

Price Rs. 500/-

**ELECTRONIC SCIENCE DEPARTMENT  
KURUKSHETRA UNIVERSITY KURUKSHETRA**

**TENDER DOCUMENTS**

**FOR**

**SUPPLY AND INSTALLATION OF  
LAB EQUIPMENTS**



<b>LAST DATE FOR SALE OF TENDER DOCUMENT</b>	<b>15-11-2008</b>
<b>LAST DATE AND TIME FOR RECEIPT OF TENDER</b>	<b>20-11-2008, 16 Hrs</b>
<b>ADDRESS FOR COMMUNICATION</b>	<b>Chairman Electronic Science Department Kurukshetra University, Kurukshetra, Haryana-136 199 (India)</b>

**KURUKSHETRA UNIVERSITY, KURUKSHETRA  
HARYANA - 136 119**

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**Telephones: 01744-238023 (O),**  
Web Site: [www.kukinfo.com](http://www.kukinfo.com), Email: [chairman.electronics@gmail.com](mailto:chairman.electronics@gmail.com)

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**INVITATION TO TENDER**  
**(For Open Tenders Only-Non-Transferable)**  
**PART I**

PHONE: 01744-238023  
FAX : 01744-238277

Electronics Science Department  
Kurukshetra University, Kurukshetra, 136119

August, 2008

Due Date : 20/11/2008  
Opening Date: 21/11/2008

Due Time : 16.00 hrs  
Opening Time: 15.00 hrs

1. The Supplies/services noted at Schedule of Requirements in Techno-Commercial Bid (Part III) are required.
2. The bidding document may be obtained from the office of **The Chairman, Electronic Science Department, Kurukshetra University, Kurukshetra** either in person or by post by paying the Rs 500/- (in the form of draft in the favor of Registrar, Kurukshetra University) or same may also be obtained from web site **www.kukinfo.com**. In case of internet downloaded document, draft of Rs 500/- should be attached.
3. The Tender should be sent as follow, in two separate envelopes
  - (a) **Techno-Commercial Bid:** Part II, Part III and Part IV in one envelop marked as "Techno-Commercial Bid".
  - (b) **Price Bid:** Part V in second envelop marked as "Price Bid".

Both envelopes are to be sealed and should bear the tender reference no, due date and time. The two envelopes should be placed in a good quality single envelop securely fastened, sealed and distinctly marked "TENDER FOR SUPPLY, NOT TO BE OPENED BEFORE 15.00Hrs, 20/11/2008" and addressed to Chairman, Electronics Science Department, Kurukshetra University, Kurukshetra-136119, Haryana. Tender should be sent by Registered Post/Speed post. **No personal/Hand delivery will be accepted.**

4. Each tender duly completed must be sent along with Earnest Money specified for each equipment in shape of Draft in favour of Registrar, Kurukshetra University payable at Kurukshetra. EMD for the product quoted must be enclosed with the **TECHNO-COMMERCIAL BID**. Tenders without Earnest money will not be considered.

**Yours Sincerely,**

CHAIRMAN  
ELECTRONIC SCIENCE DEPTT.  
KURUKSHETRA UNIVERSITY

# TENDER

## PART II

**To**

Chairman,  
Electronics Science Department,  
Kurukshetra University, Kurukshetra, 136119.  
Harayana

**I/We agree to furnish required supplies/services as detailed in the Techno-Commercial Bid (Part IV) or such portions thereof as you may specify in the Acceptance of Tender/Supply Order at the prices given in the Price Bid (Part V) in accordance with the General Terms and Conditions (Part III) governing the contract/supply order enclosed hereto duly accepted on receipt of order for the same.**

**I/We agree to hold this offer open until 31<sup>st</sup> March'2009 and shall be bound to supply/commission/erect the equipment and dispatch the same within the specified period.**

**I/We agree to supply and commission/erect the equipment and complete the whole of the work and hand over to the purchaser within the period of 8 to 12 weeks, from the date of receipt of intimation from you regarding acceptance of this tender/receipt of supply order.**

Station:  
Date:

Signature of Tenderer  
With Office Stamp  
Name & Address:

Station:  
Date:

( )  
Signature Witness:  
Name & Address:

## TECHNICAL BID

### PART III

(To be filled by the Vendor)

1. Tender No.
2. Name of Tenderer :
3. Due date & Due Time: 20/11/2008 & 1600 hrs
4. Opening Date & Time: 21/11/2008 & 1500 hrs
5. The tender shall remain valid for a minimum period of 90 days, from the date of tender opening.
6. EMD for the product quoted must be enclosed with the **TECHNO-COMMERCIAL BID**. The venders will certify in the Price bid that the EMD amount as applicable has been enclosed with the **TECHNO-COMMERCIAL BID**. However, if EMD is not found enclosed with the **TECHNO-COMMERCIAL BID**, such offers will not be entertained and tender shall be treated as technically rejected bid.
7. Place & dates on which delivery is to be made: **Electronics Science Department, Kurukshetra University**
8. Schedule of Requirements:

Sl. No.	Description & Nature of Supplies/Services	Qty.	EMD (in Rs)	Quoted/ Not quoted	Specifications (Attach Additional sheets, drawings etc. if necessary)
1.	<b>Ellipsometer</b>	<b>One No.</b>	<b>30,000</b>		<b>Specifications as per Appendix - I</b>
2	<b>Raman Spectrophotometer</b>	<b>One No.</b>	<b>70,000</b>		<b>Specifications as per Appendix - 2</b>
3	<b>UV-Visible Spectrophotometer</b>	<b>One No.</b>	<b>15,000</b>		<b>Specifications as per Appendix - 3</b>
4	<b>X-ray diffraction system for thin films</b>	<b>One No.</b>	<b>70,000</b>		<b>Specifications as per Enclosed Appendix - 4</b>
5	<b>Scanning Probe Microscope (SPM)</b>	<b>One No.</b>	<b>70,000</b>		<b>Specifications as per Enclosed Appendix - 5</b>

6	<b>Mask Aligner for photolithography</b>	<b>One No.</b>	<b>40,000</b>		<b>Specifications as per Enclosed Appendix - 6</b>
7	<b>Spin Coater with baking plate</b>	<b>One No.</b>	<b>10,000</b>		<b>Specifications as per Enclosed Appendix – 7</b>
8	<b>SEM</b>	<b>One no</b>	<b>70,000</b>		<b>Specifications as per Enclosed Appendix – 8</b>
9	<b>LCZ meter</b>	<b>One No.</b>	<b>10,000</b>		<b>Specifications as per Enclosed Appendix – 9</b>
10	<b>Potentiostat/Galvanostat</b>	<b>(Two No.)</b>	<b>40,000</b>		<b>Specifications as per Enclosed Appendix - 10</b>
11	<b>VLSI IMAGE Lab for 10 nodes towards teaching purpose</b>	<b>Two No.</b>	<b>30,000</b>		<b>Specifications as per Enclosed Appendix- 11</b>
12	<b>Intellisuite (for 5 licenses)</b>	<b>One No.</b>	<b>20,000</b>		<b>Specifications as per Enclosed Appendix- 12</b>
13	<b>Mathematica (for 25 licenses)</b>	<b>One no.</b>	<b>10,000</b>		<b>Specifications as per Enclosed Appendix- 13</b>
14	<b>Matlab (for 5 licenses)</b>	<b>One no.</b>	<b>10,000</b>		<b>Specifications as per Enclosed Appendix- 14</b>
15.	<b>MentorGraphics VLSI Design tool (for 25 licences)</b>	<b>One no.</b>	<b>12,000</b>		<b>Specifications as per Enclosed Appendix- 15</b>
16.	<b>Vertical Flow Laminar Chemical Bench</b>	<b>One No.</b>	<b>5,000</b>		<b>Specifications as per Enclosed Appendix- 16</b>
17.	<b>Four Probe Resistivity setup with Keithley source meter and Software</b>	<b>One no.</b>	<b>10,000</b>		<b>Specifications as per Enclosed Appendix- 17</b>

18.	<b>Horizontal tube High Temperature Furnace</b>	<b>One no.</b>	<b>5,000</b>		<b>Specifications as per Enclosed Appendix- 18</b>
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**CONDITIONS FOR TECHNO-COMMERCIAL BIDS**

**TECHNICAL**

1. Give brief description of item/equipment/material with accessories. Items offered should conform to specification, or as explicitly stated. Any product brief, test certificates available may be enclosed.
2. List of spares, if applicable should be attached.
3. Any optional, if offered, be provided with their full technical details including their use and advantage.
4. All the offers should include the detailed technical literature/catalogue of the product quoted.

**COMMERCIAL**

- 1 The normal payment terms are 100% within 30 days after receipt, acceptance and satisfactory installation of stores/equipment in good condition or the date of receipt of the bill whichever is later.
- 2 Give details of installation and commissioning except price which will be only in price bid (if applicable).
- 3 Warranty/guarantee required is for one year unless otherwise specified. Indicate warranty/guarantee duration offered. In case of any problem in functioning of equipment during warranty/guarantee period, the same will be sent to you for repair/ replacement. For this, you have to bear all charges including custom and handing at the port of delivery, air freight, i.e. to and fro, insurance etc
- 4 Delivery desired is within 8 -12 Weeks unless otherwise specified. Specify your delivery period.
- 5 In case of delayed supplies, liquidated damages at the rate of 0.5 percent per week for one month maximum.
- 6 Delivery: Free delivery at Electronics Science Department, Kurukshetra University, Kurukshetra, 136119. Haryana.
- 7 Mode of Dispatch: By Road for indigenous stores and by Air for foreign stores, unless otherwise specified.

