) 3 nos. • Multi-Channel Temp. Indicator			
4.08	Stefan Boltzmann apparatus	Flanged Hemisphere must be fixed in a flat non-conducting plate. Outer surface of the hemisphere should be enclosed in water jacket heated separately. Thermocouple measures mean temperature, and the response of temperature with time on a disc must be fitted at centre should be used to calculate the Stefan Boltzmann constant. Technical Specification:- • Test Section mounted at user friendly height of 800 mm • Individual frame structure, no need of laboratory platform • All wetted Parts are corrosion resistant material • Calibration certificate provided all instrumentation and sensor used • High Quality Industrial Grade make instrumentation and sensor such as Selec; Multispan; L&T etc. • Thick 18 Gauge Sheet metal used for control panel • Detailed Instruction Manual containing experimental procedure, observation table, Apparatus Diagram; Wiring diagram; factory settings and sample readings • Hemisphere Jacket: 110 mm • Water Jacket: 150 mm Dia • **Control Panel** • Digital Voltmeter (0-230V) • Digital Ammeter (0-2 Amps) • (Wattmeter: 400W) • Toggle ON/OFF • **Heater** • 400 Watt • Immersion Type • Dimmer Controller • **Thermocouples** • K-type (Cr.Al) 6 Nos. • PT-100 2 No. Multi-Channel Temp. Indicator	1		
4.09	Natural and force convection apparatus	The apparatus should be used to determine the overall heat transfer coefficient using natural convection. A Rectangular Duct with open ends must be vertical brass tube with heater fitted at bottom . The Heat Transfers should be From The Tube To The Surrounding Air By Natural Convection. Temperature sensors Measures values At Different Points must be Including duct temperature. • Test Section mounted at user friendly height of 800 mm • Individual frame structure, no need	1		

		of laboratory platform • All wetted Parts are corrosion resistant material • Calibration certificate provided all instrumentation and sensor used • High Quality Industrial Grade make instrumentation and sensor such as Selec; Multispan; L&T etc. • Thick 18 Gauge Sheet metal used for control panel • Detailed Instruction Manual containing experimental procedure, observation table, Apparatus Diagram; Wiring diagram; factory settings and sample readings • Test Pipe: Brass • Dia: 32 mm • Length: 400 mm • **Control Panel** • Digital Voltmeter (0-230V) • Digital Ammeter (0-2 Amps) • (Wattmeter: 400W) • Toggle ON/OFF • **Heater** • 400 Watt • Immersion Type • Dimmer Controller • **Thermocouples** • K-type (Cr.Al) 6 Nos. • PT-100 2 No. Multi-Channel Temp. Indicator			
5. Refrigeration and Air Conditioning					
5.01	Vapor compression test rig	The rig incorporates a hermetically sealed compressor provided with an air cooled condenser and an evaporator with water as a medium and heater. Evaporator temperature is kept constant by adjusting the heater and heater input is taken as refrigerating effect. With various measurements, Actual COP, Theoretical COP, Carnot COP and heat transfer coefficient in evaporator can be calculated. Technical Specifications: • Compressor-Hermetically sealed, having the capacity of 1/3 ton refrigeration. (approx) • Condenser - Finned tube, air cooled with fan. • Thermostatic expansion valve provided with solenoid valve. • Capillary tube of suitable length, to demonstrate operation. • Static Evaporator - Cooling coil immersed in water and a heater of suitable capacity • Rotameter for liquid refrigerant flow measurement. • Pressure gauges for condensing and evaporating pressure. • Thermometers for various temperatures of cycle. • Energy meters to measure compressor input. • Controls and safety - a) High and low pressure cutout.	1		

