Annexure-A

Specification for Automated Bioreactor Cascade Upstreaming equipment:

	Equipment	Gross Volume	Quantity
1.	5L Total Volume In-place sterilize able Fermenter Includes 3L working volume Fermenter with Temperature, ,Agitation, Aeration, Sterilization and pH control • Automatic Temperature Control • Automatic Vessel Sterilization • Automatic Agitation Control • Automatic pH Control • Automatic DO Control • Automatic Aeration Control through MASS FLOW CONTROLLER with gasMixing control of Air/O2 • Automatic Foam Control • Automatic Nutrient Feeding • Automatic Back Pressure Monitoring	5L	1
2.	20L Total Volume In-place sterilize able Fermenter Includes 15L working volume Fermenter with Temperature, ,Agitation, Aeration, Sterilization and pH control • Automatic Temperature Control • Automatic Vessel Sterilization • Automatic Agitation Control • Automatic pH Control • Automatic DO Control • Automatic Aeration Control through MASS FLOW CONTROLLER with gasMixing control of Air/O2 • Automatic Foam Control • Automatic Nutrient Feeding • Automatic Back Pressure Control	20L	1

3.	100L Total Volume In-place sterilize able Fermenter (75 L working volume) Includes 75L working volume Fermenter with Temperature, ,Agitation, Aeration, Sterilization and pH control • Automatic Temperature Control • Automatic Vessel Sterilization • Automatic Agitation Control • Automatic pH Control • Automatic DO Control • Automatic Aeration Control through MASS FLOW CONTROLLER with gasMixing control of Air/O2 • Automatic Foam Control • Automatic Nutrient Feeding • Automatic Back Pressure Control	100L	1
4.	**Combined Control Panel for 3 Fermenters** includes • SS Panel fitted on Skid • Color Touch screen interface • High speed PLC • Digital & Analog cards • Transistor Output with relays With suitable software & hardware to control the all the parameter with computer and power backup system.		1
5.	SCADA Software Premium Latest Edition with Plant Automation, Monitoring and Control		1
	UTILITIES & ACCESSORIES		
6	Steam Generator for all the 3 fermenters	30 Kg/Hr	1
7	Chiller for all the 3 fermenters	12000 BTU/Hr	1
8	Air Compressor for all the 3 fermenters	9.44 CFM	1
9.	Centrifuge (fermentation downstream Utility 1) for cell & broth separation.	25-50 L/hr	1
10	Membrane filtration system for harvesting of cells from for all the 3 fermenters with appropriate membrane pore size.	25 L/hr processing speed	1
11.	Media mixing tank (100L), 316 L grade SS, with agitator up to 200 rpm and heating 30^{o}C to 100^{o} C with feeding pipe & pump connected to fermenter for smooth transfer of media form tank to fermentation vessel.	100L SS tank	1
12.	Utility pipelining and pumps for smooth operation of the whole system.		1 Set

Fermenter Design Overview **5L Total Volume Fermenter** **Gross Vol | Working Vo 5L | 3L** **Type**	
H/D working Vol.	**2:1**
Design Guidance	
Working pressure	2.5 Kg/cm2/Full vacuum
Design Pressure	3.0 Kg/cm2/Full Vacuum
Hydraulic Test Pressure	4.5 Kg/cm2
Working Temperature	10 to 140 deg. C
Design Temperature	0 to 150 deg. C
Jacket working Pressure	3.5 kg/cm2/Full Vacuum
Jacket Design Pressure	4.5 kg/cm2/Full Vacuum
Jacket Hydraulic Test	7 kg/cm2
Jacket Design Temp.	0 to 150 deg. C
Material of Construction	
All Wetted Parts	SS-316L
Jacket (Limpet)/Non Wet Parts	SS -304
Cladding/Leg Support	SS-304
Gaskets/ O-rings	Silicon/EPDM/PTFE (FDA Compliant)
Finishing	
Inner Surface	220 grit Finished & mirror polished Ra≤0.5μm
External Finish	180 grit Mat finish
Agitation	
Drive	Top Driven Single Mechanical Dry seal
Impellers	6 Blade Ruston Turbine (RT-6) 3 Nos.,
Shaft Support	1 no. Shaft bush at Bottom
Baffles	3 or 4 Nos., 1/10th of Vessel ID Fixed Type
Type	Blade type
RPM	100-1000 RPM
Motor type	Standard motor
Ports	
In Top Plate for	
	Multi Injection Port for Nutrient, Antifoam, Acid and Alkali
	Septum type Inoculum Port
	Spare Septum ports- 2nos
	Instruments (Pressure gauge, pressure transmitter)
	Safety Valve, Air exhaust
In Side Wall for	pH Sensor
	DO Sensor
	Sampling valve
	Temperature sensor (RTD)
	Sight Glass
	Light Glass
	Jacket Inlet and Outlet
In Bottom	1/4" Bottom Flush Valve
Aeration	
Designed for	1.5 VVM
Sparger	Ring type spargers with bottom perforations
Air filters	Inlet 1 micron pre-filter and 0.2 micron filter/ Exhaust-0.2 micron filter
Filters Integrity Testing	Provision for In situ integrity testing provided
Air Volume Measurement & Control	Automatically through MASS FLOW CONTROLLER & Automatic control Valve with bypass for manual control through Rotameter