**(Signature of Tender issuing authority)**

**Chairman, Electronics Science Department,  
Kurukshetra University.**

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Tender Reference No. :  
Fax No. :  
Full Address of Tenderer :  
Station :  
Signature of Tenderer :  
Name in Block Letters :  
Date :

:

## **GENERAL TERMS AND CONDITIONS FOR TENDER**

### **PART IV**

1. Preparation of Tender:
  - (i) The complete tender form duly stamped and signed should be deposited with technical bid. Items not quoted shall be clearly marked/ written “NOT QUOTED” in front of the item mentioned.
  - (ii) In the event of space on the tender form being insufficient for the required purpose additional pages may be added. Each such additional page must be numbered consecutively should bear the tender reference number and be fully signed by the vender. In such cases reference to the additional pages must be made in the tender form.
  - (iii) If any modification of the tender form is considered necessary, you (supplier) should communicate the same by means of a separate letter sent with the tender.
  
2. Signing of Tender:
  - (a) The tender is liable to be ignored if complete information is not given therein regarding the particulars, data, specifications asked for in the techno-commercial offer (Part III) at Schedule of requirements, Specific attention must be paid to the delivery dates, technical specification, and also the general conditions of contract at Part IV and other conditions mentioned at Part III and Part V.
  - (b) Individual signing the tender or other documents connected with a contract must specify whether he signs as :
    - (i) A ‘sole proprietor’ of the firm or constituted attorney of such sole proprietor.
    - (ii) A partner of the firm if it be a partnership, in which case he must have authority to refer to arbitration disputes concerning the business of the partnership either by virtue of the partnership agreement or a power of attorney.
    - (iii) Constituted attorney of the firm if it is a Company.
  - (c) The tenderer should sign each page of the tender form and annexures, if any.
  
3. The bidder must have supplied at least 2 such equipments in last two financial years to any Govt. / Pvt. Institute in India.
  
4. The Bidder must submit Performance Certificate from at least two purchasers regarding the quoted equipment during last two financial years.

5. The bidder must have valid Sale Tax registration No (documentary evidence needed).
6. The bidder must be either Manufacturer or Authorized representative of Manufacturer and shall also attach the documents confirming to it
7. Delivery of Tender: The tender should be sent as follow, in two separate envelopes
  - (a) **Techno-Commercial Bid:** Part II, Part III and Part IV in one envelop marked as “Techno-Commercial Bid”.
  - (b) **Price Bid:** Part V in second envelop marked as “Price Bid”.

Both envelops are to be sealed and should bear the tender reference no, due date and time. The two envelopes should be placed in a good quality single envelop securely fastened, sealed and distinctly marked “TENDER FOR SUPPLY, NOT TO BE OPENED BEFORE 16.00Hrs, 20/11/2008” and addressed to Chairman, Electronics Science Department, Kurukshetra University, Kurukshetra-136119, Haryana. Tender enquiry reference, due date of opening and name of the vendor must be marked boldly on the envelope. Tender should be sent by Registered Post/Speed post. No personal/Hand delivery/courier will be accepted.

8. Opening of Tenders: The firm shall be at liberty to be present or authorize a representative to be present at the opening of the tender at the time and date as specified in the schedule. The name and address of the representative who would be attending the opening of the tender on behalf of the firm should be indicated in the tender. Please also state the name and address of firm’s permanent representative, if any. Generally the techno-commercial offer will be opened on the day specified for opening.
9. Right of Acceptance: This office does not pledge itself and reserves to itself the right of accepting the whole or any part of the tender or portion of the quantity offered and the firm shall supply the same at the rate quoted. The firm shall be at liberty to tender for the whole or any portion or to state in the tender that the rate quoted shall apply only if the entire quantity is taken from the firm.
10. If demonstration of any equipment is required that will be arranged by the supplier within India in some Government R&D Lab or universities at the cost of the supplier.
11. Negotiations if required will be held only with lowest bidder and the chairman can reject any tender without assigning any reason.
12. Items supplied are subject to inspection and acceptance and the supplier should collect/replace the rejected items at his cost and risk.
13. Expenses on the packaging/forwarding including custom and handling charges at port of delivery for the repair/replacement of the defective items/parts during the warrany/gurantee period shall be born by the supplier

14. Delayed Suppliers: In case of delayed suppliers, liquidated damages at the rate of 0.5 percent per week of delay will be levied upto four weeks. If still the firm is not able to supply the items, the institute will be at liberty to make purchase from the second lowest bidder at the risk and cost of the defaulting firm, and the earnest money of the firm will be forfeited.
15. No correspondence/ discussions/visits what so ever will be entertained on the subject unless specifically called by this office after opening the tenders for technical discussions/price negotiations. Any violation of this will render the quotations invalid and the firm is liable to be blacklisted.
16. Chairman, Electronic Science Department reserves the right to call for techno-commercial/price negotiations. The company should depute competent representative for such discussion/negotiations whenever called for and he shall be competent to take on the spot decisions.
17. SECURITY: Any information/material/document supplied in connection with this enquiry/likely order is classified and should not be disclosed/copied to jeopardize security of the department/university.
18. Office stamps of vendors must be affixed below their signatures.

(Signature of Tender Issuing Authority)  
**Chairman, Electronics Science  
 Department,  
 Kurukshetra University.**

Tender Reference No. :  
 Full Address of Tenderer :  
 Fax No. :  
 Telephone No. :  
 Signature of Tenderer :  
 Name in Block Letters :  
 Office Stamp :  
 Station :

**PRICE BID**

**PART V**

1. Tender reference No :
2. Name of tenderer/Vendor :
3. **Due Date & Time** : **20/11/2008 & 16.00 hrs**  
**Opening date & time** : **21/11/2008 & 15.00 hrs**
4. The tender shall remain valid for acceptance for 90 days, from the date of tender opening.
5. Rates for items given in Techno-commercial offer at Schedule of Requirements are as follows.  
Adhering to the Format given below is a Pre-requisite for considering your quotations:

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Sl.No.	Description	A/U	Qty offered	Unit Price	Total Cost
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- (i) **Price quoted should be inclusive of all**  
**Including** the Eqpt/Item/Material with 1  
all accessories, Packing & Forwarding  
charges (if any), Excise Duty, Custom Duty  
(if any), Freight upto Kurukshetra University,  
Transit Insurance, Total delivery cost at  
Kurukshetra University, Installation &  
Commissioning cost (if any),  
Warranty duration and cost (if any)

- (ii) VAT,
- 

6. Separate list should be attached where required in the same format giving details of each item and cost.

**Signature of the Vendor**

## OTHER CONDITIONS FOR PRICE BIDS

1. No unilateral revision in price will be admissible.
2. Rates should only be quoted in the accounting unit (A/U) mentioned in this enquiry.  
Rates must be quoted clearly on free delivery basis at Kurukshetra University, unless otherwise specified and also to be indicated in words.
3. In case any of the subheads are included in the total cost, the same should be specified.  
Any exemption of duties/taxes required should be indicated.
4. Any optional indicated in techno-commercial bids must be priced separately.
5. (a) In case spares/accessories are applicable, their list and price should be clearly indicated separately.  
(b) In case equipment offered required maintenance after the expiry of the warranty, please indicate approximate cost of comprehensive and on call basis maintenance and also availability of local support or otherwise.
6. Price :
  - (i) The prices quoted must be net per unit shown in the schedule and must include all packing and delivery charges. Refunds on account of returnable packages (if any) are to be separately specified. Prices and refunds must be clearly shown in figures and words in Indian currency.
  - (ii) The price must be stated for each item separately. The percentage of reduction, in the total price for the entire demand should also be quoted; should an order to that extent be placed with you.
8. Any other

(Signature of Tender Issuing Authority)

**Chairman, Electronics Science Department,  
Kurukshetra University.**

Tender Reference No. :  
Full Address of Tenderer :  
Fax No. :  
Telephone No. :  
Signature of Tenderer :  
Name in Block Letters :  
Office Stamp :  
Station :  
Date :

# Equipment Specifications

# 1. Ellipsometer

## Specifications

Light source	HeNe laser, 632.8 nm wavelength
Laser power	< 400 $\mu$ W (laser class 1, no safety requirement)
Set-up	PCSA (polarizer, compensator, sample, analyser) with highly stabilized compensator
Measurement accuracy	(at 90 deg ellipsometer heads position) $\delta\Psi = 0.002^\circ$ $\delta\Delta = 0.002^\circ$
Thickness range	0.1 nm ... 6000 nm
Precision of film thickness:	0.01 nm for 100 nm SiO <sub>2</sub> on Si
Precision of refractive	5x10 <sup>-4</sup> for 100 nm SiO <sub>2</sub> on Si
Detection unit	dynamic range > 60 dB at 400 $\mu$ W optical input power
Measurement time	120 ms ... 1.5 s
Goniometer	40 – 90 ° with 5 deg steps, 0.02° repeatability
Sample adjustment	auto-collimating telescope and microscope for measurement of sample position
Software	Automatic correction of depolarisation effects during refractive index and film thickness measurement, Measurement of degree of polarization
Calibrated Test wafer :	100 nm , Sio2 on Silicon substrate

## 2. LASER RAMAN MICROSCOPE

### Specifications –

#### Spectrometer –

Spectrometer system for confocal Laser Raman spectral analysis using visible excitation at 514nm ( optional second laser in NIR range 785nm) with integral plasma filters , with following specification:

- Extremely high efficiency 250mm spectrograph
- Kinematically mounted, magnetically attached, Rayleigh line rejection filters
- Raman spectrum to  $130\text{ cm}^{-1}$  from LASER LINE
- Peak Resolution better than  $2.0\text{ cm}^{-1}$
- Continuously adjustable easy confocal facility
- Encoder feedback controlled grating stage with  $2400\text{ lines mm}^{-1}$  grating on interchangeable magnetic kinematic mount.
- **‘extended scanning’ facility for measurement of high resolution spectra with wider wavelength range than can be accommodated on a single CCD exposure, without any ‘stitching’ of spectra together. Spectral resolution continuously variable via CCD binning control.**
- CCD array detector (576 x 384 pixels). Peltier cooled to  $-70\text{ }^{\circ}\text{C}$ . No water or liquid nitrogen required.
- Motorized neutral density filters offering 16 different power levels from 0.00005 to 100%.

