



Indian Institute of Technology Madras

Stores, Dept. Chem. Engg., IIT- MADRAS

Chennai -600 036, India

Form for Inviting Quotations

Ref.No.

Date: 22-Dec-2015

CHE	2015	002	SPI
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Under Certificate of Posting

Dear Sirs,

DUE DATE: 13-Jan-2016

1. Quotations are invited in duplicate for the various items shown below / overleaf / Enclosed list.
2. The Quotations duly sealed and superscribed on the envelope with the reference No. and due date, should be addressed to the undersigned so as to reach him on or before the due date stipulated above.
3. The Quotations should be valid for sixty days from the due date and the period of delivery required should also be clearly indicated.
4. If the item is under DGS&D Rate contract No. and the price must be mentioned. It may also please be indicated whether the supply can be made direct to us at the Rate contract price (Please note that we are not Direct Demanding Officers). If so please send copy of the RC.
5. Relevant literature pertaining to the items quoted with full specifications (and drawing, if any) should be sent along with the Quotations, wherever applicable. Samples if called for, should be submitted free of charges, and collected back at the supplier's expenses.
6. Local Firms : Quotations should be for free delivery to this Institute. If Quotations for Ex-Godown delivery charges should be indicated separately.
7. Firms Outside Madras : Quotations should be for F.O.R. Madras. If F.O.R. consignor station, freight charges by passenger train / lorry transport must be indicated. If Ex-Godown, packing, forwarding and freight charges must be indicated.
8. The rate of sales / General Taxes and the percentage of such other taxes legally leviable and intended to be claimed should be distinctly shown along with the price quoted. Where this is not done, no claim for Sales / General Taxes will be admitted at

any stage and on any ground whatsoever The taxes leviable should take into consideration that we are entitled to have concessional Sales Tax applicable to non Government Educational Institutions run with no profit motive for which a concession. Sales Tax Certificate will be issued at the time of final settlement of the bill.

9. Goods should be supplied carriage paid and insured.
10. Goods shall not be supplied without an official supply order.
11. Payment : Every attempt will be made to make payment within 30 days from the date of receipt of bill / acceptance of goods, whichever is later

(Two bid system. Technical and Financial bids to be enclosed separately in clearly marked envelopes)

Yours faithfully,

S. Ramanathan

Project Co-ordinator

Annexure I.**Specifications for Nonlinear electrochemical impedance spectrum analyzer.**

This must include a **potentiostat**, a **lock-in amplifier** and a **FFT analyzer** / dynamic signal analyzer, with the following specifications.

1. All equipment must operate using power source at 230 V, 50 Hz
2. Software must be compatible with Windows family operating systems
3. All equipment functionalities must be controllable from the front panel of the equipment as well as via software interface.
4. All equipment must have open command set to enable user to write custom software to control all the functionalities of the equipment.
5. The potentiostat, lock-in amplifier and FFT analyzer must be compatible with each other.
6. Communication with computer via one or more of the following modes: GPIB, TCP/IP, USB and serial port.

Detailed specifications are given in the following pages.

Potentiostat specifications

1. Potentiostat with ± 30 V compliance and maximum current of ± 1 A
2. Power amplifier band width to be >1 MHz (10 k Ω load, <100 μ A)
3. Potentiostat mode operation
 - a. Applied voltage range = ± 15 V or better
 - b. Voltage resolution = 500 μ V or better
 - c. Voltage accuracy = ± 0.2 % of setting ± 5 mV
 - d. Automatic scan rate = at least 0.1 mV/s to 10 kV/s
 - e. Noise and ripple < 20 μ V_{rms} (1 Hz to 10 kHz)
4. Galvanostatic mode operation
 - a. Applied current range = ± 1 nA to ± 1 A or better
 - b. Current resolution = 16 bit or better
 - c. Current accuracy = ± 0.5 % of reading ± 0.2 % of range or better
 - d. Automatic scan rate = 1 pA/s to 2 A/s or better
5. Voltage measurement
 - a. Range = ± 15 V or better
 - b. Resolution = 16 bit or better
6. Current measurement
 - a. Range = ± 1 nA to ± 1 A in decades
 - b. Resolution = 16 bit or better
7. Analog voltage and current outputs (for further analysis by other equipment)
 - a. Voltage output = ± 15 V
 - b. Voltage accuracy = ± 0.2 % of $V_{RE} - V_{WEsense} \pm 5$ mV
 - c. Output impedance = 50 Ω or better
 - d. Max output current = 10 mA or better
 - e. Current output = ± 2 V
 - f. Current accuracy = I_{WE} within ± 0.5 % of $(V_{BNC} \times I_{Range}) \pm 0.2$ % $\times I_{Range}$ or better
8. Techniques
 - a. Cyclic voltammetry, Square wave voltammetry, Differential pulse voltammetry, EIS

