VEER SURENDRA SAI UNIVERSITY OF TECHNOLOGY, BURLA
PO- Burla Engg. College, Dist-Sambalpur, Odisha-768018

NOTICE INVITING QUOTATION

No.VSSUT/Chemical/5628/16 Dated. 10/02/2016

Sealed quotations are invited from firms with valid VAT/IT clearance certificate and TIN for the supply of instruments for the Department of Chemical Engineering, VSSUT, Burla. The quotations should reach the office of the undersigned through **speed/registered post only** on or before **08.03.2016**. For details, visit the University web site **www.vssut.ac.in.**

Sd/-
REGISTRAR

Memo No.VSSUT/Chemical./5629(8)/16 Dated. 10/02/2016

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1. M/s. Display Lines, 219, Saheed Nagar, Bhubaneswar-751007 with request to publish the above advertisement in one issue of the all Odisha daily edition of The SAMAJ and the Times of India (Odisha, Kolkata, Delhi, Visakhapatnam, Ahmedabad edition) at the I&PR approved/lowest rate. The bill may be sent in triplicate along with a copy of the paper in which the publication is made.
2. The Dean, Faculty & Planning with a request to arrange displaying the advertisement in University website at an earliest.
3. HOD, Chemical Engg. Department.
4. Comptroller of Finance, VSSUT, Burla.
5. P.A.to the Registrar.
6. PA to V.C. for kind information of the Vice Chancellor.
7. University Notice Board.

10/2/16

REGISTRAR

Terms and conditions

1. The quotations should contain the following documents.
   I. Self attested copies of registration of VAT, Sales tax and Service tax etc. issued by appropriate Govt. authority.
   II. Self attested copies of VAT clearance/ITCC/ Service tax clearance certificate.
   III. Technical literature for the quoted equipments.
   IV. List of clients and documents related to experience of bidder (copies purchase order to be attached).
   V. Documents in support of OEM/ authorised dealer.
   VI. The quotation document must be signed on each page by the authorised signatory of the bidder.
   VII. Detailed specification of product along with the service product.
   VIII. A technical capability document describing the relevant facilities and services available with them.
2. Vendors must give the specifications of each equipment separately. (By simply copying the university technical specification is liable to be rejected by competent authority).
3. The quotation must be submitted separately for each and every equipment. If, same company quotes for more than one equipments they must submit in two or more separate pages clearly marking the equipment name.
4. If any clarification required on your technical specification, competent authority may call the intending firms to visit the University, at their own expense during office hours. It doesn't mean that university is going to place the order to that vendor. The University reserves the right to call the vendors and to conduct negotiations, if necessary and has the right to select more than one vendor for one or more items at its discretion.
5. The University is not responsible for delay, loss or non-receipt of quotation documents sent by the post.
6. The quotation shall contain the final rates inclusive of all charges in clear and unambiguous terms in Indian rupees.
7. On all matters related to this quotation call, the decision of the University shall be final and binding and the same cannot be referred to any court of law. The University reserves the right to reject any or all the quotations without assigning any reason.
8. The University reserves the right to order all or part or name of the items given in this documents.

Last date of submission of quotations to the Registrar, VEER SURENDRA SAI UNIVERSITY OF TECHNOLOGY, BURLA, PO-Burla Engg.College, Dist-Sambalpur-768018, ODISHA by SPEED/REGISTERED POST only is 08/03/2016. No other mode of receiving the quotations will be entertained.

10/2/16

Registrar

Table-I (List of equipments of Material Handling Laboratory)

Sl. No.	Name of the equipment	Number	Remarks
1	Jaw Crusher	01	
2	Roll Crusher	01	
3	Ball Mill	01	
4	Froth Flotation Cell	01	
5	Magnetic Separator	01	
6	Cyclone Separator	01	
7	Plate and Frame Filter Press	01	
8	Balance	01	
9	Rotap Sieve Shaker	01	
10	BSS & Taylor's Sieve	01(each one set)	
11	Wilflay Table	01	

Table-II (List of equipments of Fuel Technology Laboratory)

Sl. No.	Name of the equipment	Number	Remarks
1	Hot Air Oven	01	
2	Muffle Furnace	01	
3	Weight Balance	01	
4	Red Wood Viscometer	01	
5	Pen sky Martin Apparatus	01	
6	Bomb Calorimeter	01	
7	Hot Water Bath	01	
8	Engler's Viscometer	01	
9	Abel Open Cup Apparatus	01	
10	Conradson Apparatus	01	
11	Smoke Point Apparatus	01	
12	Pour Point Apparatus	01	
13	pH meter	01	
14	Rheometer	01	
15	Karl Fisher Titrator	01	
16	Distillation Apparatus	01	
17	Digital Magnetic Stirrer with Hot Plate	01	
18	Junker's Calorimeter	01	

Table-III (List of equipments of Heat Transfer Laboratory)

Sl. No.	Name of the equipment	Number	Remarks
1	Thermal Conductivity of Composite Wall	01	

2	Thermal Conductivity of Liquid	01	
3	Pin Fin Apparatus	01	
4	Shell and Tube Heat Exchanger	01	
5	Concentric Tube Heat Exchanger	01	
6	Natural and Forced Convection	01	
7	Dropwise and Filmwise Condensation	01	
8	Stefan Boltzmaan Apparatus	01	

Table-IV (List of equipments of Mass Transfer Laboratory)