#### Automation –

Fully automated and self validating , with Auto align and optimisation of input laser power.

Auto switch and auto align of laser, Self validation using built-in internal reference sample. Built-in self calibration and intensity correction using Neon & Silicon . Motorised switching between laser and white light sample images using integral video

#### Microscope -

Research Grade microscope allowing confocal measurements with better than  $2.5\text{ }\mu\text{m}$  depth resolution (using a x100 objective). Including:

- Reflected light illumination.
- x5, x20, & x50 objectives.
- Binocular head with colour video camera.
- Manual XY sample stage.

### **Support baseplate**

Quality system support platform/base plate for spectrometer, microscope & to hold up to two lasers. Kinematic honeycomb baseplate for spectrometer, microscope and up to two lasers.

### **Lasers - 20mW 514 nm Argon Ion LASER Air Cooled**

#### **Computer**

- Intel Dual core Processor – 1.8 GHz, 512 MB DDR II RAM, 160 GB HDD, DVD RW, 1 ethernet card, Windows XP operating system. 17" TFT colour monitor
- Image Capture for viewing and saving on screen white light images

#### **Software**

- WiRE 2.0 instrument control and data acquisition software, fully integrated data analysis and presentation software with image capture software for white light image display and capture.

### **OPTIONAL ITEMS**

Computer controlled Mapping stage

Automated encoder feedback controlled, XYZ mapping sample stage with joystick and software control, to allow scatter, line, and area mapping, and confocal depth profiling. Step size 0.1µm. Complete with XYZ Stage and Mapping Control software and FocusTrack software.

**NIR Laser: 300 mW 785 nm Diode Laser Air Cooled with required optics**

### 3. UV VIS SPECTROPHOTOMETER

#### Specifications

The Double beam, Double monochromator Spectrophotometer should cover the wavelength range 190-900nm or better. Fully controlled by external PC through Windows' based software.

- Should have all reflecting optical system preferable SiO<sub>2</sub> coated with holographic grating monochromator with 1200 Lines/mm blazed at 240 nm or better.
- System must have photomultiplier detector.
- The spectral bandpass should be 0.20 to 5.00nm with increment of 0.01 nm or better.
- Stray light should be less than 0.0001%T at 220, 320 and 340nm as per the ASTM methods or better
- Wavelength Reproducibility should be less than 0.06nm or better.
- Photometric accuracy should be +/- 0.0006 A or better
- Photometric linearity At 3.0 A should be +/- 0.03 A or better
- Photometric Reproducibility 0.0008 A or better
- Photometric Range up to 6 A or better
- Photometric Stability 0.0004 A/h or better
- Baseline Flatness should be +/- 0.0009 A or better
- 60 mm or better Integrating sphere for reflectance studies i.e. diffuse, Specular, Total Reflectance for solid samples
- Variable angle 15-70 degree reflectance accessory for solid samples (Film, filters, glass etc) with self alignment
- 10mm quartz Cell for liquids approx. 3 ml & 0.8 ml volume) – 2 Nos. each
- Latest Branded PC & Printer to operate the system.
- The software should be capable of performing following functions:

Fully integrated Scan, Timedrive, Wavelength Program data collection modes included with real-time spectral display and live instrument and accessory status bar. Quant and Scanning Quant applications, optimization of calibration curves, calibration lifetime and calibration acceptance criteria. Rate application also included with automatic calculation of enzyme activity and substrate concentration. Methods comprise instrument and accessory parameters, sample table, spectral processing, math calculations, conditional results checking, report template.

## 4. X-Ray Diffraction system for thin films

### Specifications

#### **X-ray generator mod. Compact.**

- 1) On-board microprocessor controlled via a PC RS232 serial port.
- 2) 3kW maximum power, 60kV and 60mA, single phase 230Vac  $\pm 10\%$ .
- 3) Stability of HV tube and current: 0.01% at 10% mains fluctuation.
- 4) CONTROL PANEL Check lamps for X-rays on, Filament, Water and Safety circuit. Emergency push button.
- 5) HIGH VOLTAGE TRANSFORMER, oil insulation, silicon rectifiers and H.V. condenser for stabilised DC output 0-60KV, 0-60mA, water cooled.
- 6) SAFETY DEVICES tripped by: overload, overvoltage, overcurrent, interruption of water flow, failure of warning lamps, case open.

#### **High-voltage cable/sockets 1.5 m. long.**

**Tube shield. One linear window, with electromagnetic shutter and mechanical safety shutter, red warning lamps, filter holder.**

**Working table made of steel, with apertures to fit the x-ray generator and a second rack.**

**Integral X-ray proof cabin, with high density PVL window, safety circuits and internal light.**

**Glass X-ray tube, Cu anode, fine focus, 0.4 x 8 mm, short anode, four windows, 3000 Watts.**

#### **Diffractometer– Vertical mod. Type: Theta/2Theta. 2axis independently controlled by two stepping motors.**

- 1) Variable scanning radius : 350 - 440 mm
- 2) Scanning angular range:  $-60^\circ < 2\theta < +165^\circ$ .
- 3) Angular reproducibility:  $0.0001^\circ$  (2 theta).
- 4) Smallest selectable stepsize :  $0.0001^\circ$  (2 theta).
- 5) Scanning speed  $0.001 - 2^\circ/\text{sec}$ .
- 6) Slewing speed  $1000^\circ/\text{min}$ .
- 7) Divergence slits:  $4^\circ, 2^\circ, 1^\circ, \frac{1}{2}^\circ, \frac{1}{4}^\circ$ .
- 8) Anti-divergence slits:  $4^\circ, 2^\circ, 1^\circ, \frac{1}{2}^\circ, \frac{1}{4}^\circ$ .
- 9) Receiving slits: 0.3, 0.2, 0.1 mm.
- 10) Soller slit:  $2^\circ$ .
- 11) Aluminium sample holders: 20x15x2 mm.
- 12) Ni Filter.

#### **Scintillation counter NaI(Tl)**

- 1) Be window preamplifier, cables.
- 2) Scaler of preset time : 0.1 – 1000 sec.
- 3) High voltage supply 600 – 2000 V, gain, low, central and high level control.
- 4) Count rate : 1,000,000 cps

**. Electronic interface with the following electronic cards:**

- 1) Microprocessor controller for data acquisition.
- 2) Analyser and amplifier card and pulse high discriminator.
- 3) Power supply card for scintil. count..
- 4) Stepping motor control

**Personal Computer (latest version)**

Including 19" LCD Flat screen monitor, Color Laser Printer

**Acquisition from scintill. counter.**

: Software for windows XP is the program designed by Ital Structures for the control of the Diffractometric System. Version 2.0 includes some new features, like the batch programming of a set of measurement and the tutorial for the alignment of the instrument.

This program can interface many other diffractometers. The program can control different kinds of detectors: scintillation and proportional counters, linear and curved position sensitive detectors

Four main sections.

- 1) File: Save As function, Transfer to data analysis programs
- 2) Conditions: check of the discrimination of the counter chain; control of the X-ray generator; selection of the X-ray tube
- 3) Motors: movement (coupled or independent) of the motors of the goniometers. Reset (zeroing) of the goniometers.
- 4) Measurements: prepares and executes the measurements. Three scans are available: Step Scan, Continuous Scan, Fast Scan. Batch programming. It is possible to program cycles of measurements, using a single or a multiple sample holder.

**Powder diffraction program**

- 1) FILE I/O: data management on disk. Hard Copy. Data printing (Any type of printer).
- 2) UTILITY: sum and multiply by a constant. Four data buffers available.
- 3) DISPLAY. Scale normalization. Zoom. Graphical windows. Overlap and comparison of diffractograms. Multiview function. Cursor scan. Creation of graphic files .BMP. ICDD-PDF2 Card Overlap.
- 4) ANALYSIS: polynomial least squares smooth. Fourier smooth. Search for Peaks (automatic and manual). Spline background subtraction.
- 5) PROFILE: single peak analysis (area, FWHM, centroid, background).  
Marquart fit (with pseudo-Voigt and Pearson VII curves, Kalpha 2 contribution, weighted sum of squares)
- 6) QUANTITATIVE Creation of calibration curves. Analysis of unknown samples.

**Search-match program**

for Windows XP, based on ICDD PDF-2 data base (on CD-Rom).

