

National Institute of Technology Meghalaya
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Meghalaya, India

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Ref: NITMGH/Pur./NIQ-EEE Lab /2015-1/2014-15/2619

Date: 23.01.2015

**NOTICE INVITING QUOTATION (NIQ) FOR SUPPLY & INSTALLATION OF EQUIPMENT
FOR ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY AT NIT
MEGHALAYA**

NIT Meghalaya invites sealed tenders in a two bid system for supply of equipment as per details at ANNEXURE-III. The first part is the **Technical Bid** which consists of technical requirements and general terms & conditions and the second part is the **Financial Bid**.

Prescribed Tender document, detailed fees and specifications, bid instructions and Terms & Conditions can be downloaded from the Institute website and should reach the undersigned on or before **1:00 PM on 24.02.2015**.

BID INSTRUCTIONS:

01. For submitting Technical and Financial bid, two separate sealed covers should be used with superscription clearly on the top of the Envelope. If two separate sealed covers are not used, the tender shall be cancelled as not conforming to the technical requirement. Both the sealed covers should be placed in the main sealed Envelope distinctly superscribed with the address of the Agency submitting the quotation and the Officer to whom the quotation is addressed to. Further, on the sealed cover, the following are to be written:

QUOTATION FOR SUPPLY & INSTALLATION OF EQUIPMENT FOR ELECTRICAL AND
ELECTRONICS ENGINEERING LABORATORY AT NIT MEGHALAYA.

NIQ REF No. NITMGH/Pur./NIQ-EEE Lab /2015-1/2014-15/2619 **dated:** 23.01.2015.

LAST DATE OF SUBMISSION: **24.02.2015, 1-00 p.m.** Technical bids will be opened on the same day at 3:00 p.m. After evaluation of technical bids, financial bids of the successful bidders will be opened on a later date which will be duly notified.

02. **Submission of Compliance Certificate:** Duly filled and signed Compliance Certificates (as per formats at Annexure-I A & B) are must with the Technical bid.
03. **Bid not transferable:** The bid documents are not transferable and the seal and signature of the authorized official of the firms must appear on all the papers and envelopes submitted.
04. The quantity mentioned for each item in the Annexure-III may vary depending on requirements.
05. **Softcopy of the Technical bid** in “.doc” or “.docx” format must also be submitted in a CD along with the Technical Bid, in addition to the hard copies.

NIQ TERMS & CONDITIONS:

01. **Rates:** Rates quoted in the Price Bid should be on DOOR DELIVERY NIT Meghalaya basis, as per details below:

Group:	Item Sl. No.	Item name
Sl. No.	Particulars	Rate
I	Basic Price (per unit)	
	Discount if any	
	Total	
	Taxes (pl. give break up)	
	Total (per unit)	
	Grand total for the item	
II	Transportation charge up to NIT Meghalaya premises (if applicable)	
III	Transit Insurance covering all risk up to 10 days after delivery (if applicable)	
	Grand total on door delivery at NIT Meghalaya	
IV	Annual Maintenance Contract rate (after expiry of warranty period)	

Note: Vague terms like “packing, forwarding, transportation etc. extra” without mentioning the specific amount will not be accepted. Such offers shall be treated as incomplete and rejected. Bidders shall indicate their rates in clear/visible figures as well as in words and shall not alter/overwrite/make cutting in the quotation. In case of a mismatch, the rates written in words will prevail. Usage of “White ink” to erase and then rewrite the rates will not be accepted. Bidders are advised to strike out wrong entries and rewrite clearly beside them. In such cases, the bidder shall have to sign and place their official seal for every corrected entry.