Sl. No.	Name of the equipment	Number	Remarks
1	Mass transfer with/without chemical reaction	01	
2	Vapour liquid equilibrium setup	01	
3	Wetted wall column	01	
4	Vapour in air diffusion apparatus	01	
5	Sieve plate distillation column	01	
6	Simple Distillation apparatus	01	
7	Steam distillation apparatus	01	

Table-V (List of equipments of Chemical Reaction Engineering Laboratory)

Sl. No.	Name of the equipment	Number	Remarks
1	Batch reactor	01	
2	CSTR in series	01	
3	PFR(Straight tube type)	01	
4	CSTR	01	
5	Isothermal batch reactor	01	
6	Isothermal CSTR	01	
7	Isothermal Plug flow tubular reactor(Coiled tube type)	01	

Table-VI (List of equipments of Process Control and Instrumentation Laboratory)

Sl. No.	Name of the equipment	Number	Remarks
1	Flow control trainer setup	01	
2	Control valve characteristics setup	01	
3	Interacting and non-interacting	01	

Table-VII (List of equipments of Computer Aided design Laboratory)

Sl. No.	Name of the equipment	Number	Remarks
1	Aspen hysis software	01	

Table-VIII (List of equipments of Mass Transfer design Laboratory and Heat transfer design Laboratory)

Sl. No.	Name of the equipment	Number	Remarks
1	Matlab software	01	

Table-IX (List of equipments of Chemical Engg. Thermodynamics Laboratory)

Sl. No.	Name of the equipment	Number	Remarks
1	Humidification and dehumidification set up	01	
2	Computer controlled vapour-liquid equilibrium set up	01	
3	Air conditioning test	01	
4	Water to water heat pump	01	

EQUIPMENT SPECIFICATIONS

MATERIAL HANDLING LAB.		
S.NO	**Name of the Equipment/Setup**	**Technical Specifications**
1	Sieve Set(2 SETS)	As per ASTM E 11-09 standard specification. Standard test sieves of 200 mm (8 in) dia. and 50 mm (2 in) height with brass sieves with the following standard openings. British std. Indian std. Taylor std. 4 4.000 4 8 2.000 8 16 1.000 16 22 0.710 22 30 0.500 30 52 0.300 52 72 0.212 72 85 0.180 85 100 0.150 100 150 0.106 150 200 0.075 200 300 0.053 300 350 0.045 350 400 0.037 400 Receiver pan+ Lid -

2	Sieve shaker	Sieve assembly: Compatible to sieves of 10-20 mm dia (5-6 sieves). Drive: By FHP motor. • Control panel should consist of Standard make on-off switch, mains indicator. • The whole set up should be well designed and arranged on a rigid structure. • Special arrangement for settling time for shaking. • An English instruction manual consisting of experimental procedure, Block diagrams should be provided along with apparatus.
3	Jaw crusher	Jaws - Manganese Steel Jaw Size – 6''× 8" Feed Size – 3-5" Product Size – 10mm -20mm Motor Capacity = 5 HP, 3 phase Capacity 300 kg/h. • An English instruction manual consisting of experimental procedure, Block diagrams should be provided along with apparatus. • The whole set up should be well designed and arranged on a rigid structure
4	Roll crusher	Rolls Material Chilled steel, Dia100-200mm, width 50-100mm approx. Max feed Size 6-10mm Product Size- 1-2mm Feed hopper: Suitable capacity. Drive: 2HP motor coupled with reduction gear box. • Control panel should consist of electronic energy meter, starter and an MCB. • The whole set up should be well designed and arranged on a rigid structure. • An English instruction manual consisting of experimental procedure, block diagrams should be provided along with apparatus.

5	Ball Mill	Material MS, Dia 250-275mm, Length 300-350 mm, thickness 4-5 mm. Discharge suite: Suitable size. Feed size 4-6mm approx. Product size: 200 mesh approx. Drive: 1/2HP motor coupled with reduction gear box. Product receiver: Material SS of suitable size. Revolution counter: Mechanical type. • The whole set up should be well designed and arranged on a rigid structure. • An English instruction manual consisting of experimental procedure, block diagrams should be provided along with apparatus.
6	Plate and Frame filter press	No of frames: 4-6 No of plates: 5-7 Size: 200 mm×200 mm Material: Acrylic Filter medium :Filter cloth Filtrate collecting tray: Material SS suitable size. Slurry feed tank: Material SS capacity 20-40 Ltrs. Slurry tank agitator: SS impeller with SS shaft coupled to motor and reduction gear box. Slurry feed pump: Gear pump with motor. Piping system: GI and PVC. Filtration rate measurement: Using measuring tank, Material SS. Pressure measurement: Bourden type pressure measurement. Overhead water tank: Material SS, Capacity 20-25 Ltrs. • Control panel should consist of Standard make on-off switch, mains indicator. • The whole set up should be well designed and arranged on a rigid structure. • An English instruction manual consisting of experimental procedure,

