INDIAN INSTITUTE OF TECHNOLOGY BOMBAY
MATERIALS MANAGEMENT DIVISION
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Ref. PR No. 1000044870 Rfx. No. **6100002042**

Item Description - **Gas Chromatography (GC) System**

Sr. No	Item Description	Detailed Technical Specification	Technical Compliance (Yes / No)	Additional Information (if any)
1.	Gas Chromatography (GC) System	An automatic computer-controlled, high-speed customized Gas Chromatography system having high sensitivity, capillary/packed columns, oven, flow control systems, flame ionization detector (FID), thermal conductivity detector (TCD), and appropriate software is required for the quantitative analysis of CO_2, CO, H_2, O_2, N_2, CH_4, C_2H_6, C_2H_4, CH_3OH, HCHO gas samples in CO_2/CO/air/N_2/Ar gas feed, C1-C4 alcohols, aldehydes, and carboxylic acids in liquid water, and other organic compounds in organic solvents		
1.1		Automatic computer-controlled system with programmable pneumatic control (digital control) for injector, detector, and purge gas.		
1.2		EPC/PPC/AFC should provide optimum performance with all types of columns and detectors.		
1.3		Equipment must have a touchscreen interface display to indicate real-time parameters such as carrier gas supply pressure, sensor temperature, etc.		
1.4		All parameters should be stored as a part of the		

		method for better analysis and reproducibility.		
1.5		All the required valves must be factory fitted only in the dedicated option box.		
1.6		GC instrument should be equipped with intelligent self-diagnostic functions for detailed diagnosis of the septum, glass insert usage status, temperature sensor error, gas supply pressure, status of each gas ignition function etc.		
1.7		GC instrument must support manual sample injection.It should be upgradeable with online sample injection for future applications.		
1.8		Power Supply:+230V AC power supply		
1.9		A brochure or authentic website link containing all the required modules, specifications, detection limits, etc. must be provided with their proofs. Failing this, the tender will be rejected.		
2.		**Column oven**		
2.1		There should be a provision to install at least two columns or more at once, for the simultaneous analysis/detection of samples.		
2.2		Capacity: 10 litres or above for easy fixing and removing different types/dimensions of columns without compromising the rate of heating or cooling of the oven.		
2.3		Operating temperature range of column oven: near ambient to 450 ^{o}C, with set point resolution of at least 1^{o}C.		
2.4		Cooldown time from 250 °C to 50 °C: 5 min or less (at 25 ^{o}C ambient).		
2.5		Column oven ramp rate: 120 ^{o}C/min or better.		
2.6		Column oven should have the possibility to program minimum 15 temperature ramps with 16 plateaus or better.		

2.7		Should have 8 or more heated zones		
2.8		Column over heat protection must be there.		
2.9		Proper mounting of columns so that during cooling/any operation(shifting), columns do not vibrate.		
3.		**Inlets for sample injection**		
3.1		Split/Splitless Injection: Split/Splitless injector with split ratio 9999.9:1 or better. Injector ports should be temperature-programmable from 50 ^{o}C to 400 ^{o}C in 1 ^{o}C increment.Pressure range up to 100 psi with stability of pressure up to ± 0.1 psi		
3.2		Purge Packed Inlet: Direct injection onto packed and widebore capillary columns. Max. operating temperature: 400 ^{o}C. Electronic flow/pressure control: Pressure range: 0 to 100 psi; Flow range: 0.0 to 200.0 mL/min.		
3.3		Suitable injector ports should be provided for sample introduction through off-line syringe injection.It should be upgradeable with online sample injection for future applications.		
3.4		Injectors should be controlled by EPC/PPC/AFC.		
3.5		Removable glass liner for trapping non-volatile residues must be present.		
3.6		Injector should be suitable for repetitive constant volume of gas sample injections.		
3.7		Pressure programming facility along with constant flow, constant pressure, and constant velocity facility should be available		
3.8		Setting split ratios (particularly low split ratios) is limited by column parameters and control of system flows (particularly low system flows)		

