

SCHEDULE OF REQUIREMENTS
FLUID MECHANICS LABORATORY, CHEMICAL ENGINEERING DEPARTMENT

S.No	Description	Quantity	Unit Price C&F	Total Price C&F
1	<p>Basic Hydraulic Bench The basic hydraulic bench should be design as a portable and self-contained service unit. The bench should be constructed from light weight corrosion resistant glass reinforced plastic & the hydraulic bench must have side channel (LOW FLOW VOLUMETRIC TANK) to support the accessory on test. The hydraulic bench should be single moulded, to avoid any possible leakage for a long time. ABB Power Protection against all Electric hazards. The Hydraulic Bench should be equipped with U-Tube Manometer for High flow volumetric tank to continuous measurement of flow Discharge. Computer Aided Learning Software for Hydraulic Benches</p> <p>Technical Specification :- Pump : Centrifugal Type, Max. Head 21m H₂O, Max. flow 1.35L/S Motor rating : 0.36kW at least Sump tank capacity : 200-250Liters High flow volumetric tank:30-40Liters Low flow volumetric tank: 6Liters</p> <p>Software The equipment must be accompanied educational Software, PC and all standard accessories necessary for computerized data acquisition/upgrade. It should also allow all relevant system parameters to be automatically recorded on a PC.</p> <p>Manual: The equipment must be accompanied by manual containing information regarding Services requirements, Assembly and Installation, Starting-up, Safety, Maintenance & Practices Manuals.</p> <p>Services and parts Agreement All standard accessories and spares for three years normal operation together with a full three year warranty should be the part of standard agreement.</p>	06		
2	<p>Flow Over Weirs The service unit should be capable to * Determination the characteristics of flow over a notch rectangular * Demonstrating the characteristics of flow over a veenotch * Determining the coefficient of discharge</p> <p>Technical Specification :- Overall dimensions of weir plates : Height 160mm, Width 230mm, Thickness 4mm. Dimension of rectangular notch : Height 82mm, Width 30mm, Angle of v- notch weir : 90o inclusive Hook's and point gauge range : Accuracy 0.1mm</p> <p>Air Compressor to provide the air at 900kN/m² (9 Bar Gauge) at up to 8g/s (400 litre/min free air)</p> <p>Software The equipment must be accompanied educational Software, PC and all</p>	01		

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	<p>standard accessories necessary for computerized data acquisition/upgrade. It should also allow all relevant system parameters to be automatically recorded on a PC.</p> <p>Manual: The equipment must be accompanied by manual containing information regarding Services requirements, Assembly and Installation, Starting-up, Safety, Maintenance & Practices Manuals.</p> <p>Services and parts Agreement All standard accessories and spares for three years normal operation together with a full three year warranty should be the part of standard agreement..</p>			
3	<p>Bernoulli's Theorem Demonstration The unit should be capable to</p> <ul style="list-style-type: none"> * Demonstrating Bernoulli's Theorem and its limitations * Directly measuring the static and total head distribution along a venturi tube. * Determining the meter coefficient at various flow rates <p>Technical Specification :- Manometer range : 0 to 300mm Number of manometer tubes : 8 min. Throat diameter : 10.0mm, Upstream diameter : 25.0mm Upstream taper : 14o, Downstream taper : 21o Note : To be used with F1-10-A for operation.</p> <p>Educational Software The equipment must be accompanied educational Software, PC and all standard accessories</p> <p>Manual: The equipment must be accompanied by manual containing information regarding Services requirements, Assembly and Installation, Starting-up, Safety, Maintenance & Practices Manuals.</p>	01		
4	<p>Orifice Discharge The unit should be capable to</p> <ul style="list-style-type: none"> * Determining the contraction and velocity coefficients * Calculating the discharge coefficient <p>Technical Specification :- Standard orifice : Sharp-edged 30mm diameter Max. head : 365mm Traverse mechanism : Lead screw with adjusting nut calibrated 0.1mm per division</p> <p>Software The equipment must be accompanied educational Software, PC and all standard accessories necessary for computerized data acquisition/upgrade. It should also allow all relevant system parameters to be automatically recorded on a PC.</p> <p>Manual: The equipment must be accompanied by manual containing information regarding Services requirements, Assembly and Installation, Starting-up, Safety, Maintenance & Practices Manuals.</p>	02		

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5	<p>Osborne Reynold's Demonstration The unit should be capable to</p> <ul style="list-style-type: none"> * Reproducing the classic experiments conducted by professor Osborne Reynolds concerning fluid flow condition. * Observing the laminar, transitional, turbulent flow & velocity profile. <p>Technical Specification :- Test pipe diameter : 10mm Length of test pipe : 700mm Dye reservoir capacity : 0.45 liters</p> <p>Software The equipment must be accompanied educational Software, PC and all standard accessories necessary for computerized data acquisition/upgrade. It should also allow all relevant system parameters to be automatically recorded on a PC.</p> <p>Manual: The equipment must be accompanied by manual containing information regarding Services requirements, Assembly and Installation, Starting-up, Safety, Maintenance & Practices Manuals.</p> <p>Services and parts Agreement All standard accessories and spares for three years normal operation together with a full three year warranty should be the part of standard agreement.</p>	01		
6	<p>Flow Meter Demonstration (Venturi Meter) The unit should be capable to</p> <ul style="list-style-type: none"> * Directly comparing flow measurement using a venturi, meter, variable area meter and orifice plate * Calibrating each flow meter using the volumetric measuring tank of the bench * Comparing pressure drops across each device <p>Technical Specification :- Manometer range : 0 to 440mm Number of manometer tubes : 8 Orifice plate diameter : 20mm Variable area meter : 2 to 20 Liters/Min Venturi dimensions : - Throat diameter 15mm - Upstream pipe diameter 31.75mm - Upstream taper 21o Inclusive - Downstream taper 14o Inclusive</p> <p>Software The equipment must be accompanied educational Software, PC and all standard accessories necessary for computerized data</p>	01		