		block diagrams should be provided along with apparatus.
7	Froth Flotation Cell	Floatation chamber: Material SS, compatable capacity Agitator: Stainless steel impeller with SS shaft coupled to motor. Diffuser: Material SS holding the impeller. Froth collecting tank: Material SS, Capacity 10-20 Ltrs • Control panel should consist of Standard make on-off switch, mains indicator. • The whole set up should be well designed and arranged on a rigid structure. • An English instruction manual consisting of experimental procedure, block diagrams should be provided along with apparatus.
8.	Wilfley table	Size: 1' width x 4' length Capacity: 50 to 250 kg/hr RPM: 250 to 350 Amplitude: 5 mm to 13 mm Motor:0.75 hp/415 v/3 ph/50 cycles/1440 rpm/TEFC (Totally enclosed fan-cooled)
9	Magnetic separator	Belts: Width 100-150 mm, Length 400-500 mm. Feed hopper: Material SS, suitable capacity (continuous vibrating). Drive: Motor with reduction gear box. Magnets: Permanent magnets kept in a SS chamber. Collecting Bins: 2 Nos one for magnetic and other for non-magnetic material. • Control panel should consist of Standard make on-off switch, mains indicator. • The whole set up should be well designed and arranged on a rigid structure. • An English instruction manual consisting of experimental procedure, block diagrams should be provided along with apparatus.

10	Balance	Weight:0.001-5kg
11	Cyclone separator	Material Stainless steel, Dia.: 50-100 mm Solid discharge silo: Material Stainless steel, suitable capacity with discharge control valve. Blower: ID Fan blower with 1 HP provided motor. Air flow measurement: Flow meter with manometer. Solids collector: Transparent PVC controller fixed with cyclone. Fine dust collector: Bag of nylon cloth fixed on exit of air. • Control panel should consist of Standard make on-off switch, mains indicator. • The whole set up should be well designed and arranged on a rigid structure. • An English instruction manual consisting of experimental procedure, Block diagrams should be provided along with apparatus.

HEAT TRANSFER LAB.		
S.NO	**Name of the setup**	**Technical Specifications**
1	Thermal conductivity of composite wall	1) Slab Size: a) M.S – 25 cmϕ × 25mm thick b) Bakelite – 25cmϕ × 10mm thick c) Brass – 25cmϕ × 10mm thick 2) Nichrome heater wound on mica former and insulator with control unit capacity 200 watt maximum. 3)Heater control unit – 230 V, 0—2 A single phase Dimmerstat 1 no 4)Voltmeter – 0 – 250 volts 5) Ammeter – 0 -1 1 amps. 6)Multichannel digital temperature indicator, Wall thickness Conductivity:

		7) M.S = 2.5 cm; 0.46 w/m^{o}K 8) Bakelite = 1.0 cm ; 0.12w/m^{o}K 9)Brass =1.0 cm; 110w/m^{o}K
2	Thermal conductivity of liquid	1) Main Heater – Mica heater ϕ 100 mm sandwiched between plates-300 watts 2)Ring Heater – Mica Ring heater, sandwiched between plates – 300 watts 3) Top Heater – Mica Heater, sandwiched between plates – 200 Watts 4) Cooling Plates with test liquid cavity 5) Glass wool insulation covers for heater and cooling plate assembly. 6) Measurements and controls: • Separate dimmers for heaters, 2 Amp. Capacity: 3 nos. • Voltmeter and Ammeter for heater input measurement. • Voltmeter/Ammeter selector switch. • Multichannel digital temperature indicator 0^{0}c to 200^{0}c with 0.1^{0}c least count.
3	Pin Fin Apparatus	1) Duct size: 150mm x 100mm. Cross section, 1000mm long connected to suction side blower. 2)Diameter of the fin:12 mm. O.D, effective length 102 mm with 5 nos. of thermocouples positions along the length, made of mild steel 3) Fin is screwed in block which is heated by a band heater. 4) No. of thermocouples on fin: 5nos. 5) Temperature indicator: 0 – 300 ^{0}C with compensation of ambient temperature up to 50^{0}C. 6) Dimmerstat for heat input control: 0- 230V, 2 Amps. 7) Voltmeter : 0 – 250 V 8) Ammeter: 0 – 1 Amps.
4	Shell and Tube Heat Exchanger	1) Shell 150 NB, 750 mm long provided with end boxes. 2)One end box with divider box 3) 25% cut baffles – 4 nos. In shell side 4) Tube – 4.5 I.D, 6.35 O.D, 750 mm copper with triangular pitch – 32 nos.

		5) Instantaneous water heater, capacity, to supply hot water. 6) Thermometer for measuring the water temperature. 7) Valves to control hot and cold water flow.
5	Concentric Tube Heat Exchanger	1) Heat exchanger: a) Inner tube - ϕ 12.7 mm O.D., ϕ 11.7 mm I.D. copper tube. b) Outer tube - ϕ 25 mm NB G.I pipe c) Length of heat exchanger is – 1m. 2) Electric heater – 3 KW capacities to supply hot water. 3) Valves for flow and direction control – 5 nos. 4) Thermometers to measure temperatures – 10 to 110 ^{o}C – 4 nos. 5) Measuring flask and stop clock for flow measurement.
6	Natural and Forced convection	Stainless steel tube, Outer Diameter of the tube (d) = 38-40 mm 2. Length of the tube (L) = 500 mm 3. Duct size = 20cm × 20cm × 1m length 4. Number of the thermocouples = 8 5. Thermocouple number. 6. Temperature Indicator 0-300°C. Multi-channel type calibrated from iron constantan thermocouples with compensation of ambient from 0-50°C. 7. Ammeter 8. Voltmeter 9. Dimmerstat
7	Drop wise and Film wise condensation	1. Steam generator of suitable capacity. 2. Copper tubes with - i) Natural finish. ii) Polished surface finish. 3. Temperature Indicator 0-300°C with chromel alumel thermocouples.
8	Stefan Boltzmaan Apparatus	1)Hemisphere dia.: 200-400 mm (approx) 2) Jacket dia-250-500 mm (approx) 3) Test disc size -20 mm dia.: x 1.5 mm thickness.