Lock-in Amplifier

1. Dual phase lock in amplifier, with frequency range of 1 mHz to 100 kHz (or better)
2. Signal channel characteristics
 - a. Voltage inputs – Single ended or differential
 - b. Sensitivity = 2 nV to 1 V or better
 - c. Current Input = 10^6 or 10^8 V/A
 - d. Gain accuracy = ± 1 % or better
 - e. Dynamic reserve > 100 dB
3. Reference channel characteristics
 - a. Frequency 1 mHz to 100 kHz (or better)
 - b. Reference input : TTL or sine
 - c. Input Impedance = 1 M Ω , 25 pF
 - d. Phase resolution = 0.01 $^\circ$ or better
 - e. Absolute phase error = at the most 1 $^\circ$
 - f. Orthogonality = 90 $^\circ$ \pm 0.001 $^\circ$
 - g. Harmonic detection = 2nd, 3rd, 4th and 5th harmonic (highest harmonic frequency can be up to 100 kHz)
4. Demodulator
 - a. Harmonic rejection = -90 dB or better
5. Internal oscillator
 - a. Range 1 mHz to 100 kHz or better
 - b. Accuracy = 25 ppm + 30 μ Hz or better
 - c. Amplitude = 4 mV to 5 V_{rms} into 10 k Ω (2 mV resolution)
6. Outputs
 - a. X and Y signal components (or R and θ) in two channels with full scale of ± 10 V, updated at 512 Hz

Dynamic Signal analyzer (FFT Analyzer)

1. Dual channel dynamic signal analyzer with frequency range from DC to 100 kHz (or better)
2. FFT span = 191 mHz to 100 kHz or better
3. FFT resolution = 100, 200, 400 or 800 lines
4. Real time band width = 102.4 kHz or better
5. Dynamic Range
 - a. Typical value to be 90 dB
 - b. Harmonic distortion < -80 dB
6. Amplitude accuracy
 - a. Single channel = ± 0.2 dB, and Cross channel = ± 0.05 dB
7. Phase accuracy
 - a. Single channel (relative to external TTL) = $\pm 3^\circ$
8. Signal inputs
 - a. Capable of handling 2 channel inputs
 - b. Input configuration : single ended or differential
 - c. Maximum input = $57 V_p$
 - d. Input impedance = $1 M\Omega + 50 pF$
 - e. Input noise < $10 nV_{rms}/\sqrt{Hz}$ above 200 Hz (< -160 dBVrms/ \sqrt{Hz})
9. Trigger input = Free run, Internal, External, or External TTL
10. Transient capture
 - a. continuous data recording, 262,144 samples/s for both inputs
 - b. capture length = 2Ms (single input) or better
11. Source output
 - a. Sine, two tone, white noise, swept sine, chirp,
 - b. Single sine source: frequency 0 to 100 kHz or better, amplitude $0.1 V_p$ to $5 V_p$, with < 10 mV dc offset. DC offset adjustable to $\pm 5 V_{DC}$.

Optionally, quote

1. Rack mount kit separately for each component (potentiostat, Lock-in Amplifier, FFT analyzer), if it is not part of the main equipment.
2. Replacement terminal cable for potentiostat
3. 5 amp power booster for potentiostat
4. RS 232 cable, USB-to-RS232 cables, LAN cable for TCP/IP connection for controlling via computer