02. All documents submitted should be self-attested with seal of the bidder.
03. Bidder must unconditionally accept all terms and conditions stipulated in the tender document and all pages of the bid including all enclosures should be numbered and must be duly filled in, signed and stamped by the bidder or his authorized representative. Offers received without signature and seal on all pages are liable to be rejected.
04. **Validity of Quotation:** Quoted rates must be valid for 180 days from the date of quotation.
05. **Warranty:** The quoted equipment and components must be warranted for a minimum of one Year or period specified against the item.
06. **Literature must:** All the quotations must be supported by the printed technical data sheet/ literature and the specifications mentioned in the quotation must be reflected/ supported by such printed technical data sheet/ literature. The model no. and specifications quoted should invariably be highlighted in the data sheets/ literature for easy reference.
07. **Details of supply** of similar items to Institutes of National Importance in the North Eastern region must be provided.
08. **Presentation:** Technically qualified bidders may be called upon to give full presentation of the quoted equipment at NIT Meghalaya campus before opening of Price bid as a support of their Technical Quotations and for any clarifications.
09. **Equipment breakdown:** Any Equipment breakdown must be attended to within 72 hours during the warranty period of the equipment free of cost.
10. Supplier should produce Purchase Orders of similar equipment from Govt. Educational Institutes (like NIT, IITs, etc.) all over the India within last 3 years.

11. **Training:** If required, free training is to be provided to NIT Meghalaya personnel on the operation, maintenance and trouble shooting of the supplied items.
12. **After Sales Service:** Vendor should clearly state the available nearest after sales service facilities in the region, without which the offer will be rejected.
13. **Dealership Certificate:** The bidder/tenderer should be either a manufacturer or authorized agent of the foreign/Indian manufacturer. Dealers or Agents quoting on behalf of Manufacturer must enclose valid dealership certificate.
14. **Quality Certificates:** Valid certificate to prove the genuineness of the products and of International standard, as mentioned below, must be enclosed
 - (a) Manufacturer's certificate and
 - (b) ISO/ISI certificate.
15. **End user list:** Vendor should provide end user list of their products at least for last 3 years with documentary evidences.
16. **Earnest Money:** Refundable earnest money deposit (EMD) of 2.5% of the quoted value through demand draft **only** drawn in favour of National Institute of Technology Meghalaya, payable at Shillong, will have to accompany the technical Bid. The EMD of unsuccessful bidders shall be returned after award of contract without any interest. EMD of the successful bidder will be released on submission of the Performance Bank Guarantee or delivery of the ordered items, as applicable.
 Firms registered under DGS&D will be exempted from submitting EMD. In case of firms registered under NSIC, exemption will be given to the permissible extent, as indicated in their Certificate. All vendors claiming exemption must submit copies of their valid DGS&D / NSIC registration Certificate (along with the Technical Bid).
 Offers received without Earnest Money or valid Certificate shall be summarily rejected.
18. **Performance Bank Guarantee (PBG):** In case of items with order value of INR 5,00,000/- (Rupees Five lakhs) and above, the successful bidder shall furnish an unconditional PBG (as per format at Annexure II) for 10% of the Purchase Order value from a scheduled Bank of India, before release of the payment. Else 10% of the billed amount will be deducted as security deposit. Where the PBG is obtained by a foreign bank, it shall be got confirmed by a Schedule Indian bank and shall be governed by Indian Laws and be subject to the jurisdiction of courts at Shillong. The PBG shall guarantee that,
 - a) The Vendor guarantees satisfactory operation of the Equipment & components against poor workmanship, bad quality of materials used, faulty designs and poor performance.
 - b) The Vendor shall, at his own cost, rectify the defects/replace the items supplied, for defects identified during the period of guarantee.
 - c) This guarantee shall be operative from the date of installation till 60 days after the warranty period.
19. **Delivery:**
 - a. Time Limit: Maximum within 45(forty five) days from the date of issue of this purchase order.
 - b. Safe Delivery: All aspects of safe delivery shall be the exclusive responsibility of the vendor. At the destination site, the package will be opened only in the presence of NIT user/representative and vendor's representative. The intact condition of the package and the seal/indicators for not being tampered with, shall form the basis for certifying the receipt in good condition.
 - c. Insurance: The supplier is to establish 'All Risk Transit Insurance' coverage till door delivery at NIT Meghalaya.
 - d. Part Delivery: Acceptance of part delivery shall be a prerogative of the institute.