		4) Water tank of sufficient capacity with a 1.5kw immersion heater. 5) Control panel comprises of :- i) Supply for heater. ii) Digital temperature Indicator 0-300°C with 0.1 C least count. iii) Built in timer for temperature readings at 5 seconds interval.

FUEL TECHNOLOGY LAB.		
S.NO	**Name of the setup**	**Technical Specifications**
1	Hot air oven	Temp. range up to 300°C, Heating rate of 5-50°C /min, Accuracy 1°C, Material: Made up of Stainless steel with 3 shells with provision of air flow rate or cooling
2	Muffle furnace	Max. temp. 1200°C , Heating rate 50-100°C /min, Accuracy 1-5°C, Heating Zone area: 15×30 cms, Controller type :PID Provision for air cooling, Supported with wheel stand
3	Weight balance	Range 0.0001 - 500g , Accuracy:0.001 g
4	Red Wood Viscometer	Liquid Flow: 15-2500 sec. Stain less steel bath with electrical heating arrangement and controlled by digital temperature controller com indicator. The apparatus comprises tap, silver plated steel jet, and cup cover with precision stainless steel jet, cup cover, ball valve, thermometer clip, stirrer and M.S sheet stand with levelling screws. The temperature should uniformly distributed throughout the chamber by stirrer. Suitable to operate on 220 volts, single phase, 50 Hz.
5	Pen sky – Martin apparatus	ASTMD-93 and IS 1448 (Part I)1270 (P.21) and IS 1209-1953 method B. Used for finding out Flash Point above 700 C and below 3000 C. The Instrument having Oil Test Jet/Gas Test Jet Flame Device, stirrer with flexible shaft. The Assembly rests in Air Bath which is covered with Dome shape metal top. The cup is fitted with insulated Handle and locking arrangement near Cup flange. The assemble should be kept on round shape electric heater with Separate temp regulator. Suitable for operation on 220 Volts 50 cycles AC Circuits.
6	Bomb Calorimeter	Complete Digital with 0.01 deg C readout with one no. of S.S.Bomb with crucible, 3000 cc

		jacketed vessel, motorised stirrer, briquette press, firing Unit, Pressure guage with copper pipe fitting, magnifying glass, nichrome wire 40 SWG & digital thermometer with printing facility. Along with O_2 gas cylinder All the necessary equipment required for smooth running
7	Hot water bath	Water bath rectangular thermostatic (double walled) with 12 holes and with digital temp. Indicator
8	Engler's viscometer	As per IP 212 and ASTMD-490.Device should be mounted on a stand, a thermometer clip to the water bath and the oil cup lid should have a thermometer socket Heater specifications: 500 W, the bath should be fitted with 500W heater and can be operated at 220 Volts AC main. It consists of SS water bath with double walled lid and stirrer.
9	Abel open cup apparatus	This apparatus is used for determining the close cup flash point of petroleum and mixtures according to IP 33 and IP 170 and also IS 1448 (Part I) 1985 (P: 20). It should be suitable for oils which flash below 700° C. It should be supplied with oil cup, cover fitted with stirrer, thermometer socket S.S. Water Bath, Stand. An electric heater should be fitted at bottom for operation on 220 Volts AC Circuits. Elect. Driven Stirrer (170 R.P.M.)
10	Carbon Residue Apparatus (conradson apparatus)	It should be made as per IP 13, ASTM D- 189 Specifications. It is useful to determine amount of Carbon Residue when the oil is evaporated under Specified Conditions. The apparatus consists of spun sheet iron crucible 25 cc Capacity, Sheet Iron hood and sheet iron block on a stand, gas Burner.

11	Smoke Point Apparatus	Smoke Point Apparatus as per IP 57 & IS 1448 (P-31) & ASTM D 1322 **172 a** Spare Candle **172 b** Spare Wick. Sturdy construction with superior dimensional stability, equipped with cured glass window to aid smoke detection, Maintenance free, light weight construction, Testing apparatus: Made up of brass, Scale: made up of glass, stand made up of cast iron and a iron shaft rod.
12	Pour point apparatus	This should be made according to specification laid by IP15 & IS 1448 (P :10) 1970. The pour point is lowest temperature at which the oil will just fail to flow. The apparatus Consists main cooling bath made out of S.S. sheet and stand unit with drain plug and cover has provision for fitting thermometer and a filling aperture for adding freezing mixture. A Glass jar for containing oils, Jacket, disc and gasket as specified are also provided.
13	pH meter	water proof (pH Spear) pH meter
14	Rheometer	Please see Annexure 01 for detailed specifications
15	Karl Fisher Titrator	For water analysis
16	Distillation apparatus	As per ASTM standard to distillate the petroleum fractions: Temperature room temp. - 350^0C b) Temperature controlled by energy regulator or Voltage Variac. • A 100ml sample should be distilled under prescribed conditions which are appropriate to its nature. • 16 distillation of petroleum products as per ASTM D 86 should be used by both gas and electrical heating. • Distillation unit for gas or electric heating, draught shield with toughened glass window,