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	<p>acquisition/upgrade. It should also allow all relevant system parameters to be automatically recorded on a PC.</p> <p>Manual: The equipment must be accompanied by manual containing information regarding Services requirements, Assembly and Installation, Starting-up, Safety, Maintenance & Practices Manuals.</p> <p>Services and parts Agreement All standard accessories and spares for three years normal operation together with a full three year warranty should be the part of standard agreement.</p>			
7	<p>Energy losses in bends The unit should be capable to</p> <ul style="list-style-type: none"> * Measuring the losses in the devices related to flow rate and calculating loss coefficients related to velocity head * Comparing the pressure drop across each device <p>Technical Specification :- Pipe diameter : 19.48mm Differential pressure gauge : 0 to 1.3.5bar Enlargement diameter : 26.2mm Contraction diameter : 19.48mm Fitting : 45oC mitre, elbow,short bend,large band,enlargement,contraction Manometer range : 0 to 440mm Number of manometer tubes :12 Differential manometer : 6</p> <p>Software The equipment must be accompanied educational Software, PC and all standard accessories necessary for computerized data acquisition/upgrade. It should also allow all relevant system parameters to be automatically recorded on a PC.</p> <p>Manual: The equipment must be accompanied by manual containing information regarding Services requirements, Assembly and Installation, Starting-up, Safety, Maintenance & Practices Manuals.</p> <p>Services and parts Agreement All standard accessories and spares for three years normal operation together with a full three year warranty should be the part of standard agreement.</p>	01		
8	<p>Series / Parallel Pumps The unit should be capable to determining the head/flow rate characteristics of:</p> <ul style="list-style-type: none"> * A single centrifugal pump at a single speed * Two similar pumps operating in a parallel configuration at the same speed * Two similar pumps operating in a series configuration at the same speed 	01		

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	<p>Technical Specification :- Pump:centrifugal type : max.head 21m H2O, max.flow 1.35 litres/sec Motor rating :0.36kW Pressure gauge range :0 to 45m H2O Compound gauge range : -10 to +45m H2O</p> <p>Software The equipment must be accompanied educational Software, PC and all standard accessories necessary for computerized data acquisition/upgrade. It should also allow all relevant system parameters to be automatically recorded on a PC.</p> <p>Manual: The equipment must be accompanied by manual containing information regarding Services requirements, Assembly and Installation, Starting-up, Safety, Maintenance & Practices Manuals.</p> <p>Services and parts Agreement All standard accessories and spares for three years normal operation together with a full three year warranty should be the part of standard agreement.</p>			
9	<p>Centrifugal Pump Characteristics The unit should be capable to determining the relationship between head, discharge, speed,power and efficiency for a centrifugal pump at various speeds * Determining the head/flow rate characteristics of two similar pumps operating in either parallel or series configuration at the same speed</p> <p>Technical Specification :- Pump : centrifugal type : max.head 21.0m H2O max.flow rate 1.35 l/sec Motor : 0.36kW, Speed controller : PWM inverter Speed range : 0 to 1500 rpm Pressure gauge : 0 to 60 m H2O Compound gauge : -10 to 32m H2O</p> <p>Software The equipment must be accompanied educational Software, PC and all standard accessories necessary for computerized data acquisition/upgrade. It should also allow all relevant system parameters to be automatically recorded on a PC.</p> <p>Manual: The equipment must be accompanied by manual containing information regarding Services requirements, Assembly and Installation, Starting-up, Safety, Maintenance & Practices Manuals.</p> <p>Services and parts Agreement All standard accessories and spares for three years normal operation together with a full three year warranty should be the part of standard agreement.</p>	01		

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	TOTAL COST C&F	
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Note:

- If a bidder submits bids on behalf of more than one Manufacturer, unless each such bid is accompanied by a separate Bid Form for each bid, and a bid security 2% of total quoted amount, when required, for each bid, and authorization from the respective Manufacturer, all such bids will be rejected as nonresponsive. in case of discrepancy between unit price and total price, **the unit price shall prevail.**
- Installation CDs and lab manual must be provided by bidder/supplier/authorize manufacturer at free of cost.
- Free of cost training shall be provided by the supplier/bidder.

According to SPP rules 2010 (amended in 2013) of Rule 42:

For the purpose of comparison of bids quoted in different currencies, price shall be converted into a PKR. The rate of exchange shall be the selling rate prevailing seven working days before the date of opening of the bids, as notified by the State Bank of Pakistan;