Gas Supply (O2/CO2)	Separate entry through Pressure Regulator and NRV is provided with Rotameter for Gases
Air Exhaust	Reflux condenser that can efficiently handle a volume of out flowing air with provision for heating system in the future for exhaust air
Back pressure control	Monitoring Only, Manual control with Diaphragm valve
Sampling System	
Type	Zero Dead Leg Sampling valve with complete assembly consists of steam in, Steam lock and Sampling valve. Whole assembly Insitu Sterilizable
Harvesting System	
Type	Zero Dead Leg Harvesting valve with steam in valve, Transfer Valve and Drain valve. Whole assembly is Insitu Sterilizable
SIP System	
Type	Auto SIP system
Requirements	121 Deg C in all the wet process area
Thermal Circuit	
Temperature control	With heat exchanger and circulation pump, temperature gauge, and all required valves to be connected to water supply.
Vessel Support with Skirt Support	
Skid Mounted	Complete independent System will be provided in modular SS skids
Utility Pipelines	All utility pipelines and process Pipelines will be connected and integrated into separate skids.
Aesthetics	Complete system with skid will be designed in such a way to have exquisite feel

Instrumentation

Temperature Control	
Type	PID Fully Automatic
Range	0-60 deg C
Measurement precision	$\pm$ 0.1 °C
Control precision	$\pm$ 0.1 °C (up to 40° C)
Temp. sensor	PT.-100 RTD, range from 0°C to 200°C, MOC SS-316L with <0.8 Ra finish
	1 no. on the inlet and 1 no. on the outlet of Jacket
	1 no. 25mm Ingold port, located on the side ports of fermentor
Heating Assembly	With Heater for temperature control during process with bypass for manual control
Sterilization Control	
Type	PID
Range	0-150 deg. C
Timer	0-60 Min
Type	Automatic
RPM Control	
RPM range	100-1000 rpm
AC drive	Electronic Variable Frequency Drive Control, Fully Automatic
Automatic pH Control	
pH Sensor	Gel filled autoclavable probe (High quality International brands)
Housing	SS-316 housing
Type	ON/OFF timer based and PID based

Range	0-14 pH
Timer	Acid or Base Timer
Peristaltic Pump	2 no.
DO Control	
Sensor	Polarographic, Autoclavable
Type	PID
Housing	SS-316L housing
Range	0-100%
Foam Control	
Sensor	Conductivity Sensor
Type	Automatic
Control	With Peristaltic Pump
Nutrient Feeding	
Type	Timer Based/PLC control
Peristaltic Pump	1 no.
Automatic Aeration & Gas Mixing Control	
Fluid	Air
Type	Automatic
Flow meter	Digital Flow Controller
Range	0-5 LPM
Output	4-20mA
Back Pressure Monitoring	
Sensor	Piezo-resistive Sensor
Range	0-4 kg/cm2
Connection	Sanitary connection TC type
Control	Manual Control with Diaphragm Valve
Safety	
Safety Valve	Sanitary Safety valve
Range	2 barg
Seat	EPDM
MOC	SS -316
Jacket Safety	
Safety Valve	Safety valve
Range	4 barg
Seat	EPDM (Soft seat)
Wet part MOC	SS -304/SS-316
20L Total Volume Fermenter	
Gross Vol | Working Vol	**20L |15L**
Type	Sterilization in Place & Clean in Place (SIP & CIP)
H/D working Vol.	**2:1**
Design Guidance	
Working pressure	2.5 Kg/cm2/Full vacuum
Design Pressure	3.0 Kg/cm2/Full Vacuum
Hydraulic Test Pressure	4.5 Kg/cm2
Working Temperature	10 to 140 deg. C
Design Temperature	0 to 150 deg. C
Jacket working Pressure	3.5 kg/cm2/Full Vacuum
Jacket Design Pressure	4.5 kg/cm2/Full Vacuum
Jacket Hydraulic Test	7 kg/cm2
Jacket Design Temp.	0 to 150 deg. C
Material of Construction	