		front opening, levelling support for heat resistant board, and drilled for fitting electrical heater, available separately if required, for left or right hand side operation. • This unit should be consist of one heating shield with gas or electric heating with control, one Stainless Steel cooling with drain valve and condenser with top cover, Stand to hold the cooling bath, one cylinder, one distillation flask, two silicon cork one for side arm and one for top thermometer, two asbestos pad of diameter 37.5mm and 50mm. • The supply should be 230 V ac, 50 hz, 6 A Total load. • Size of the Heating Unit is approximately 470mm X 200mm X 200mm. & weight 8 Kg. • Size of the condenser Unit is 330mm X 450mm X 185mm with weight 5.0 Kg.
17	Digital Magnetic stirrer with hot plate	Digital Magnetic stirrer with hot plate, ceramic top, acid/alkali proof, digital speed control from 100-1200 rpm. 18 cm X 18 cm.
18	Junkers calorie meter apparatus	Measuring range: 100Kcal/m^3-30000 Kcal/m^3 of fuel, Gases at low pressure: 1-15w.g. • Equipment consists of powder coated SS exterior with burner (with choice of 2 nozzles) on a tripod stand, a gas flow meter and pressure governor. • Used to determine the calorific value of gas. • The Calorimeter mainly consists of a gas combustion chamber, heat exchanger and water flow system. • Heat exchanger is fabricated out of heavily tinned copper sheet. A constant water head maintenance device provided in the feed water pipe along with the inlet water flow regulator is

		fixed to the outer housing of the Calorimeter. The outer housing is of powder coated SS .
MT and HT design Lab.		
1	Matlab	Single user
Computer Aided design lab		
1	Aspen Hysis	Single user

MASS TRANSFER LAB.		
S.NO	**Name of the setup**	**Technical specifications**
1.	Mass transfer with/without chemical reaction	Reactor: Material Stainless Steel, Capacity 1-2 Ltrs.(approx) Water Bath: Material Stainless Steel, Double Wall, Insulated with ceramic fibre wool. Heater: Nichrome Wire Heater Stirrer: Stainless Steel Impeller and shaft couples with DC motor drive for variable speed. Temperature Sensors: RTD PT-100 type. Control panel comprises of RPM Indicator: Digital, Non-contact type Digital Temp. Controller: 0-199.9° C for hot water tank. With standard make on/off switch, main indicator & fuse etc. Peltilizer setup required • The whole unit should be assembled rigidly on a base plate. • Whole setup should be well designed and arrangement in a good quality painted structure.
2.	Vapour liquid equilibrium set-up	Distillation Still:1-2Ltrs capacity, made of stainless steel, insulated by ceramic wool. Condenser: Concentric Tube Type. Heater: Nichrome wire Cooling Water Tank: Material Stainless Steel, Capacity 15-20Ltrs. Approx. Cold Water Circulation Using FHP Pump Temperature Sensors :RTD PT-100 type Control panel comprising of Digital Voltmeter:0-300 Volt. Dimmerstat: 0-230 V, 2A. Digital temperature indicator: 0-199.9° C, RTD PT-100 type with multi channel switch. Refractometer: Standard make (digital) • With Standard make on/off switch, Mains Indicator etc. • The whole set-up should be mounted on a powder coated base plate.
3.	Wetted wall column	Column: Borosilicate Glass, Dia 45-50 mm, Length 1000-2000 mm (Aprox.) Water Circulation :FHP pump Water Tank: Material Stainless Steel, Capacity 15-20 Ltrs. Heating Chamber : Compatible capacity

		Heater: Nichrome wire heater Rota meter: For Water Flow rate measurement. Dry & Wet Bulb Temp.: With digital temperature indicator. Temperature Sensors: RTD PT-100 type. Control panel comprises of digital temperature indicator: 0-199.9° C, RTD PT-100 type with multi channel switch Compressor :1 HP Compressor, 4 CFM with standard make, motor & automatic switch • With standard make on/off switch, mains indicator etc. • Whole setup should be well designed and arranged in a good quality painted structure.
4.	Vapour in air diffusion apparatus	Tube: Material Borosilicate Glass. Water Bath: Material Stainless Steel with two sides made of glass Capacity 8-10Ltrs, Fitted with heater and stirrer. Heater: Nichrome Wire Heater. Stirrer : Stainless Steel, Impeller and shaft coupled with FHP motor. Air Circulation: Air Pump. Travelling Microscope:0-150 x 0.1 mm resolution. Temp. Sensor :RTD PT-100 type • Control panel should comprise of Digital Temp. Controller cum-Indicator (For water Bath 0-199.9°C and Standard make On/off switch, Mains Indicator etc. • The whole set-up should be mounted on a powder coated base plate.
5.	Sieve plate distillation column	Distillation Column: Material Stainless Steel, Dia100- 110 mm, seven sieve trays. Pressure Gauge: Bourdon type, 0-2 kg/cm^2. Rotameter: For cooling water flow rate measurement. Steam Generator: Made of Stainless Steel, provided with pressure gauge & level Indicator, Safety valve & insulated with ceramic wool and cladding with Aluminium foil. Reflux Divider: Special arrangement to change R/D ratio automatically. Condenser: Shell& Tube type made of Stainless Steel. Bottom Product Tank: Made of Stainless Steel, capacity 5 Ltrs. Distillate Tank: Made of Stainless Steel, capacity 5-6Ltrs. Heaters: Nichrome wire heater.