- 1) FILE: samples data management. Data printing.
- 2) CARDS: JCPDS card reading (CD-Rom) Experimental data comparison (overlap, subtraction, angular position correction).
- 3) SEARCH: search-match. Auxiliary information: subgroups, chemical elements present or absent; peak intensity. Print out of results.

**Powder data bank ICDD**

: Release 2007 full files data base on CD-ROM disk.

**Material Analysis Using Diffraction**

It is an analysis software for diffraction/ reflectivity spectra based on the Rietveld method for diffraction with the following characteristics:

- 1) It is written in Java; it runs on any Java enabled platform. Requires Java 1.4.1 or better version.
- 2) Load different data format as provided by most of the major vendors and facilities

- 3) Work for different instruments, X-ray, neutron, TOF and geometries(Bragg-Brentano, Debye-Scherrer etc.)
- 4) Graphical interface to drive the software analysis
- 5) Automatic minimization routines for some standard analyses
- 6) Load phases, geometries from databases in CIF format
  - may perform different analyses using different model as for the following list:
    - 1) Crystal structure (Rietveld, ab initio structure solution, electron density map model, etc.)
    - 2) Microstructure. Size-strain (models: isotropic, anisotropic, Popa rules). Distribution, planar faulting....
    - 3) Quantitative phase analysis (Rietveld standard, amorphous).
    - 4) Texture (WIMV, E-WIMV, Harmonic, Standard functions). Pole figures, and inverse pole figures, using reconstructed or experimental intensities. ODF calculation. Pole figure coverage. Residual Stresses (No texture: tri-axial tensor; with texture: tri-axial for Reuss, Voigt, Geometrical mean).
    - 5) Reflectivity (Matrix method, DWBA LS fit, electron density profile, evolutionary computation)
    - 6) Minimization algorithms (Marquadt least squares, Simulated annealing, Evolutionary computation).
- 7) Other features: Plot of experimental and recalculated spectra. Plot selected dataset. MapPlot of selected dataset. Difference 2D plot of selected **dataset**.

#### **Thin Film Attachment**

by using a special detector holder, secondary Soller slit and a flat graphite monochromator, this attachment convert the geometry of the APD 2000 to parallel optics. It is an ideal method for the analysis of thin films, multi-layer samples and sample surfaces.

- 1) Technical data:
  - Soller slit: length 116 mm, divergence 0.2°
  - Secondary flat monochromator: graphite.

#### **Water cooling system.**

- The self contained system consisting of:
  - 1) hermetic reciprocating compressor
  - 2) Peripheral water pump (with anti-block design)
  - 3) Inspectionable stainless steel water tank with make-up cap on top of the unit

## **5. SCANNING PROBE MICROSCOPE Specifications**

We are seeking to purchase a computer controlled high-resolution imaging system consisting of a Scanning Probe Microscope (SPM) with controller and software and capable of Nanolithography, Nanomanipulation, and Multiple Mode Imaging Techniques (AFM&STM). The following minimum instrument specifications are required including installation:

### **1. Measuring modes:**

Following measuring modes should be provided by offered specification of device:

- 1.1. Contact mode
- 1.2. Noncontact and semicontact mode
- 1.3. Lateral Force Microscopy
- 1.4. Phase Imaging
- 1.5. Force Modulation Microscopy
- 1.6. Adhesion Force Microscopy
- 1.7. AFM Lithography and Nanomanipulation
- 1.8. Magnetic force microscopy
- 1.9. Electrostatic force microscopy
- 1.10. Kelvin Probe Microscopy
- 1.11. Piezo Response Force Microscopy
- 1.12. Scanning Contact Capacitance Microscopy dC/dV in contact mode
- 1.13. Spreading Resistance Imaging
- 1.14. Atomic Force Acoustic Microscopy with the sample actuated by piezoelectric transducer which emits acoustic waves into the sample. The surface vibrations are transmitted into cantilever via the sensor tip
- 1.15. AFM operation in liquids
- 1.16. Scanning Tunneling Microscopy
- 1.17. AFM/STM spectroscopies

### **2. Scanning Probe Microscope (SPM)**

- 2.1. Must be able to perform vertical engage, where the scanner moves in such a way as to eliminate lateral translation of the tip during engage.
- 2.2. Must include integrated software capable of automated step and repeat measurements.
- 2.3. Sample size must be up to 100 mm diameter and up to 20 mm height. Possibility to use scanning head alone for unlimited sample size.
- 2.4. Must include integrated top view optics and optical microscope with real-time color video display / image capture and cross hair (inside the AFM software).
- 2.5. Must include temperature and humidity sensors for control of atmosphere during the measurements
- 2.6. Must be compatible for operations in relatively low vacuum ( $10^{-4}$  Torr)

Sample size:	Up to Ø100x20 mm, and unlimited for use stand alone
Scan range:	100x100x10um, 10x10x2um, 1x1x1um

Non-linearity XY:	0.1% or better
Noise level of XY	0.001 nm or better
Noise level of Z:	0.03 nm or better
Min Control Resolution:	XY- 0.0004 nm;
Voltage:	220/110V, 50 Hz;
Power consumption:	~200 Wh.

### **3. Closed Loop AFM Head XYZ**

- 3.1. Must be a tip scanning system, with no motion of the sample.
- 3.2. Must be piezo-tube type construction
- 3.3. The tip scanning system must incorporate a laser tracking design that minimizes added mass to scanner.
- 3.4. The scanner must be equipped with sensors in X, Y, and Z – and operated in open or closed-loop mode. These sensors must be capacitance or optical with minimum noise 0.06nm
- 3.5. For speed and accuracy, laser and deflection detection system must not be mounted on the X, Y, or Z axis.
- 3.6. Must support a scan range of at least 100 microns square.
- 3.7. Vertical noise floor must be less than 0.05 nm RMS  
XY noise floor must be less than 0.01 nm RMS (0.2 nm peak-to-peak with closed loop feedback)
- 3.8. X-Y linearity must be less than 1%
- 3.9. Z -Sensor Noise in typical imaging bandwidths must be less than 0.06 nm RMS
- 3.10. The scanner must support all operating modes listed above without the need for additional hardware.
- 3.11. Scanning head **must** be made from non-magnetic material to have possibility of its use with external magnetic field. And can be used in low vacuum of  $10^{-4}$  torr.

#### **Optical video system**

Top view optical system with possibility to observe cantilever and sample.  
Side view possibility to control tip to sample approach process.

Resolution 1um or better

Numerical aperture 0.1 or better

Field of view 4.5 mm or better

Magnification 1050x or better

Videomicroscope with manual zoom

Color CCD camera (SSC-DC50AP ½' CCD, 470 TVL or better) with power supply and 20"

LCD display (Sony SSM-14NSE horizontal resolution 500 TVL or better).

***PC with latest configuration suitable for interface and control of the SPM, and data acquisition.***

#### **Vibration Isolation:**

Active vibration isolation desktop system. Isolation: dynamic 0.7 to 1000 Hz, passive beyond 1000 Hz. Transmissibility: Above 10 Hz transmissibility less than 0.01 ( -40dB ). System

Noise: less than 50 ng/Hz<sup>1/2</sup> from 0.1-200 Hz in any direction. Max. load 150 kg. Table top 400 X 450 mm. Weight 16 kg

#### **Heating/cooling options:**

The system must be equipped with heating/cooling stage for operation in ambient air and liquid environments.

Temperature range -30°C-120°C

Temperature stability not worse than 0.005°C

#### **4. Upgradeability**

- 4.1. For crucial long term experiments must have possibility to be upgraded with low drift unit: 5nm/hour
- 4.2. Upgradeable with heating up to 300°C
- 4.3. Must be compatible with SNOM-attachment
- 4.4. Modular system of basement should provide possibility to upgrade with vacuuming to 10<sup>-4</sup> torr
- 4.5. Must be compatible to install basement onto inverted optical microscope.

#### **5. Controller**

- 5.1. Three 22 bit compound DACs for each channel (X,Y,Z). A single large area scanner (100 microns) must be able to provide small scans (<50nm) without artifacts caused by quantization or aliasing.
- 5.2. 3 ADC: 16-bit with preamplifiers
- 5.3. 16-bit DAC for Bias Voltage control
- 5.4. 12-bit DAC for user output
- 5.5. 5 external inputs for user flexibility
- 5.6. 4-input 5 MHz Lock-In with I,Q,R, outputs.
- 5.7. Frequency synthesizer: two independent full digitally controlled output generators for modulation modes amplitude: 0-20V(p-p), frequency: 0-5MHz (or better)
- 5.8. Lock-in phase detector having at least four 16-bit analog-to-digital (A/D) converters with software controlled variable gain inputs to digitize the outputs of the lock-ins.
- 5.9. Controller must provide dual lock-ins, each capable of 360 degree quantitative cantilever phase detection, 0 Hz to 5 MHz.
- 5.10. Supports signal access module (break-out box) for user defined experiments and access to all signals
- 5.11. Must include Integrated two-channel pulse counter with Impulse frequency up to 10 MHz
- 5.12. Controller must be able to provide simultaneous images from at least 3 data acquisition channels (note that trace an retrace or first pass and second pass are not considered to be simultaneous)
- 5.13. Automatic system hardware identification, control of external devices (**I2C bus**).