All Wetted Parts	SS-316L
Jacket (Limpet)/Non Wet Parts	SS -304
Cladding/Leg Support	SS-304
Gaskets/ O-rings	Silicon/EPDM/PTFE (FDA Compliant)
Finishing	
Inner Surface	220 grit Finished & mirror polished Ra≤0.5μm
External Finish	180 grit Mat finish
Agitation	
Drive	Top Driven Single Mechanical Dry seal
Impellers	6 Blade Ruston Turbine (RT-6) 3 Nos.,
Shaft Support	1 no. Shaft bush at Bottom
Baffles	3 or 4 Nos. , 1/10th of Vessel ID Fixed Type
Type	Blade type
RPM	100-1000 RPM
Motor type	Standard motor
Ports	
In Top Plate for	
	Multi Injection Port for Nutrient, Antifoam, Acid and Alkali
	Septum type Inoculum Port
	Spare Septum ports- 2nos
	Instruments (Pressure gauge, pressure transmitter)
	Safety Valve, Air exhaust
In Side Wall for	pH Sensor
	DO Sensor
	Sampling valve
	Temperature sensor (RTD)
	Sight Glass
	Light Glass
	Jacket Inlet and Outlet
In Bottom	1/2" Bottom Flush Valve
Aeration	
Designed for	1.5 VVM
Sparger	Ring type spargers with bottom perforations
Air filters	Inlet 1 micron pre-filter and 0.2 micron filter/ Exhaust-0.2 micron filter
Filters Integrity Testing	Provision for In situ integrity testing provided
Air Volume Measurement & Control	Automatically through MASS FLOW CONTROLLER & Automatic control Valve with bypass for manual control through Rotameter
Gas Supply (O2/CO2)	Separate entry through Pressure Regulator and NRV is provided with Rotameter for Gases
Air Exhaust	Reflux condenser that can efficiently handle a volume of out flowing air with provision for heating system in the future for exhaust air
Back pressure control	Monitoring Only, Manual control with Diaphragm valve
Sampling System	
Type	Zero Dead Leg Sampling valve with complete assembly consists of steam in, Steam lock and Sampling valve. Whole assembly Insitu Sterilizable
Harvesting System	
Type	Zero Dead Leg Harvesting valve with steam in valve, Transfer Valve and Drain valve. Whole assembly is Insitu Sterilizable
SIP System	
Type	Auto SIP system

Requirements	121 Deg C in all the wet process area
Thermal Circuit	
Temperature control	With heat exchanger and circulation pump, temperature gauge, and all required valves to be connected to water supply.
Vessel Support with Skirt Support	
Skid Mounted	Complete independent System will be provided in modular SS skids
Utility Pipelines	All utility pipelines and process Pipelines will be connected and integrated into separate skids.
Aesthetics	Complete system with skid will be designed in such a way to have exquisite Feel

INSTRUMENTATION

Temperature Control	
Type	PID Fully Automatic
Range	0-60 deg C
Measurement precision	± 0.1 °C
Control precision	± 0.1 °C (up to 40° C)
Temp. sensor	PT.-100 RTD, range from 0°C to 200°C, MOC SS-316L with <0.8 Ra finish
	1 no. on the inlet and 1 no. on the outlet of Jacket
	1 no. 25mm Ingold port, located on the side ports of fermentor
Heating Assembly	With Heater for temperature control during process with bypass for manual Control
Sterilization Control	
Type	PID
Range	0-150 deg. C
Timer	0-60 Min
Type	Automatic
RPM Control	
RPM range	100-1000 rpm
AC drive	Electronic Variable Frequency Drive Control, Fully Automatic
Automatic pH Control	
pH Sensor	Gel filled autoclavable probe
Housing	SS-316 housing
Type	ON/OFF timer based and PID based
Range	0-14 pH
Timer	Acid or Base Timer
Peristaltic Pump	2 no.
DO Control	
Sensor	Polarographic, Autoclavable
Type	PID
Housing	SS-316L housing
Range	0-100%
Foam Control	
Sensor	Conductivity Sensor
Type	Automatic
Control	With Peristaltic Pump
Nutrient Feeding	
Type	Timer Based/PLC control
Peristaltic Pump	1 no.
Automatic Aeration Control	
Fluid	Air