		Temp. Sensors :RTD PT-100 type Control panel comprises of Digital Temp. Controller: 0-199.9 °C, For Steam Reboiler Digital Temp. Indicator :0-199.9°C, with multi-channel switch Refractometer: Standard make • With Standard make on/off switch, Mains Indicator etc. • The whole set-up should be well designed and arranged in a good quality painted structure.
6.	Simple Distillation Setup	Distillation flask Flask capacity: 1-2litres, Material: Borosilicate glasss Condenser: Concentric tube type Distillate receiving flask :1-2litre, Material borosilicate glass Heater: Nichrome wire Refractometer: Standard make (digital)
7.	Steam distillation Setup	Steam generating flask Distillation flask Flask Capacity: 0.5-1 Lts, Material borosilicate glass Condenser: Concentric tube type Receiving Flask: 0.5-1 Lts Material borosilicate glass Separating funnel: 0.5-1 Lts, Material borosilicate glass Heater: Nichrome wire
Chemical Reaction Engineering Lab.		
1.	Batch reactor	Reactor: Material stainless steel, capacity 1-2 Ltr. (approx). Agitator: Variable speed with speed control facility. Impeller: Material stainless steel Baffles : 4 Nos. detachable Heating coil :Material stainless steel for heating purpose Piping: PVC • The whole unit should be assembled rigidly on a base plate.
2.	CSTR in series	Reactor (3nos.): Material stainless steel, Capacity 1-2 Ltr. (approx). Stirrer (3 nos.) :Stainless steel impeller and shaft coupled with FHP motor

		Feed tank(2 nos.) :Material stainless steel, capacity 10-20 Ltr Feed circulation: By compressed air. Flow measurement: Rotameter (2nos) Piping: Material stainless steel and PVC. Pressure regulator :0-2 kg/cm^2 Pressure gauge: Bourdon type 0-2 kg/cm^2 Stop watch: Electronic. Control panel comprises of: Standard main on/off switch, mains indicator • The whole unit should be assembled rigidly on a base plate and mounted on a stand. • Most of the parts should be powder coated and rest painted with auto paints
3.	PFR(Straight tube type)	Reactor : Material Borosilicate glass OD 25-32 mm, ID 25-30 mm length 1200-1500mm Feed tank(2 nos) :Material stainless steel, capacity10-20 Ltr. Feed circulation: By compressed air. Flow measurement: Rotameter (2nos) Piping: Material stainless steel and PVC. Pressure regulator :0-2 kg/cm^2 Pressure gauge: Bourdon type 0-2 kg/cm^2 Stop watch: Electronic. • The whole unit should be assembled rigidly on a base plate and mounted on a stand. • Most of the parts should be powder coated and rest painted with auto paints
4.	CSTR	Reactor : Material Stainless steel Capacity 1-2 Lts approx Feed tank (2 nos):Material stainless steel, capacity 10-20 Lts. Stirrer :Stainless steel impeller and shaft coupled with FHP motor Feed circulation: By compressed air. Flow measurement: Rotameter (2nos) Piping: Material stainless steel and PVC. Pressure regulator :0-2 kg/cm^2 Pressure gauge: Bourdon type 0-2 kg/cm^2 Stop watch: Electronic. Control panel comprises of:

		Standard main on/off switch, mains indicator • The whole unit is assembled rigidly on a base plate and mounted on a stand. • Most of the parts are powder coated and rest is painted with auto paints
5.	Isothermal batch reactor	Reactor : Material stainless steel, volume: 1Ltr (approx) Water bath: Material stainless steel, double wall, insulated with ceramic wool. Heater: Nichrome wire heater. Stirrer (2 nos): Stainless steel impeller and shaft coupled with FHP motor. Stop watch :Electronic Temperature Sensor :RTD PT-100 type Control panel comprises of Digital temperature controller cum indicator : 0-199° C, RTD PT-100 type • With standard make on/off switch, mains indicator etc. • The whole unit should be assembled rigidly on a base plate and mounted on a stand. • Most of the parts should be powder coated and rest painted with auto paints
6.	Isothermal cstr	Reactor : Material stainless steel, Capacity 2 Lts.(approx.) Water Bath: Material stainless steel, Double wall, insulated with ceramic wool. Heater: Nichrome wire heater. Stirrer (2 nos): Stainless steel impeller and shaft coupled with FHP motor. (One each for water bath and reactor) Feed tank (2 nos) :Material stainless steel, capacity: 10-20 Lts Feed circulation: By compressed air. Flow measurement: Rotameter 2 nos, one each for reactants. Piping: Stainless steel and PVC Pressure regulator : 0-2 kg/cm^2 Pressure gauge: Bourdon type 0-2 kg/cm^2 Stop watch : Electronic Temperature Sensor :RTD PT-100 type Control panel Comprises of Digital temperature Controller :0-199° C (for hot water bath) • With standard make on/off switch, mains indicator etc. • The whole unit should be assembled rigidly on a base plate and