- 5.14. Must include self-diagnostic board for automatic testing
- 5.15. It must be possible to overlay trace & retrace scans during imaging.
- 5.16. The software must provide the capability to determine the cantilever resonance frequency and set the resonance amplitude by one mouse-click operation. It must also be possible to set the phase at resonance to 90 degree, by one mouse-click operation.
- 5.17. Controller must be capable of digitally reading and controlling tip-sample separation so advanced software enhancement techniques can be utilized.
- 5.18. Support 2 scanners with max scan size 200x200x22um
- 5.19. Controller must be able to provide real time piezo linearity correction for piezo voltage/response to better than 2%. Linearization must operate on all scan rates and scan sizes over the entire range of the scanner without introducing noise.
- 5.20. Controller must provide complex feed-forward and feedback algorithms to optimize control of tip-sample forces.

## **6. Software**

- 6.1. Automatic cantilever spring constant calibration required
- 6.2. Graphical User Interface within SPM Software for customized force Measurements: enables design of complex force experiments, implementation of Macro routines etc. Scripting support of user-defined force curve paths. Powerful off-line export and processing tools.
- 6.3. Free life-time software update
- 6.4. Image analysis Windows-based software should include at least following features:
  - Cross section analysis
  - Roughness measurement
  - Grain size analysis
  - Depth analysis
  - Power spectral analysis
  - Histogram analysis
  - Fractal analysis
  - Fourier analysis
  - Image mixing
  - Autocorrelation
  - Enhanced image filtering tools
- 6.5. Image modification and presentation software should include at least following features:
  - Force-distance curve analysis
  - 2D Fast Fourier analysis
  - Plane-fit
  - High pass and low pass filters
  - Zoom in/out
  - Optional grid on images and curves
  - Variable shading and display angle tilt
  - Color bar completely user definable 2D and 3D height presentation
  - Menu for image series presentation
- 6.6. Image and data export format at least:
  - Export to BMP, JPG, TIFF
  - Export to ASCII format and MatLab

- 6.7. The software must include Macro Language scripting possibilities for optimization of routine operations and user-defined experiments
- 6.8. Must include automated system configuration for operation in liquids to operate these modes by one mouse click
- 6.9. Must include automated system configurations for advanced modes like SKM, MFM etc to operate these modes by one mouse click
- 6.10. Software must be a sole package for all modes and attachments with no need for additional software programs.
- 6.11. Software package must include both image acquisition and data processing software in one package with no need for different programs operation.
- 6.12. Software must be free-for copy, e.g. can be installed on unlimited number of off-line PC

NOTE:

- (i) The vender must provide the list of accessories, spares and consumables for minimum operating period of 5 years and enclose such list. Any additional feature will be considered.
- (ii) The supplier shall erect and commission the equipment in our laboratory, demonstrate the performance of the equipment.
- (iii) Pre-requisites, if any, for installation of equipment at site should be clearly indicated in Technical Bid.
- (iv) The vender must provide 1 copy each of operation and maintenance manuals along with complete circuit diagram of the main equipment and all its accessories.
- (v) Minimum two to three weeks training free of cost, is required to be imparted at the installation site for willing persons and one to two persons at manufacturing site.

## 6. Mask Aligner for photolithography

### Specifications

#### *Mask Alignment & Exposure System Model :*

##### **Standard Features**

- Manual Control system
- Sample size : Piece~4" wafer
- Mask size : up to 5"x5"
- UV Exposure Light source with 350Watt Power Supply
- Dual CCD zoom microscope and LCD ( 17 inch ) monitor
- Large Area Stationary Alignment Tooling Module with X,Y,Z and Theta motion
- Wedge Error Compensation ( Air bearing type )
- Dimension : 1000 (W) x 950 (D) x 800 (H) mm

##### **System specification**

###### A. Light source module

- Near UV light source : 350nm to 450nm
- 365nm Intensity : > max 30 mW/cm<sup>2</sup>
- Max. Beam Size : 4" x 4"
- Beam Uniformity : <±5%

###### B. Microscope

- Dual CCD zoom microscope with 17" LCD monitor
- Magnification : 80x ~ 1000x

###### C. Stage and controller module

- Exposure Timer : 0.01 sec to 999.9 Hour
- Stage movement : X,Y,Z and Theta
- X, Y : 10 mm,
- Theta : ±5°
- Z Motion Travel : 10 mm
- Contact Mode : Soft, Vacuum, Hard, Soft Contact Vacuum & Hard contact force is adjustable
- Alignment Accuracy : <±1.0 micron
- Vac. / Pneumatic Controls : Substrate, Mask, Contact, , Chuck lock

###### D. Resolution

- Vacuum Contact : 1um ( Thin PR@Si Wafer )
- Pressure Contact : 2um
- Soft contact : 3um
- 20um Proximity : 5um

#### F. Utilities requirement

- Electric power : 220VAC, 15 Amp , single phase with Ground
- Nitrogen : >40 psi ( 3 kg/cm<sup>2</sup>), Ø 6 mm
- OFA : >85 psi ( 5 kg/cm<sup>2</sup>), Ø 6 mm
- Vacuum : < -200 mbar ( Vacuum Pump Include )

***Note:- Suitable Vacuum pump should be provided with the system***

#### **G Vibration Isolation Table**

- Isolation size : 1000 x 1000 x 20t
- Type : Vibration Isolation system
- Top plate : Steel
- Top Skin : SUS 304 H/L
- Height : 750 mm ( From Floor To Top )
- leveling : 3-Point self leveling

-Natural Frequency :

Vertical : 1.2 ~ 1.5 Hz

Horizontal : 1.5 ~ 1.8Hz

-square arm Rest

-Under Shelf

#### 2. UV Lamp

capacity : 350W

life time : 600 Hour

## 7. Spin coater with baking plate

### Specifications

#### Motor Spinner:

- \* 0 to 6,000 rpm spin range
- \* 1 to 30,000 rpm/s acceleration (unloaded)
- \* 0-999 sec in 1 sec increments timer
- \* Repeatability with +/- 5 rpm and +/-1 rpm resolution
- \* Coating uniformity: < +/-3% over 4" diameter area, 2 mm edge exclusion zone
- \* Vacuum interlock to prevent motor spinning when there is no vacuum

#### Programmability:

- \* should be programmable with multi steps per program
- \* PID control in speed, acceleration, and time with display

#### Machine construction:

- \* Bench top stainless steel body casing (chemical resistant and ease of cleaning)
- \* Exhaust and drain port located below the wafer level (for better uniformity control by exhaust adjustment)
- \* Utilities connections (vacuum, drain, exhaust, power) should be located at the rear of the system
- \* Acrylic transparent top cover plate, for full viewing of process during spinning
- \* Adjustable exhaust flow

#### Vacuum Chucks:

- \* Vacuum chuck for 3"/4" wafers

#### Hotplate:

- Suitable for maximum 6" round wafers
- \* Temp. Resolution: 0.1°C
- \* Temp. Uniformity: 0.5°C
- \* Temp. Range: 50-300°C
- \* Programming: multiple programs with multiple steps

#### \* On-Site Installation and Training

#### \* 12 Months Warranty

## 8. Scanning Electron Microscope

### Specifications

**Resolution :-**

SE Image- 3.0nm or better

BSE Image 4nm or better

**Accelerating voltage:** upto 30KV or better

**Standard Detectors:**

Secondary Electron Detector & High sensitivity 5 Quardant semiconductor type  
Back scattered Electron Detector(BSED)

**Magnification:** 5X to 300,000X or better

Large and standard analytical specimen chamber to accommodate samples of 20mm in diameter.

**Large Compueucentric Five axis motorized specimen Stage** with X/Y 100x50 mm  
Z-5 to 65 mm(with high tilt – 20 to +90 Degree, and Rotation 360 degree.

Raster Rotation/Dynamic Focus/ Tilt Correction

**Latest Pentium D945 (3.4GHz) PC** latest configuration, 512MB DDR-SDRAM, 80GB HD,  
CD-RW/DVD with mouse, Keyboard.

**Wehnelt Assembly** for cartridge Filament and standard Filament which are factory pre centered Tungsten (W) Hairpin Filament

Standard Control Panel with Rotary Knob for Manual operation standard tools and consumables.

Auto Transformer

To operate SEM on 220/50Hz AC.

17” LCD Monitor

Printer (Mono Laser Printer)

Sputter Coater with Au target assembly for sample preparation

Step down Transformer

Carbon Coating Attachment for sputter coater with carbon rods set.

Suitable UPS (if recommended by manufacturer) should be supplied with the complete system.

## 9. Precision LCZ meter

### Specifications

LCR/LCZ meter fully automatic for high speed measurements (Preferably HP or Agilent make)

Parameters to be measured	L, C, R, Z, D, Q, G etc.
Equivalent circuits for measurement	Parallel, Series
Measurement modes	Auto, manual
Triggering modes	internal, external, manual, GPIB
Test frequencies	20 Hz to 2 MHz
Capacitance Range	$1.000000 \times 10^{-18}$ F to $999.9999 \times 10^{18}$ F
Inductance Range	$1.000000 \times 10^{-18}$ H to $999.9999 \times 10^{18}$ H
R, Z range	$1.000000 \times 10^{-18}$ ohm to $999.9999 \times 10^{18}$ ohm
Vdc	$1.000000 \times 10^{-18}$ V to $999.9999 \times 10^{18}$ V
Accuracy	>0.1%
Test cable length	> 2 meter

## 10. Potentiostat /Galvanostat

### Specifications

For Electrodeposition of Nanostructures/Nanowires, EIS applications.