4.		**Flame ionization detector (FID)**		
4.1		Maximum operating temperature should be 450 °C or more.		
4.2		Minimum Detectable limit <1.2pg/ C/s for tridecane or any equivalent compound. Valid proofs for detection limits must be provided.		
4.3		Linear dynamic range >10^7		
4.4		Data rate up to 1000 Hz or better		
4.5		Detector should be controlled by EPC/AFC/PPC		
4.6		Quantitative analysis: 1) 10 ppm or better for CH_4, C_2H_4, C_2H_6 in N_2/CO/CO_2/air/Ar gas feed 2) 1 ppm or better for C1-C4 alcohols, aldehydes, and carboxylic acids in water-based solvents. 3) All the analytes must be separated and detected in a single sample injection run. 4) Appropriate sampling valves must be provided along with necessary accessories to achieve the separation and detection of multiple analytes in a single sample injection run.		
4.7		Valid proofs for detection limits must be provided. Failing this, the tender will be rejected.		
5.		**Thermal conductivity detector (TCD)**		
5.1		Minimum detectable level: : 400 pg tridecane or > 40000 mV x ml/mg decane with He carrier gas or any equivalent compound.		
5.2		Linear dynamic range: >105 ±5 %		
5.3		Maximum temperature: 350°C or better		
5.4		Detector should be controlled by EPC/AFC/PPC/APC		
5.5		Sensitivity/Quantitative analysis:		

		1. 100 ppm or better for H_2, O_2, CO, N_2, CO_2, CH_4 in N_2/CO/CO_2/air/Ar gas feed. 2. All the analytes must be separated and detected in a single sample injection run. 3. Appropriate sampling valves must be provided along with necessary accessories to achieve the separation and detection of multiple analytes in a single sample injection run.		
	5.6	Valid proofs for detection limits must be provided. Failing this, the tender will be rejected.		
6.		**Gas flow/pressure controller**		
6.1		Equipment shall automatically compensate for variations in atmospheric pressure and temperatures during analysis.		
6.2		Must come with standard programmable pneumatic control		
6.3		Digital Pneumatic Control for setting column flow with pressure, flow, and linear velocity.		
6.4		Pressure range: 0- 100 psi or better		
6.5		Pressure program ramps: 3 or more		
6.6		Gas flow/pressure in all the injectors, columns and detectors should be controlled by advance flow/pressure controllers (AFC/APC).		
6.7		AFC flow range: 0 to 100 mL/min with setpoint resolution of 0.1 and flow rate ramps of up to 3 or better.		
6.8		APC should adjust the pressure resolution up to 0.01psi		
6.9		Carrier Gas: Should allow for selection of carrier gas from Ar/N_2/He from the control panel without requiring any new connections/changes.		
7.		**GC columns**		
7.1		Suitable column for gases: H_2, O_2, N_2, CO_2, CO, CH_4, CH_3OH, HCHO, C_2H_4, C_2H_6.		

		All the analytes must be separated and detected in a single sample injection. <u>Limits of quantification</u>: a) H_2: 50 ppm - 10% in air/Ar/CO_2/CO/N_2 feed b) O_2: 50 ppm - 10% in air/Ar/CO_2/CO/N_2 feed c) N_2: 50 ppm - 10% in air/Ar/CO_2/CO feed d) CO_2: 50 ppm - 10% in air/Ar/CO/N_2 feed e) CO: 50 ppm – 10% in air/Ar/CO_2/N_2 feed f) CH_4: 10 ppm – 1000 ppm in air/Ar/CO/CO_2/N_2 feed g) CH_3OH: 1-1000 ppm in air/Ar/CO/CO_2/N_2 feed h) HCHO: 1-1000 ppm in air/Ar/CO/CO_2/N_2 feed i) C_2H_4: 10-1000 ppm in air/Ar/CO/CO_2/N_2 feed j) C_2H_6: 10-1000 ppm in air/Ar/CO/CO_2/N_2		
7.2		Suitable columns for aqueous phase detection of alcohols, aldehydes and carboxylic acids in liquid water using Head Space <u>Headspace Sampler</u> • Minimum vial capacity 10 or more • Temperature range for Transfer line/ sample up to 200^0C or more. • Should have a closed sampling design without exposure to atmosphere or ambient temperature. System must be syringeless to avoid exposure to atmosphere/contamination. System must be controllable through software only. • Headspace should have automatic leak check, power saving and gas saving facility All the analytes must be separated and detected in a single sample injection.		

		Limits of quantification: a) C1-C4 alcohols (methanol, ethanol, propanol, butanol): 10-1000 ppm dissolved in liquid water. b) C1-C4 aldehydes (formaldehyde, acetaldehyde, propanal, butanal): 1-1000 ppm dissolved in liquid water. c) C1-C4 carboxylic acids (formic acid, acetic acid, propionic acid, butanoic acid): 1-1000 ppm dissolved in liquid water/.		
7.3		Valid proofs for detection limits must be provided. Failing this, the tender will be rejected.		
7.4		All the columns must be compatible with the configured GC instrument.		
7.5		All the columns should be easily detachable from column oven.		
7.6		The instrument should be supplied with 1 year warranty.		