		mounted on a stand. • Most of the parts are powder coated and rest painted with auto paints.
6.	Isothermal plug flow tubular reactor (coiled tube type)	Reactor : Material stainless steel, Capacity:0.5- 0.7 Lts (approx) (Helical coiled tube type) Water bath: Material stainless steel, double wall, insulated with ceramic wool. Heater: Nichrome wire heater Stirrer(water bath) : Material SS impeller and shaft coupled with FHP motor Feed tank (2 nos) : Capacity: 10-20 Lts Feed circulation: By compressed air. Flow measurement: Rotameter 2 nos. one each for reactants. Piping: Stainless steel and PVC. Pressure regulator :0-2 kg/cm^2 Pressure gauge :Bourdon type 0-2 kg/cm^2 Stop watch: Electronic. Temperature sensor : RTD PT-100 type Control panel: Comprises of standard make on/off switch, mains indicator etc. Digital temperature controller : 0-200°C, RTD PT-100 type (for water bath) • Most of the parts should be powder coated and rest painted with auto paints. • The whole unit should be assembled rigidly on a base plate and mounted on a stand.
Process Control and Instrumentation Lab.		
1.	Flow control trainer	DP Transmitter: Output 4-20 mA Orifice meter: Material stainless steel Water Circulation: FHP Pump Water tank: Material stainless steel, Capacity 10Ltr. Flow measurement :Rotameter Control Valve: Compatible capacity with Pneumatic Actuator. I/P converter :Input 4-20 mA, Output 3-15 Psig Pressure regulator :0-2 kg/cm^2 Pressure gauge: Bourdon type, 0-2 kg/cm^2 Piping :Size 1/4"

		Interfacing unit: For input-output communication with auto/manual facility. Micro-processor controller: PID setting, auto tuning, fully programmable with serial communication. Software: For experimentation, PID control, Data logging, trend plot, offline analysis and printing. Compressor :1 HP air compressor, with standard make motor and automatic switch • The whole unit should be assembled rigidly on a base plate
2.	Control valve characteristics	Control Valve Type: Pneumatic Size:1/2". Actuator: 15 sq inch. Stroke:14 mm Input: 3-20 Psig Water tank Material : Stainless steel, Capacity: 20-25 Lts Water circulation : FHP Pump Overhead tank Material: stainless steel, Capacity: 10-15 Lts Flow measurement: Rotameter Pressure Drop management: Using manometer Pressure regulator : 0-2.5 kg/cm2 Pressure gauge : Bourdon type 0-2.5 kg/cm^2 Piping Size :1/2" Compressor :1 HP air compressor, with standard make motor and automatic switch, pressure 2 bar, clean, oil and moisture free air, consumption capacity 50 LPH. • The whole set up should be stand-alone type in a good quality painted structure.

3.	Interacting & non-interacting system	Process tank : Material Stainless Steel, Circular, with level scale (3 nos) Supply tank :Material stainless steel, capacity 10-20 Lts Overhead tank: Material stainless steel, capacity4- 5 Lts. Water circulation: FHP pump. piping : SS/PVC, size 1/4” Flow measurement: Rotameter (10 -200 LPH) • The whole unit should be assembled rigidly on a base plate. • Most of the parts should be powder coated and rest painted with auto paints.
Chemical engineering thermodynamics Lab.		
1	Humidification and dehumidification set up	Column: Material Borosilicate Glass Dia 40-60 mm, Length 450-550 mm (2 Nos.) Packing: Rasching Rings & Silica Gel Air Flow Measurement:By Rotameter Water Flow Measurement :By Rotameter. Water Tank: Material Stainless Steel, compatible capacity Water circulation:By Pump Heate:Nichrome wire heater Condenser:Material SS, compatible capacity An ENGLISH instruction manual consisting of experimental procedures, block diagram etc. is required along with the Apparatus.
2	Computer controlled vapour-liquid equilibrium set up	Distillation Still:1 Ltrs. Capacity, Material-Stainless Steel. Insulated by ceramic wool. Condenser: Concentric Tube type. Cooling Water Tank:Material Stainless Steel, Capacity 15 Ltrs. Approx. Temp. Measurement:By Temperature transmitter, 4-20 mA- 2Nos. Temperature control:Arrangement for control temperature of reboiler Control panel comprising of : Digital Voltmeter:0-300 Volt. Dimmerstat:0-230 V, 2A. An ENGLISH instruction manual consisting of experimental procedures, block diagram etc. is required along with the Apparatus.

3	Air conditioning test	Compressor:Hermitically sealed compressor, capacity 1 Ton Kirloskar make. Condenser:Finned Tube type Air cooled compatible to 1 Ton Compressor. Condenser Cooling Fan:Compatible capacity with permanent lubricated motor. Pressure Transmitter:2 Nos. Temperature Transmitter:6 Nos. Evaporator: Compatible to 1 Ton, made of copper tube and aluminum fins fitted with compatible capacity fan. Expansion Device:Capillary Tube compatible capacity. Temperature Sensor:RTD PT-100 Type. An ENGLISH instruction manual consisting of experimental procedures, block diagram etc. is required along with the Apparatus.
4	Water to water heat pump	Compressor:Hermitically sealed compressor.Capacity 1/3 Ton, Kirloskar make. Condenser: Water cooled type shell and coil condenser with refrigerant inside the tube. Evaporator: Water cooled type shell and coil condenser with refrigerant inside the tube. Pressure Measurement:By Pressure Transmitter (02 Nos.) Water Flow measurement:By Flows sensor (02 Nos.) Temperature Measurement: By RTD Pt100 sensor with Temperature Transmitter (07 Nos.) sensor for both condenser and evaporator . An ENGLISH instruction manual consisting of experimental procedures, block diagram etc. is required along with the Apparatus.