#### **Detailed Specifications:-**

- Potentiostat/Galvanostat/FRA with Zero Resistance Ammeter
- Voltage available at counter electrode:  $\pm 100V$  (Compliance Voltage) at  $\pm 2A$
- Potential range:  $\pm 10V$
- Modulation: DAC, Resolution: 16 bits
- Rise Time :< 250ns (No-Load)
- Frequency Range ( for EIS): 10  $\mu Hz$  – 1 MHz
- Slew Rate : >15V/ $\mu s$  (No-Load)
- Current Range: 40pA -  $\pm 2A$
- Current Resolution: 1.2 fA
- Electrometer Bandwidth: 3dB@ >15MHz
- Input Impedance:  $10^{13}.\Omega$  or >10 T $\Omega$
- Input Current: < 5pA at 25 Deg C
- External signal recording (temperature, pH)
- Interface with PC: USB
- Software with at least the following features - Corrosion Techniques-CV-CA-CP, Pulse Techniques, Electrodeposition and Electroanalytical Techniques, EIS (Single Sine, Fast Multi Sine). Software should be compatible with: Microsoft Windows 98/XP

#### **Accessories:**

1. Flat Specimen Holder:  
The specimen holder should be made of Tefzel<sup>®</sup> and designed to accept flat specimens 0.625  $\pm$ 0.010 inch in diameter and up to 1/8 inch thick, exposing 1cm<sup>2</sup> of the specimen to the test solution.
2. AgCl Reference Electrode, Pt Electrode, Glassy Carbon Electrode

#### 1. **Softwares:-**

***The Instrument should contain the following software's.***

1. ***Corrosion Measurement software***
2. ***Cyclic Voltammetry and Linear sweep software***
3. ***Impedance Spectroscopy software***
4. ***Chronoamperometry and Chronopotentiometry software***

**5. (Electro Analytical software) Normal pulse and Differential pulse voltametry software**

**6. Electrochemical Impedance spectroscopy modeling software.**

**2. Software should enable:**

**Potentiodynamic Polarisation study, Tafel plot, anodic and linear and cyclic polarization, potentiostatic and galvanostatic and galvanodynamic plots, galvanic corrosion study, chronopotentiometry, chronoamperometry, cyclic square wave and square wave voltammetry, normal, reverse normal, & differential pulse voltammetry, linear scan, staircase cyclic & ramp cyclic voltammetry, electrochemical impedance spectroscopy, recurrent potential pulsing, recurrent galvanic pulsing, windows compatible data and graphics ability.**

**3. Software should be compatible with:**

**Microsoft windows, 95/98/2000/NT/XP**

**4. The Instrument should have the capability of interfacing the Following Accessories in future.**

**1. Quartz Crystal Microbalance(QCM)**

**2. Rotating Disk Electrode(RDE)**

**3. Rotating Ring Disk Electrode(RRDE)**

**4. Static Mercury Drop Electrode**

**5. Power boosters for High current applications.**

**6. Flat Specimen Holder**

**5. Accessories required:**

**2. Flat Specimen Holder:**

*The specimen holder should be made of Tefzel® and is designed to accept flat specimens 0.625 ±0.010 in. in diameter and up to 1/8 in. thick. It should expose 1cm<sup>2</sup> of the specimen to the test solution.*

**6. System should be Interface with PC through USB.**

**7. Installations:**

***Complete installation of all hardware and software with successful demonstration of equipment at user site***

**8. Warranty:**

***The whole set up (incl. all hardware and software) shall be guaranteed to work satisfactorily for a period of one year from the date of installation.***

## 11. VLSI Prefab IMAGE Lab; 10 node Lab

### Specification

- 1.1 HookIN Observability: Random internal signal visibility tool, which enables to monitor any signal or port, implements VHDL-in-VHDL-out and Verilog-in-Verilog-out; observing ports or signals of any level in the design hierarchy.
- 1.2 ForceIT Controllability: Forces any signal to any desired value i.e. stuck at “0” or stuck at “1”.Deliberately inducing a glitch by forcing a signal. It should provide a procedure by which the user can freeze a signal value, force it to some logic level and observe the changes and then release it, and retain the previous values.
- 1.3 MiRAGE Memory Mapping: It enable the IMAGE tools to map these instances to on-board memory resources. This can save FPGA resources, and increase the effective capacity of the hardware. Arbitrarily ported memories as well as ROMs can be modeled using this feature.
- 1.4 IMAGE API and Simulator Interfaces: IMAGE comes with a full-featured API using which a user application that works together with the hardware can be constructed.
- 1.5 The simulation is going to be clock based if one has specified no signals in sensitivity list, i.e. specifying no events. Else it will be event based.
- 1.6 TiGER Automatic Time Division Multiplexing (TDM): for data exchange between the four FPGAs. There is a limited number of i/o for each FPGA, the signals at any, which need to be passed from one FPGA to another might be more than available, for this we apply TDM logic, sending some signals at a time.
- 1.7 IMAGE Star System: A customized IMAGE System with high computational processor Server on which the card & the software are running; and connected to ten Pentium nodes in start topology; with eleven monitors for student usage.
- 1.8 IMAGE ScaleUP: Software and hardware for adding more four FPGA PCB Card on the machine, to scale-up the Capacity to maximum 80 Million FPGA Gates and 96 MB SRAM.
- 1.9 Black-boxes, Unsynthesizable Entities: A black-box in the system is piece of already synthesized RTL which needs to be ”dropped-in” to the hardware. An unsynthesizable entity/module is a design unit which the user marks as unsynthesizable; The Software should pull this unit out of the hardware and place it on the host-side for the co-simulation process.
- 2.0 IMAGE Board: Two Boards; Four FPGAs on a single PCB Board with a t capacity of 20 Million FPGA gates. The total FPGA capacity should be 40 Million FPGA Gates.
- 2.1 48 MB SRAM on the two FPGA Boards.
- 2.2 The board sits on a 32-bit, 33 MHz PCI bus, talk to it through PLX chip, PCI-9054. An API is attached to the board, which helps us have Simulation Software as the user interface using FLI/FMI of the respective simulators.
- 2.3 IMAGE Signal Coding: It should use bits to encode complex user-defined types. In particular the VHDL std logic type and the Verilog wire types can be coded as multi-valued types as well as two-valued types.
- 2.4 For Synthesis
  - 2.4.1 IMAGE Bottom-up software to reduce the synthesis time.

- 2.4.2 The software should have the ability to use the ten nodes of IMAGE Star System for Parallelizing; the four machines in a star topology with the main IMAGE server for reducing synthesis time.
- 2.5 Software that make the FPGA Board compatible with simulation software.
- 2.6 Mixed HDL support i.e. VHDL as well as Verilog.
- 2.7 Software that make the FPGA Board compatible with standard synthesis tool.
- 2.8 PartIT Partitioning of Design:: Automatic partitioner of design at RTL level; which respects the design hierarchy. Design fits into multiple smaller capacity FPGAs. Intelligent partitioner: less inter-FPGA communication between the partitions. The basic functionality remains unchanged. Each partition has approximate equal gate count
- 2.9 IMAGE Flow Debugging: in order to track down the source of a possible mismatch between your software simulation and IMAGE accelerated simulation, the IMAGE installation includes a set of utilities which can allow you to break the IMAGE mapping flow at different points and to simulate the transformed RTL.
- 3.1 For embedded software development: the system for which embedded software is to be developed should be mapped to hardware by the Software. The Software provides mechanisms for loading code onto the hardware mapped design together with examination/deposit debug features.
- 3.2 Clocks and Timing: It should allow the source RTL to have an arbitrary number of clocks. Clock-gating logic should also be permitted and so are asynchronous descriptions.
- 3.3 Design Re-use: A design unit that is already mapped to IMAGE hardware may be re-used in another simulation without having to repeat the mapping process.
- 3.4 Standard Simulator, Synthesis, Place & Route and other tools required for making an in-house prefab level Chip to be provided with the above tools.
- 3.5 All Software tools will have a perpetual license.
- 3.6 Onsite support for the above tools for a period of one year.
- 3.7 For a period of one year, all new versions and upgrades of the software will be provided free.
- 3.8 IMAGE Learning Resource (ILR)
- 3.8.1 IMAGE Learning Resource (ILR-Video) : A set of CDs; Lab teaching and VLSI learning from eminent IIT professors via CD.
- 3.8.2 IMAGE Learning Resource (ILR-Books) : Lab Exercise Books for students so as to make best use of the laboratory. This should cover examples on simple chip design to graduating the student to making a complex chip. This is to make learning easy.
- 3.9 Vendor has to work with the University/Department as Industry and Research (I&R) partner.
- 3.9.1 To be I&R partner, it is important that vendor come from top technology & research institute, like IITs/IISc; so that the interaction opens a new window opportunity for the University/Department; this interaction is of great value for students, faculty & University.

- 3.9.2 The vendor has to organize interaction, (within Department or at the IITs/Company premises), of the Department/University Professors/Students with top IIT/Industry innovators/ academicians/ scientists from VLSI field. This will help make Department/University reach global standards in the field of VLSI.
- 3.10 Original manufacturers should bid directly. Lobbying agents or bribery in any form from the vendor will make the vendor liable for disqualification.
- 3.11 Networking & Computational Facilities for the VLSI Lab i.e. Computers, servers, connections and wiring to be done by the vendor.
- 3.12 Detailed faculty training program to be conducted after the installation.

