INDIAN INSTITUTE OF TECHNOLOGY BOMBAY
MATERIALS MANAGEMENT DIVISION
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Ref No. (PR No. 1000037421) **(Rfx No. 6100001620)**

Technical Specification of Gas Chromatographic (GS) System

Sr.No	Item Specification	Quantity	Compliance (YES/NO)
1. General	a. An automatic computer controlled gas chromatographic system, capillary/ packed columns, oven, flow control systems, FID, TCD, gas sampling valves, headspace sampling with appropriate loops, fittings, and powerful and versatile software capable of analysing gases is required for quantitative analysis of CO2, CO, H2, O2, N2, CH4, C2H6, C2H4, in CO2/CO/air/N2 gas feed and methanol, ethanol, propanol in liquid water based 0.1-10 M KOH/K2CO3 solutions. b. The equipment shall be capable of **quantitatively** charactering: - CO, CO2, H2, O2, N2 with concentrations 100 ppm – 10% in air/N2/Ar/CO/CO2 feeds (via GSV) - CH4, C2H6, C2H4 with 10 ppm – 1000 ppm in air/N2/Ar/CO/CO2 feeds (via GSV) - methanol, ethanol, propanol 1 ppm – 1% in liquid water based 0.1-10 M KOH/K2CO3 solutions (via headspace_ FID). c. All accessories needed to have online injection shall also be included with equipment. Further, the equipment	1	

	should allow for manual injection of gas/liquid samples (5 – 10 ml gases) via syringe (necessary syringes [multiple count]/accessories shall be included with equipment). d. All columns/detectors should be simultaneously installed in the equipment and all analysis should be possible without removal/replacement of column. e. Equipment should have suitable gas sampling valve, suitable pre-columns, main columns, TCD and FID for analysing above components. Column switching technique should be incorporated to avoid moisture or heavier species in the main column.		
2. Gas Chromatographic (GC) system:	a. Automatic computer controlled system with programmable pneumatic control (digital control) for injector, detector, and purge gas. b. EPC/ PPC/AFC should provide optimum performance with all types of columns and detectors c. Equipment must have a touchscreen interface display to indicate real-time parameters such as carrier gas supply pressure, sensor temperatures, etc.	1	

	d. All parameters should be stored as a part of the method for better analysis reproducibility e. The needed Valves must be factory fitted only in the dedicated option box. f. The equipment 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.		
2. <u>Column Oven</u>	a) 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. b) Proper mounting of columns so that during cooling/any operation(shifting) columns should not get vibrated. c) All temperature and time functions should be microprocessor controlled and displayed on the screen d) column over-heat protection e) should be settable up to 450 °C, set point resolution must be at least 1 □C f) cooldown time from 250 °C to 50 °C 5 min or less (at 25 C ambient) g) Temperature ramp rate should be 45 °C/min or more h) Temperature ramps should be 3 or more. i) Should support a minimum of 20 oven ramps with 21 plateaus. j) Settable time for each step: 9000 minutes or more k) Should allow for negative ramps.	1	

3. Automatic Gas Sampling/other Valves	a. Factory fitted, full Pneumatic Controlled Gas Sampling/other Valves with 6 or 8 or 10 ports (valco make) – for gas sample analysis, column selection, etc b. Valves should be controllable through GCSystem Interface without requiring PC Control. c. Wall Mount Pressure Controllers should be offered with GSV/other valves d. Backflush facility should be available e. Solenoid valves for pressure balance in sample loop should be provided. f. Vendor is required to submit the plumbing diagram along with the technical bid.	1	
4. Thermal Conductivity Detector (TCD):	a. Maximum Temperature: 400 C or more b. Detector should be controlled by EPC/PPC/AFC c. Sensitivity/quantitative analysis: i. 100 ppm or better for H2, O2, CO, CO2, CH4, C2H4, C2H6 in nitrogen gas feed with 100- 10,000 ppm of above gases. ii. 100 ppm or better for H2, O2, CO, CH4, C2H4, C2H6 in CO2 gas feed with 100- 10,000 ppm of above gases. iii. 100 ppm or better for H2, O2, CO2, CH4, C2H4, C2H6 in CO gas feed with 100- 10,000 ppm of above gases. d. Linear Dynamic Range: 10^5 or better	1	
5. Flame Ionization Detector (FID):	a. Maximum Temperature: 400 C or more b. Detector should be controlled by EPC/PPC/AFC c. Sensitivity: Minimum detectable level (for tridecane) : <1.2pgC/S d. Quantitative analysis: iv. 10 ppm or better for CH4, C2H4, C2H6 in nitrogen gas feed with 100-10,000 ppm of above gases.	1	