Annexure -01

Specifications for Advanced Modular Rheometer

The Rheometer should conform to the following specifications:

1. The Rheometer should have an Asynchronous/synchronous Dynamic Motor having low inertia allowing fast transient response and excellent high frequency response.
2. The Asynchronous Drag Cup motor/ synchronous motor should be supported by extremely sensitive 4^{th} generation micro porous carbon air bearings to ensure good low viscosity measurements for most weakly structured viscoelastic samples. Air Bearing should be Diffused type Air bearings for eliminating the Wind Mill effect with better thermal stability.
3. The Rheometer should be equipped with integrated chip for calibration parameters and High resolution optical encoder with high resolution Digital Signal Processor technology for precise measurement of the angular deflection.
4. The Rheometer should be equipped with a High Resolution Normal Force for measurements between -50 N and +50 N allowing axial force measurements during rotation as well as measurements of axial movement in tension and compression
5. The Rheometer should be enabling for all types of measurements in CS, CR and CD Mode in Rotation and Oscillation.
6. The housing and frame of the Rheometer should be rigid and stable with maximum stiffness with optimized force flow i.e. the active forces from the sample and the re-active forces in the stand should be in one plane to make the measurements with minimum mechanical interferences. The Rheometer should be with high modularity with open and enough space for easy sample loading, trimming.
7. The specified values of control parameters for the rheometer should be as follows:
    a. Bearing: Air bearing
    b. Torque Range : 0.01 µNm to 200 mNm
    c. Torque resolution: 0.1 nNm
    d. Internal angular resolution: 12 nrad
    e. Min. speed: 10^{-6} rpm (CS mode); 10^{-7} rpm (CR mode)
    f. Max. speed: 3000 rpm
    g. Frequency Range : 1×10^{-5} or lower to 100 Hz
    h. Normal Force Range : 0.01 N to 50 N
    i. Normal Force Resolution : 0.001 to 0.003 N
    j. Lift Speed : 0.05 µm/s to 15 mm/s
    k. Gap Resolution : 0.5 µm
8. High Temp. Control Device with a combination of convection and radiant heating to ensure an even temperature distribution within the chamber. The chamber should have two halves to allow convenient handling and optimal access to the sample without any

special tools. Each chamber half should be equipped with a window to visualise the sample during measurement. The Temp. range must be Ambient to 650°C or higher. Suitable temperature sensor should be provided for handling molten Alluminum alloy.

9. The following measurement cone and plate/ concentric cylinder are desired:
    a. Suitable diameter with 1° Cone alongwith Ceramic Shaft
    b. Suitable diameter Parallel Plate with Ceramic Shaft
    c. Suitable diameter concentric cylinder with Ceramic Shaft
    d. Material used should be one of them, mentioned below
       Titanium steel/stainless steel/graphite (cost & life of each may be mentioned separately in the price bid)
10. The rheometer should enable performing the following tests :
    a. Controlled Stress – Rotation (CS)
    b. Controlled Rate – Rotation (CR)
    c. CS creep / recovery
    d. CD jump / relaxation (CD = Controlled Deformation)
    e. CS oscillation
    f. CD oscillation
    g. Multiwave oscillation
    h. Oscillation with superimposed rotation
    i. Oscillatory tests (frequency and amplitude sweep)
    j. Automatic Maintenance of the gap between the geometries
    k. Normal force measurement & control
    l. Multi wave test
    m. Oscillation data Lissajous plots for data evaluation, display of inertia and Compliance influence

11. The Rheometer should be interfaced with PC through RS 232 Serial Port, preferably through TCP/IP Ethernet for fast data acquisition.
12. The rheometer should be driven by user-friendly software that allows Measurements, Data acquisition, evaluation and report print out with true Multi Tasking also for creating Methods (Jobs) by using predefined measuring and evaluation elements. The software should be enable of easy export of data in graphical (pdf etc.) and numerical like ASCII, Excel etc. The software should be capable of export and import of data in IUPAC XML format.
13. Software and programming of the tests as follows :
    a) Viscosity as a function of Time, Temp. and Shear Rate
    b) Yield Stress Measurement
    c) Constant Shear Rate Measurement

d) Shear Rate Sweep

e) Oscillation with Stress Control (Frequency Sweep with Controlled Shear Stress)

The software should be able to show, calculate and plot the standard Rheological parameters as follows :

- Shear Rate
- Stress
- Strain
- Thixotropy
- Angular Velocity
- Yield Stress
- Gelation Point
- Loss Modulus
- Steady Shear Viscosity
- Temp.
- Time
- Torque
- Angular Frequency
- Storage Modulus
- Complex Shear Modulus

14. Suitable Air Compressor, Air Dryer, Computer etc. should be offered as essential utilities
15. Detailed Training for operation of the Rheometer should be provided.

Computer specification

Branded Computer

Intel core i7 processor-3.2 GHz

Ram: 4 G.B

Hard disk: 500 G.B

Monitor: 22 inch TFT

Keyboard, Mouse

O.S – Windows XP/Windows 7 professional with media & License

The vendors shall enclose the following documents with technical bid.

1. Physical evidence i.e. micrograph/graphical results in support of rheological analysis of Aluminium alloy.
2. P.O. copies of the similar equipment supplied to other academic institutions / R&D organizations.
3. Assurance that spares will be available for next 7 years after installation of the machine.
4. Balance sheet/ Financial statement of the manufacturer
5. Details of support service available.
6. Cost of annual maintenance after warranty period should be quoted in the financial bid.