**Support:**

1. Support for the above software tools for a period of one year.
2. Software tool will have a perpetual license.
7. For a period of one year, all new versions and upgrades of the software will be provided free of cost.

**Additional requirement:**

1. Annual Maintenance Cost support should be provided for the tool in addition to the one-year warranty. Kindly quote the price for the same.

## 12. Intellisuite

### Specifications

*Latest version of the software (for 5 licenses) should be provided with following specifications*

#### **2D Mask Layout Editor**

- Support All angle layout, Curvilinear elements and Boolean operations
- Multi-Layered Mask Layout editor with Scripting capability
- Parametric Element and device library including active MEMS, passive MEMS, Packaging MEMS and inertial MEMS like accelerometer designs (Poly-si, SOI, bulk), and gyro designs (Poly-Si, SOI, DETF, rotary, distributed mass and mDOF gyros)
- Inversion from clear field (CF) to dark field (DF), and vice versa.
- Support Cell Based hierarchy, full Layer Transparency and deeply nested cells
- Support formats including DXF, GDSII, CIF, Gerber, RS-274X, EMASK, PS.

#### **MEMS Process Flow Traveler**

- 3D virtual prototyping using actual 2D mask layouts and actual process flows to create, edit and debug process flows that can be exported for thermo-electrical-mechanical analysis
- Fabrication database including support for all major MEMS process steps such as photolithography, lift-off processing, thin film deposition, metallization, electroplating, doping, wet and dry etching, wafer bonding and assembly
- Standard Design Rule Checker
- Ready to use Foundry Templates: MEMSCAP MUMPS, Sandia (SUMMIT), Infotonics (SOI hybrid), AMI-MOSIS, Bosch Surface Micromachining, LIGA, Cornell SCREAM.
- Implant and Doping, CMOS Process Modeling, Etch Modeling
- Auto-meshing (tetrahedral and hexahedral) & Auto-hex-meshing

#### **Thin-Film Material Database and Process Characterization tool**

- Comprehensive thin film database featuring over 70 processes
- Characterize thin film material properties based on actual fabrication machine settings.
- View graphically the fabrication dependence of material properties
- Predict Material properties based on interpolation, extrapolation, extension, and averaging criteria
- Add and model proprietary data

#### **Anisotropic Etch Simulation Software**

- Support Advanced Cellular Automata-based accurate etch simulation technique
- Simulate KOH/TMAH/Dry etching of <100> and <110> wafers
- Inbuilt TMAH and KOH etch-rate databases, or use customized etch-rate data
- Simulate etching under different time, temperature, and concentration parameters
- Perform corner compensation and process deviation studies
- Support double side etching and Multiple protective etch stops
- Visualize and export 3D results in DXF and VRML formats

#### **RIE/ICP Process Optimization tool:**

- 3-D Simulation of isotropic, RIE/ICP and BOSCH process
- ICP/BOSCH Etching, Ion Assisted Etching
- RSM Derived STS Database, STS Etch Database, Rigorous Characterization
- Predict sidewall scalloping, roughness, periodicity
- Predict final dimensions, sidewall angles and shape of features
- Simulation of RIE lag, RIE notching and etch termination (pinch-off) behavior
- Front-side release processes in SOI based processes

- Release prediction: isotropic release of plates for polysilicon-based MEMS Trench refill and trench isolation simulation for high voltage circuits

#### **Interactive 3D Device Modeling tool:**

- Interactively create or refine structured or unstructured 3D meshes
- Rectilinear and polar grids to aid in the creation of optimal meshes
- Automeshing of complex layouts and direct conversions of a mask set to solid
- Import/Export grids in formats like ABAQUS, ANSYS, PATRAN etc
- Mesh refinement techniques such as spider webs, corner frame meshes or zippered meshes
- Model Higher order Bi-cubic elements
- Mask to Mesh capability

#### **Coupled Thermo-Electro Mechanical and Piezo Analysis with System Model Extraction:**

- Perform thermal, electrostatic, mechanical, magnetostatic and coupled ThermoElectroMechanical analysis for static, dynamic, transient or frequency.
- Independent electrostatic and mechanical meshing based on exposed face mesh algorithm and support multi-bank exposed face meshing.
- Create Finite Element Models from masks layouts and process flows, or directly element by element using interactive builder
- Import/Export files from ANSYS, PATRAN, and IDEAS
- Direct integration transient analysis (both auto increment and fixed increment analyses) and time dependent loading
- Full contact, post-contact and hysteresis analysis, squeeze film damping, piezoelectric and piezoresistive, and packaging analysis
- Parametric variations and Sub modeling in Piezo analysis
- Investigate second order coupling such as temperature dependent Piezo properties, hysteresis modeling and piezoresistive joule heating
- Micro assembly and latching modeling
- Perform Simulation of static and frequency responses of magnetic and electromagnetically actuated MEMS.
- Simulate Lorentz force driven actuators like mirrors, switches and mechanisms
- Design of Nanostructures and MEMS combined with Nanostructures such as CNT based sensors
- Perform piezoresistive and electro-thermal-stress simulations to understand CNT response to TEM loading

#### **System Model Extractor:**

- Creates N-DOF models that accurately capture the dynamic response of MEMS
- Automated or semi-automated behavioral model extraction
- Generation of rigid body models for designing readout electronics, generate second order effects for compensation electronics and capture harmonic and sub-harmonic response for design of active MEMS control.
- Automatic calculation of modal contribution factors and modal energies.
- Automatic formulation of device dynamics (Lagrangian formulation)
- Model output to HDL, Verilog and Matlab support

#### **Microfluidic Analysis:**

- Navier-Stokes solver optimized for Microfluidic and BioMEMS applications
- Multi-block finite volume solver for open/closed boundary flow incorporating multiphysics transport conservation
- Electrokinetics (including electroosmosis, electrophoresis and dielectrophoresis)
- Support for Acids, bases, ampholytes and Strong and weak analytes
- Reaction kinetics of multi-valent analytes
- Fully coupled transport stoichiometry
- Distributions solved exactly with no a priori approximations (pH, current, voltage,

conductivity, ionic strength)

- Redox reactions at electrodes (Galvanostatic or potentiostatic), Electrochemistry and Stoichiometry along with flow
- Unique boundary conditions such as Adsorption
- Simulation of Electrowetting on Dielectric (EWOD)

#### **ElectroMagnetic Analysis:**

- 3D FEA based electromagnetic solver with capability to perform 3D full wave analysis of deformed structures from ThermoElectroMechanical solver
- Built-in solvers like CG and GMRES
- 3D display of Electrical and magnetic field, Smith Chart display
- Network Parameters Extraction like S, Z, Y etc....

#### **Packaging Analysis:**

- Stress/Strain, Deformation/Warping analysis
- Modal, buckling, Mechanical shock analysis, Vibration variable frequency testing
- Coupled squeezed film damping analysis
- CTE mismatch & thermal gradient analysis
- Q factor determination
- Parasitic/ Substrate coupling and cross talk
- Package/board resonances
- Reflection noise & Transmission characteristics
- Circuit-package interaction

#### **System Level Tools:**

- Export data from the fully coupled ThermoElectroMechanical Analysis module to EDA Industry Standard formats like SPICE (H, P, & etc...), Verilog, Verilog A and VHDL for system level simulation.
- Create accurate NDOF dynamic system models from MEMS FEA/BEA models
- Compatible with EDA tools from Cadence, Tanner, Mentor or Synopsys
- Integrated CMOS-MEMS (SoC/SiP) compatibility

#### **Multi-Domain System Modeling Tool:**

- Element libraries for analog, digital, mixed signal, mechanical, and MEMS elements.
- Analyze transient response, small and large signal analysis, steady-state analysis, sensitivity analysis (AC and DC), noise analysis, parametric analysis etc...
- Easy and Flexible element definition
- Create and simulate arbitrary N-DOF MEMS (12 DOF beam elements, 24 DOF gap elements, 24 DOF plate elements)

#### **Multiphysics**

Fluid structure interaction (Coupled 3D Fluid-Structural-Piezo), multi-processing, TEM + Fluidics + Magnetics + Electromagnetics + ....

Fast BAW / SAW Solver

Fast impedance extraction (3D MoM based fast field full wave solver)

Mechanics (FEM), Fluidics (VOF), Electrostatics (Multipole accelerated BEM),

Electromagnetics (Multipole accelerated pFFT BEM)

3D Electrowetting simulations, advanced chemical reactions.

#### **Enhanced Etch Simulator**

Visual tool for understanding etching (wet etch and dry etch simulator)

GUI simulator of wet chemical and DRIE etching with multi-masking capabilities, built upon an octree representation of the substrate

Atomistic simulations

Predict high order planes, surface morphology, design corner compensations and composite etches

Apply and release different kinds of mask layouts, such as silicon nitride (Si<sub>3</sub>N<sub>4</sub>) and silicon oxide (SiO<sub>2</sub>), on the silicon substrate many times on both the top and bottom wafer surfaces in a flexible manner, which is one of the important features to support the

Simulation of complex MEMS fabrication processes.