	v. 10 ppm or better for CH4, C2H4, C2H6 in CO2 gas feed with 100-10,000 ppm of above gases. vi. 10 ppm or better for CH4, C2H4, C2H6 in CO gas feed with 100-10,000 ppm of above gases. vii. 1 ppm or better for Ethanol, Methanol, Propanol in water based solvent feed with 100- 10,000 ppm of above alcohol liquids. e. Linear Dynamic Range: 10^7 or better f. Data rates : up to 1,000 Hz		
6. <u>Sample Injector port</u>	a. Injectors should be controlled by EPC/PPC/AFC. b. Removable glass liner for trapping non-volatile residues c. Injector suitable for repetitive constant volume of gas sample injections d. <u>Offline Syringe Injection</u>: Suitable Injector port should be provided for sample introduction through off-line syringe injection. e. <u>Online Injection</u>: Suitable Injector port should be provided for sample introduction through on-line injection. All needed accessories should be included for online injection directly from reactor. Should be programmable for sample volume, frequency, etc. f. <u>Split/Splitless Injection</u>: Split/Splitless Injector with split ratio 9999.9 :1 or better. Injector ports should be temperature-programmable from 50 C to 400 C or more in 1 C increment. Pressure range up to 100 psi with stability of pressure up to ± 0.1 psi g. <u>Purge Packed Inlet</u>: Direct injection onto packed and wide-bore capillary columns. 400 °C maximum operating temperature. Electronic flow/pressure control: 0 to 100 psi pressure range, 0.0 to 200.0 mL/min flow range.	1	

7. <u>Gas Flow / Pressure Controller</u>	a. Equipment shall automatically compensate for variations in atmospheric pressure and temperatures during analysis. b. Must come with standard programmable pneumatic control c. Digital Pneumatic Control for setting column flow with pressure, flow, and linear velocity. d. Pressure Range: 0 – 100 psi or better e. Pressure Program Ramps: 3 or more f. Gas flow/pressure in all the injectors, columns and detectors should be controlled by advance flow/pressure controllers (AFC/APC) g. AFC flow range: 0 to 100ml/min with setpoint resolution of 0.1 and flow rate ramps of up to 3 or better. h. APC should adjust the pressure resolution up to 0.01psi i. Carrier Gas: Should allow for selection of carrier gas from Ar/N2/He from the control panel without requiring any new connections/changes.	1	
8. <u>Columns</u>:	a. Molecular Sieve 5 A (30 m or longer)-based or equivalent for permanent gases separation; b. Porapak-N or equivalent pre-column (2 m or longer) or equivalent for CO2/CO c. Suitable packed/capillary columns for following liquid compositions for HeadSpace analysis of voltaic organic solvents: **<u>Limit of Quantification:</u>** **<u>Gases (injection via GSV)</u>** H2 100 ppm – 10% (in N2/Ar/CO/CO2 feed) O2 100ppm – 10% (in air/N2/CO/CO2 feed) N2 100ppm – 10% CO 100 ppm -10% ppm (in CO2 feed) CO2 100 ppm – 10% (in air/CO feed)	1	

	Methane 10-1000 ppm (in CO2/CO feed) Ethylene 10-1000 ppm (in CO2/CO feed) Ethane 10-1000 ppm (in CO2/CO feed) **Dissolved Liquids (injection via HeadSpace)** Propanol: 1 ppm – 100 ppm (dissolved in liquid water based 0.1-10 M KOH/K2CO3) Ethanol: 1 ppm – 1000 ppm (dissolved in liquid water based 0.1-10 M KOH/K2CO3) Methanol: 1 ppm – 1000 ppm (dissolved in liquid water based 0.1-10 M KOH/K2CO3)		
9. HeadSpace	a. Capacity: The basic model headspace sample injector must have a sample capacity of 12 samples b. Electronic pneumatic control c. Pressor sensors: Accuracy: < ± 2% full scale - Repeatability: < ± 0.05 psi - Temperature coefficient: < ± 0.01 psi/°C	1	
10. Installation and Training	a. Supplier / Indian agent should install the instrument at IIT Bombay (no additional cost). b. Operational training to be provided to respective group of research fellows at IIT Bombay (no additional cost). c. Commissioning and Demo should be done with both the standards and real gas samples under both online and offline analysis	1	
11. Warranty	**Minimum one year of warranty on the system from the date of installation & commissioning**.	1	

12. Software	a. Software suitable for dual channel GC should be upgradeable. b. Windows 10 (or newer) compatible workstation software of same make c. License copy of Software should be supplied along with/pre-loaded on PC and GC system. d. Real-time chromatographic data acquisition and post-run analysis should be possible. e. Software should allow for high-speed data acquisition and bulk analysis. f. Full qualitative & quantitative processing, column performance, system suitability, QA/QC.	1	
13. Consumables	a. Injector port Septa pkg of 200. b. Injector and Detector ferrules of 0.32 mm and 0.53 mm ID.(Pkg of 50 should be quoted)	1	
14. Miscellaneous	a. Suitable sample loop, gas supply pipes & OEM make gas filteration kit. b. Any other required items to be included.	1	

The scope of supply consists of installation, commissioning, training of system at IIT Bombay laboratory. System to be supplied with method set up parameters, plumbing diagram, and schematics.

Bidders are required to provide point-by-point compliance details (along with their product specifications for each of the above bulleted/sub-bulleted/sub-sub-bulleted points in a Tabular format)