		b) Thermostat. c) Overload protector for compressor motor. d) Ammeter to visualise proper operation of compressor motor. e) Filter cum drier for refrigerant. • Calibration certificate provided all instrumentation and sensor used • High Quality Industrial Grade make instrumentation and sensor such as Selec; Multispan; L&T etc. • Thick 18 Gauge Sheet metal used for control panel • Detailed Instruction Manual containing experimental procedure, observation table, Apparatus Diagram; Wiring diagram; factory settings and sample readings • All Parts mounted at user friendly height of 800 mm • Individual frame structure, no need of laboratory platform			
5.02	Vapor absorption test rig	Small capacity vapor absorption refrigeration unit. It uses an electrically operated generator, where, the ammonia vapours dissolved in water are separated and pure ammonia vapours enter the condenser. In the condenser, the high-pressure vapours reject its latent heat to the surroundings and get liquefied. The liquid ammonia expands through expansion device where its pressure and temperature is reduced and cold low-pressure vapour enters the evaporator where it absorbs heat from the space to be cooled and then vaporized ammonia absorbs in water. This strong solution then enters the generator and the cycle repeats Technical Specifications: • Gross volume: 40 liters • Refrigerant: water, ammonia, hydrogen • Generator: electrically heated • Condenser: natural convection type • Evaporator: natural convection type • Material of construction: m.s. • Multichannel digital temperature indicator. • Evaporator variable load • Supply: 230 volts, 50 hz, 1 ph • Energy consumption:1.07 kwh per 24 hrs • Calibration certificate provided all instrumentation and sensor used • High Quality Industrial Grade make instrumentation and sensor such as Selec; Multispan; L&T etc. • Thick 18 Gauge Sheet metal used for control panel • Detailed Instruction Manual containing experimental procedure, observation table, Apparatus Diagram; Wiring	1		

		diagram; factory settings and sample readings • All Parts mounted at user friendly height of 800 mm • Individual frame structure, no need of laboratory platform			
5.03	Sectional models of various type of compressors	1.**Cut section model of Open Type Automobile compressor:** It Should be made out of original, old, reconditioned part with different color painting mounted on a sturdy MS, Powder coated stand. **2. Cut section model of Rotary compressor:** It Should be made out of original, old, reconditioned part with different color painting mounted on a sturdy MS, Powder coated stand. 3. **Cut section model of hermetically sealed compressor:** It Should be made out of original, old, reconditioned part with different color painting mounted on a sturdy MS, Powder coated stand. 4.**Cut section model of Semi sealed compressor:** It Should be made out of original, old, reconditioned part with different color painting mounted on a sturdy MS, Powder coated stand. **5. Cut section model of open type Reciprocating air compressor:** It Should be made out of original, old, reconditioned part with different color painting mounted on a sturdy MS, Powder coated stand.	1 each		
5.04	Air cooler apparatus	In the apparatus, air flow is generated by an axial flow fan, enclosed in a box. The fan draws air over the porous curtain. Over the curtains water is sprayed by a small pump and sprinkler arrangement. Shutter in front of fan controls air flow. Various measurements provided enable the students to study the characteristics of a desert cooler at various air conditions. Technical Specifications • Main plastic box, housing an axial flow fan with adjustable shutters on front side. • Porous curtains inside three walls of box. • Suitable water pump and spray arrangement for water circulation. • Necessary switches. • Temperature Measurements - Dry/wet bulb thermometers for ambient and outlet air temperatures. • Calibration certificate provided all instrumentation and sensor used • High Quality Industrial Grade make instrumentation and sensor such as Selec; Multispan; L&T etc. • Thick 18 Gauge Sheet metal used for control panel • Detailed Instruction Manual containing experimental procedure, observation table, Apparatus Diagram; Wiring	1		

		diagram; factory settings and sample readings • All Parts mounted at user friendly height of 800 mm Individual frame structure, no need of laboratory platform			
5.05	Apparatus to perform various psychrometric processes	The unit consists of ducting fitted with various air conditioning components. Air flow is generated by an axial flow fan and in the air flow, heaters, cooling coil and steam humidifier connection are provided. Cooling circuit consists of a hermetic compressor, air cooled condenser, thermostatic expansion valve and evaporator (i.e. cooling coil). Measurements of various parameters for cooling cycle and heating cycle are provided and students can easily visualise and understand the basic principles of psychometry and air conditioning. Technical Specifications Cooling circuits - It consists of • Hermetic compressor, having the capacity of 2/3 ton of refrigeration (approx) using R- 22 refrigerant. • Pressure gauges for high and low pressure. • Pressostat (i.e. high and low pressure cutout) • Thermometers for temperature measurement at various points in the cycle. • Energymeter for compressor input measurement. • Condensate measuring arrangement. Heating circuit – • Finned air heaters with stepped input control provided with energymeter for input measurement. Max. heating capacity 1500 Kcal/hr. • Steam generator and injector for humidification of air. All above components are connected to a duct of size 200mm. x 200mm. in which air flow is generated by axial flow fan. • Anemometer for measurement of air velocity, (range 0-15 m/sec.) • Calibration certificate provided all instrumentation and sensor used • High Quality Industrial Grade make instrumentation and sensor such as Selec; Multispan; L&T etc. • Thick 18 Gauge Sheet metal used for control panel • Detailed Instruction Manual containing experimental procedure, observation table, Apparatus Diagram; Wiring diagram; factory settings and sample readings • All Parts mounted at user friendly height of 800 mm • Individual frame structure, no need of laboratory platform	1		