Creation and editing of Mask files in standard BMP image files like many image-processing tools such as MS Paint, PhotoShop or GIMP

Micromachining of (111) plates in (001) oriented silicon

Micromachining of silicon beams in (001) oriented silicon

Novel Compensation process for Perfect Convex Corner

Fabrication of Multi-level Microfluidic Channel

Surface/Bulk Micromachining Process on the (111) oriented wafer

Fabrication of Pen-shaped Microneedle Array

**Note: Installation and a training covering examples demonstrating the entire package along with its applications should be provided at client's site. Perpetual floating license should be provided and terms and condition for AMC should be clearly indicated.**

## 13. Mathematica

### Specifications

*Only the latest version of the software (version 6.0 or higher) with following specifications should be quoted(for 25 Licences)*

#### **Add-on modules (1 user license)**

- Control System Professional Suite with Advanced Numerical Methods
- Digital Image Processing
- Mathematica Link for Excel
- Signals and Systems
- Wavelet Explorer
- Geometrica
- Operations Research 2.0
- Tsi ProPac
- UnRisk
- Dynamic Visualizer
- Analog Insydes
- Best viewpoint
- Experimental data Analyst
- Mathcode C++
- MathGL3D
- Mathmodelica System Designer
- SchematicSolver

## 14. MatLab

### Specifications

<b>Module Name</b>	<b>No. of Licences</b>
<i>Application Deployment</i>	<b>5</b>
Excel Link MATLAB Compiler	
<i>Control System Design and Analysis</i>	<b>1</b>
Control System Toolbox	
<i>Image Processing</i>	<b>1</b>
Image Processing Toolbox	
<i>Math and Optimization</i>	<b>1</b>
Extended Symbolic Math Toolbox	
Genetic Algorithm and Direct Search Toolbox	
Optimization Toolbox	
Partial Differential Equation Toolbox	
Symbolic Math Toolbox	
<i>Signal Processing and Communications</i>	<b>1</b>
Communications Toolbox	
Filter Design HDL Coder	
Filter Design Toolbox	
Fixed-Point Toolbox	
RF Toolbox	
Signal Processing Toolbox	

Wavelet Toolbox

*Statistics and Data Analysis* **1**  
Curve Fitting Toolbox

*Control System Design and Analysis* **1**  
Simulink Control Design

Simulink Parameter Estimation

Simulink Parameter Estimation

*Event-Based Modeling* **1**  
SimEvents

Stateflow

*Fixed-Point Modeling* **1**  
Simulink Fixed-Point

*Signal Processing and Communications* **1**  
Communications Blockset

RF Blockset

Signal Processing Blockset

Video and Image Processing Blockset

*Simulink* **1**  
Simulink

Simulink Accelerator

Simulink Report Generator

*Verification, Validation and Testing* **1**  
Link for ModelSim

Simulink Verification and Validation

## 15. MentorGraphics VLSI Design tool

### Specifications

#### **FPGA Design, Simulation and Synthesis Tool (S/W) 25-user license (Latest Version)**

Specifications:

Should include the following software with specified features:

##### **1. Design Creation Software**

Should manage complex ASIC or FPGA designs in VHDL/Verilog

- Should accelerate RTL Reuse
- Interactive HDL visualization and creation
- Automatic documentation and reporting
- Intelligent debug and analysis
- Concurrent design entry and checking

##### **2. Simulation Software**

- Should have integrated ModelSim verification and debug environment
- Should have language-neutral environment support
- Should support at least Verilog, VHDL, SystemVerilog and SystemC
- Should integrate with emulation, hw/sw-coverification and mixed-signal simulation
- Assertion-based verification with PSL support and functional coverage

##### **3. Synthesis Software**

- Integrated RTL and physical synthesis environment
- High-performance, easy-to-use, vendor-independent RTL synthesis
- RTL and technology schematic views
- Retiming algorithm
- Synthesis tool for designing PLDs, FPGAs and ASICs in VHDL as well as Verilog
- Should support FPGA devices from leading FPGA manufacturers like Xilinx & Altera

##### **4. Equivalence Checking Software**

- Equivalence checking for fast regression testing to verify all stages of gate-level implementation of designs
- Should compare two designs : (i) RTL to gate for synthesis and ECOs, (ii) Gate to gate for layout spins, and (iii) RTL to RTL for language conversion.
- Should have capacity to verify multi-million gate ASICs as one unit
- Should give exact location of errors

##### **5. Hardware / Software Co-Verification Software**

- Verification of hardware and software in embedded systems
- Should work on virtual prototype instead of physical prototype
- Accelerated firmware debugging

##### **6. Design-for-Test Support**

- Complete solution for Testability analysis, Scan, Boundary scan, Memory test synthesis and Automatic test pattern generation

### **Mixed Signal Design & Simulation Tools (S/W) 25-user license**

Specifications:

1. Complete Environment for the design, capture, layout and verification of analog, digital and mixed-signal integrated circuits.
2. **Design Software** : For schematic capture, netlisting, simulation setup and results viewing.
3. **Physical Layout Software** : For full custom IC design flow, including application bundle for editing, schematic-driven layout and top-level floor planning /routing.
4. **Assembly Software** : For floor planning, top-level assembly and interactive routing.
5. **Analog Simulator** : Should offer simulation and modeling options to deliver high performance and high-speed simulation with the accuracy required by the user.
6. **Mixed-signal Simulator** : Should enables top-down design and bottom-up verification of multi-million gate analog/mixed-signal SoC designs, and should be language-neutral.
7. **Parasitic Extraction Software** : Should have accurate transistor-level, gate-level and hierarchical xRC parasitic extraction.
8. **Physical Verification Software** : Should have both flat and hierarchical algorithms.

Please note:

1. All above tools must be compatible with Linux OS
2. Proprietary & Authorization certificate be provided with quotation
3. Onsite training to be provided after installation

## 16. Vertical laminar flow chemical bench (Wet)

### Specifications

#### Dimensions

**Inches : W x D x H**

Overall Dimensions : 77 38 100

Supply air : HEPA Filter efficiency. 99.99 % to 0.3 microns

- Ø Nouveau Minipleat rehabitatable prefilter of EU-6 rating inherently bacteriostatic, fungistatic for fresh air intake.
- Ø The total quantity of air exhausted will be approximately 1500 cfm @ 2" wg. Per unit.

#### **CONSTRUCTION : Non Metallic**

##### **The unit should Comprises :**

- Ø Toughened glass side panels.
- Ø Polypropylene rear panels.
- Ø Work table in Polypropylene with perforation.
- Ø The table should comprise of a built-in sink with DI water feed, a plain water feed and drain fittings. The drain with cock terminating on rear lower end of the unit.
- Ø Built-in polypropylene drain pan.
- Ø Polypropylene exhaust plenum.
- Ø Front shutter : Sliding type with Glass in Aluminium frame with counterweight arrangement

#### **CONTROLS :**

- Ø Custom-built direct drive type motors duly epoxy coated with blower housing in polypropylene casing & with polypropylene impeller, which is statically and dynamically balanced, sized to exhaust at least 1250 cfm @ 2" wg.

#### **INSTRUMENTATION & ACCESSORIES :**

- Ø Magnehelic Gauge : 1 – OFF
  - 0 – 25mm to indicate differential pressure across HEPA filter with respect to ambient.

Ø Air / gas cock

Ø 1-piece fully openable sliding toughened glass front sash with counterweight arrangement.

**ELECTRICALS :**

Ø Sealed white light in excess of 200 LUX

Ø 5/15 Amps. electrical sockets with switch for external equipment on the back side within the work area : 2 – OFF

## **17. Four Probe Resistivity Setup with Keithley source meter and software**

### **Specifications**

1. 4-point probe head & mounting stand with a Teflon isolation disc.
2. Dual configuration method and auto-ranging to assure accurate measurement.
3. System accuracy better than 1%.
4. Probe heads – 2 Nos.
5. 100 mm Probe stand with two probe head quick mounting blocks
6. Range 1 miliohm to 800K ohm per square.
7. System should be compatible to Keithley Sourcemeter. Vendor should quote necessary connectors.
8. vendor should provide Keithley Sourcemeter for measurement.
9. Necessary spares and consumables may be quoted in option.

### **Software:-**

1. Software for accurate measurement & control of probe head and Keithley Sourcemeter.
2. Should be able to display the parameters like Sheet Resistance, Resistivity and V/I.
3. Should allow printout and export of the data.

### **Laptop**

1. For installation of measurement and control software.
2. Configuration.: Latest version of Dell (Core 2 Duo with >2GB RAM, hard disk >300GB, CD-R/W and DVD writer) with necessary ports for controlling Keithley sourcemeter and Four probe setup.

## 18. Three Zone Horizontal Tube Furnace for heating up to 1200 °C

### Specifications:

Heating Zones	:	Three zones: central zone approximately zone length 6" (152 mm)
Maximum Temperature	:	1200 °C
Maximum heating rate	:	$\leq 20$ °C/minute
Normal Heating rate	:	10 °C /minute
Tube size and Materials	:	2"Dia. x40"L fused quartz tube included (500D x 44ID x 1000L mm)
Temperature controllers	:	Three Digital Controller, and each has 10-segement programmable
Heating Element	:	+/-1 or better, Fe-Cr-Al Alloy doped by Mo
Temperature Accuracy	:	+/-0.5 °C or better
Power	:	AC 220-240 single phase 50/60 Hz
Accessories	:	<ol style="list-style-type: none"><li>1. One quartz tube (2"D X 40" L) extra</li><li>2. One extra Temperature controller as mentioned above</li><li>3. One Rotary pump for vacuum annealing in furnace</li></ol>