Type	Automatic
Flow meter	Digital Flow Controller
Range	0-30 LPM
Output	4-20mA
Back Pressure Monitoring	
Sensor	Piezo-resistive Sensor
Range	0-4 kg/cm2
Connection	Sanitary connection TC type
Control Valve	Sanitary SS Pressure Control Valve
Bypass	Provided for Manual Control with Globe/Diaphragm Valve
Safety	
Safety Valve	Sanitary Safety valve
Range	2 barg
Seat	EPDM
MOC	SS -316
Jacket Safety	
Safety Valve	Safety valve
Range	4 barg
Seat	EPDM (Soft seat)
Wet part MOC	SS -304/SS-316
Type 100 L Total Volume Fermenter **Gross Vol | Working Vo 100L | 75 L** **Type**	Sterilization in Place & Clean in Place (SIP & CIP)
H/D working Vol.	**2.5:1**
Design Guidance	
Working pressure	2.5 Kg/cm2/Full vacuum
Design Pressure	3.0 Kg/cm2/Full Vacuum
Hydraulic Test Pressure	4.5 Kg/cm2
Working Temperature	10 to 140 deg. C
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Jacket Hydraulic Test	7 kg/cm2
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Material of Construction	
All Wetted Parts	SS-316L
Jacket (Limpet)/Non Wet Parts	SS -304
Cladding/Leg Support	SS-304
Gaskets/ O-rings	Silicon/EPDM/PTFE (FDA Compliant)
Finishing	
Inner Surface	220 grit Finished & mirror polished Ra$\leq$0.5μm
External Finish	180 grit Mat finish
Agitation	
Drive	Top Driven Single Mechanical Dry seal
Impellers	6 Blade Ruston Turbine (RT-6) 3 Nos.,
Shaft Support	1 no. Shaft bush at Bottom
Baffles	4 Nos. , 1/10th of Vessel ID Fixed Type
Type	Blade type
RPM	50-500 RPM
Motor type	Standard motor
Ports	
In Top Plate for	

	Multi Injection Port for Nutrient, Antifoam, Acid and Alkali
	Septum type Inoculum Port
	Spare Septum ports- 2nos
	Instruments (Pressure gauge, pressure transmitter)
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In Side Wall for	pH Sensor
	DO Sensor
	Sampling valve
	Temperature sensor (RTD)
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	Jacket Inlet and Outlet
In Bottom	3/4" Bottom Flush Valve
Aeration	
Designed for	1.5 VVM
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Type	Auto SIP system
Requirements	121 Deg C in all the wet process area
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Temperature control	With heat exchanger and circulation pump, temperature gauge, and all required valves to be connected to water supply.
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INSTRUMENTATION

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Sterilization Control	
Type	PID
Range	0-150 deg. C
Timer	0-60 Min
Type	Automatic
RPM Control	
RPM range	50-500 rpm
AC drive	Electronic Variable Frequency Drive Control, Fully Automatic
Automatic pH Control	
pH Sensor	Gel filled autoclavable probe (High quality branded Probe)
Housing	SS-316 housing
Type	ON/OFF timer based and PID based
Range	0-14 pH
Timer	Acid or Base Timer
Peristaltic Pump	2 no.
DO Control	
Sensor	Polarographic, Autoclavable
Type	PID
Housing	SS-316L housing
Range	0-100%
Foam Control	
Sensor	Conductivity Sensor
Type	Automatic
Control	With Peristaltic Pump
Exhaust Gas Control (OPTIONAL)	
Sensor	IR, Zr-O2 Sensor
Type	Automatic
CO2	0-10% Vol.
O2	0.1 to 25% Vol.
Redox Control (OPTIONAL)	
Sensor	Gel Filled Autoclavable
Housing	SS-316
Type	On/Off Timer Based
Nutrient Feeding	
Type	Timer Based/PLC control
Peristaltic Pump	1 no.
Automatic Aeration Control	
Fluid	Air
Type	Automatic
Flow meter	Digital Flow Controller
Range	0-150 LPM
Output	4-20mA
Back Pressure Monitoring	
Sensor	Piezo-resistive Sensor
Range	0-4 kg/cm2
Connection	Sanitary connection TC type

Control Valve	Sanitary SS Pressure Control Valve
Bypass	Provided for Manual Control with Globe/Diaphragm Valve
Safety	
Safety Valve	Sanitary Safety valve
Range	2 barg
Seat	EPDM
MOC	SS -316
Jacket Safety	
Safety Valve	Safety valve
Range	4 barg
Seat	EPDM (Soft seat)
Wet part MOC	SS -304/SS-316

Note:

- **Kindly mention separate pricing for all the reactors. & other parts of the equipment**
- **User list with contact details and model supplied to the users**
- **Warranty period: 3 years**
- **Technical bid and price bid must be separately given**
- **Brands of all the probes, pump, sensor, centrifuge, chiller, agitator, steam generator, filtration system, software must be mentation in the technical bid.**