		Following experiments can be conducted on the unit. a) Cooling of atmospheric air. b) Heating of atmospheric air. c) Humidification of atmospheric air. d) Dehumidification and heating of atmospheric air. (Cooling coil acts as dehumidifier at reduced air flow.)			
5.06	Tools for refrigeration tubing	Various Tools For Refrigeration For Tubing Kit comprise of tools necessary to demonstrate key tubing operations such as Flaring, Swaging, Bending and Brazing	1		
5.07	Mechanical heat pump	The heat pump is a compact, self contained unit. It uses R-12 refrigerant and a hermetically sealed compressor. Both the condenser and evaporator are continuous water circulated. Flow of water in condenser and evaporator and of liquid refrigerant are measured by rotameters. Energy input to compressor is also measured and balance of heat added during the cycle and heat removed by the condenser can be checked. Also actual, theoretical and carnot COP's of system can be determined and principle of energy conservation by heat pump can also be studied. Heat transfer coefficients on coils of condenser and evaporator can also be studied. Technical Specifications: • Compressor - Hermetically sealed, having capacity of 1/3 ton of refrigeration (approx). using R-12 refrigerant. • Condenser & Evaporator - Continuous flow water circulated coils with glass wool insulation outside. • Thermostatic expansion valves of suitable capacity. • Rotameter for liquid refrigerant flow measurement. • Rotameters for water flow measurements -2 nos. • wattmeter for compressor input measurement. • Thermometers for measurements of temperature at 4 nos. points in the cycle • Pressure gauges for condensing & evaporating pressure (i.e. high & low pressure) • Ammeter for compressor current • Controls and safety - • Pressostat (i.e. High/low pressure cutout • Overload protector for compressor • Filter cum drier for refrigerant. • Fan for compressor cooling. • Calibration certificate provided all instrumentation and sensor used • High Quality Industrial Grade make instrumentation and sensor such as	1		

		Selec; Multispan; L&T etc. • Thick 18 Gauge Sheet metal used for control panel • Detailed Instruction Manual containing experimental procedure, observation table, Apparatus Diagram; Wiring diagram; factory settings and sample readings • All Parts mounted at user friendly height of 800 mm • Individual frame structure, no need of laboratory platform			
6. Dynamics of Machines					
6.01	Static and dynamic balancing setup of rotating masses.	• All parts are chrome coated or powder coated ensuring long life • Detailed Instruction Manual containing experimental procedure, observation table, Apparatus Diagram; Wiring diagram; factory settings and sample readings • Variable Frequency Drive (VFD) for motor speed control rather than Dimmer for precision • Rectangular Frame section 96 x 48 for better rigidity • Storage cupboard for keeping all accessories • High Quality Industrial Grade make instrumentation and sensor such as Delta; Fuji; Selec; Multispan; L&T etc. • 1. Table Size: 600 x 300 x 600 mm • 2. 1/8 HP 6000 rpm DC Motor with controller • 3. No. of Discs: 4 Nos. • 4. No. of Weights: 8 Nos. • 5. Detailed Technical Manual and On-site Training.	1		
6.02	Vib-Lab setup.	• All parts are chrome coated or powder coated ensuring long life • Detailed Instruction Manual containing experimental procedure, observation table, Apparatus Diagram; Wiring diagram; factory settings and sample readings • Variable Frequency Drive (VFD) for motor speed control • Rectangular Frame section 96 x 48 for better rigidity • Storage cupboard for keeping all accessories • High Quality Industrial Grade make instrumentation and sensor such as Delta; Fuji; Selec; Multispan; L&T etc. • Net Dimensions: 1400 x 600 x 1600 mm • A heavy and sturdy MS frame with a useful cupboard to store all accessories. • A Control panel with Digital RPM Indicator • Arrangement for plotting	1		

		amplitudes of vibrations by a strip chart recorder. • Arrangement for changing the damping positions. • No. of long steel Beam = 3 nos. • No. of Shaft = 3 nos. • No. of Spring of Varying Stiffness = 2 Nos • Tools Included: Allen key set, Stopwatch and measuring tape • A Comprehensive and a detailed technical Manual **Experiment Scope:** •Simple pendulum • Compound pendulum • Bifilar Suspension • Trifler Suspension • Mass-spring systems • Equivalent Spring Stiffness •Torsional oscillations of a single rotor • Torsional oscillations of a single rotor with viscous damping • Torsional oscillations of a two rotors system •Transverse vibration of a beam with one or more bodies attached • Free vibration of a Spring-mass system • Forced damped vibration of Spring-mass system • Dunkerley's Theorem Verificat			
6.03	Whirling of shaft setup.	The main must be part thick powder coated frame that hold a variable speed motor which turns the horizontal test shaft. Two bearings must be hold the shaft, one bearing at the 'driven end' and the other bearing at the 'tail end' of the shaft. The tail end bearing slides in its housing to allow the shaft length to change as it 'whirls'. Similar to a beam on two simple knife-edge supports, both bearings allow free angular shaft movement (free ends condition). Also supplied with the equipment are extra bearings that restrict angular movement when fitted, to give 'fixed ends'. The apparatus should be a set of test shafts of different length and diameter to show how these properties affect whirling. Also supplied must be a set of weights to show how concentrated loads affect whirling. One weight has an extra hole to make it an eccentric load. • All parts are chrome coated or powder coated ensuring long life • Detailed Instruction Manual containing experimental procedure, observation table, Apparatus Diagram; Wiring diagram; factory settings and sample readings • Variable Frequency Drive (VFD) for motor speed control, Rectangular Frame section 96 x 48 for better rigidity • Storage cupboard for keeping all accessories High Quality Industrial Grade make instrumentation and sensor such as Delta; Fuji; Selec; Multispan; L&T etc.	1		

		1. Table Size: 1500 x 300 x 300 mm 2. 1/6 HP 6000 rpm Motor with controller 3. No. of Sleeve Weights: 4 Nos. 4. No. of Shaft of Different Diameter: 3 Nos. 5. Shaft End Configurations: Fixed and Free Ends 6. Detailed Technical Manual and On-site Training			
6.04	Cam dynamics setup.	The apparatus must be dynamic investigation of cam and follower mechanisms, as used in motors, engines and machinery. The cam mechanism consists of 3 interchangeable cam plates and 3 different followers. A mass and a spring should be used to simulate the valve. In order to demonstrate the "jump speed", the spring rate, mass and speed are adjustable within broad limits. This must be open design allows the observation of every detail of the movement process. • All parts are chrome coated or powder coated ensuring long life • Detailed Instruction Manual containing experimental procedure, observation table, Apparatus Diagram; Wiring diagram; factory settings and sample readings • Variable Frequency Drive (VFD) for motor speed control • Rectangular Frame section 96 x 48 for better rigidity • Storage cupboard for keeping all accessories • High Quality Industrial Grade make instrumentation and sensor such as Delta; Fuji; Selec; Multispan; L&T etc. 1. Table Size: 600 X 300 mm 2. ¼ HP 1500 rpm PMDC Motor with controller 3. No. of CAMS and Followers: 3 Each as specified above. 4. No. of Spring of Different Stiffness: 2 Nos. 5. No. of Masses : 2 Nos. 6. Dial Indicator 0-10 mm 7. Full Protractor with angle measurement arrangement 6. Detailed Technical Manual and On-site Training **TYPES OF CAMS** • Eccentric Arc Cam • Tangent Arc Cam • Circular Arc Cam **TYPES OF FOLLOWERS** • Knife Edge Follower • Roller Follower • Flat Face Follower	1		
6.05	Oscilloscope	DIGITAL STORAGE OSCILLOSCOPES(DSO) 100 MHz Sampling Rate 1GS/s (Color LCD Display) • 100 MHz 2 Channel Digital storage	1		

		Oscilloscope • 100 MHz Bandwidth • Dual Analog channel • 2 GS/Sec sampling Rate • Record length per analog channel simultaneously- 2500 points • Minimum Display size – 7 inch			