- e. Penalty for delay in delivery: The date of delivery should be strictly adhered to otherwise the Director, NIT Meghalaya reserves the right not to accept delivery in part or full.
20. **Genuine Pricing:** Vendor is to ensure that quoted price for the particular item is not more than the price quoted to any other customer in India, particularly to IITs/NITs and other Government Organization. Copy of the latest price list for the quoted item, applicable in India, must be enclosed with the offer.
21. **Conditional tenders not acceptable:** All the terms and conditions mentioned herein must be strictly adhered to by all the vendors. Conditional tenders shall not be accepted on any ground and shall be rejected straightway. Conditions mentioned in the tender bids submitted by vendors will not be binding on NIT Meghalaya.
22. **VAT deduction at source:** In case of suppliers within Meghalaya, VAT deduction at source, as per Order/ notification of the Govt. of Meghalaya will be applicable.
23. **Late and delayed tender:** Late and delayed tender will not be considered. In case any unscheduled holiday occurs on the prescribed closing/opening date the next working day shall be the prescribed date of closing/opening.
24. **Payment:**
- (a) 100% payment within 30(thirty) days from date of delivery, installation and acceptance.
- Or**
- (b) 70% payment on delivery and balance after installation, acceptance and submission of PBG, wherever applicable.
- Or**
- (b) in case of acceptance of part delivery, 50% payment would be made towards the value of the partly delivered item/s.
25. **Enquiry during the course of evaluation not allowed:** No enquiry from the bidder(s) shall be entertained during the course of evaluation of the tender till final decision is conveyed to the successful bidder(s). However, the Purchase Committee or its authorized representative may make enquiries/seek clarification from the bidders. In such a case, the bidder must extend full co-operation. The bidders may also be asked to arrange demonstration of the offered items, in a short period of notice.
26. At any time prior to the date of submission of bid, NIT Meghalaya may, for any reason, either of its own or in response to a clarification from a prospective bidder, modify the bidding documents by an amendment / corrigendum. Any such amendment / corrigendum will be duly notified through newspapers and also uploaded on the Institute's website. Prospective bidders are advised to check the Institute's website every now and then for any amendment / corrigendum. In order to provide reasonable time to take the amendment into account in preparing the bid, NIT Meghalaya may extend the date and time for submission of bids.
27. The acceptance of the quotation will rest solely with the Director, NIT Meghalaya, who in the interest of the Institute is not bound to accept the lowest quotation and reserves the right to himself to reject or partially accept any or all the quotations received without assigning any reasons.
28. **Force Majeure:**
- If the performance of the obligation of either party is rendered commercially impossible by any of the events hereafter mentioned that party shall be under no obligation to perform the agreement under order after giving notice of 15 days from the date of such an event in writing to the other party, and the events referred to are as follows:
- (a) Any law, statute or ordinance, order action or regulations of the Government of India,
- (b) Any kind of natural disaster, and

(c) Strikes, acts of the Public enemy, war, insurrections, riots, lockouts, sabotage.

31. Termination for default: Default is said to have occurred

- (a) If the equipment or any of its component is found having poor workmanship, faulty designs, poor performance and bad quality of materials used.
- (b) If the supplier fails to deliver any or all of the services within the time period(s) specified in the purchase order or any extension thereof granted by NIT.
- (c) If the supplier fails to perform any other obligation(s) under the contract.

Under the above circumstances NIT may terminate the contract / purchase order in whole or in part and forfeit the EMD/PBG as applicable. In addition to above, NIT may at its discretion also take the following actions: NIT may procure, upon such terms and in such manner, as it deems appropriate, goods similar to the undelivered items/products and the defaulting supplier shall be liable to compensate NIT for any extra expenditure involved towards goods and services obtained.

32. Applicable Law:

- (a) The contract shall be governed by the laws and procedures established by Govt. of India and subject to exclusive jurisdiction of Competent Court and Forum in Shillong / India only.
- (b) Any dispute arising out of this purchase shall be referred to the Director NIT Meghalaya, and if either of the parties hereto is dissatisfied with the decision, the dispute shall be referred to the decision of an Arbitrator, who should be acceptable to both the parties, to be appointed by the Director of the Institute. The decision of such Arbitrator shall be final and binding on both the parties.

ADDITIONAL TERMS FOR IMPORTED GOODS

Following terms, besides the fore mentioned terms, will be applicable in case of foreign purchases:

01. Rates : Rates quoted in the Price Bid should be on **DOOR DELIVERY NIT Meghalaya basis**, as per details below:

- a. Ex-works value
- b. Documentation & Handling Charge, if any
- c. Estimated Overseas Freight to be paid at actual against authentic documents and monetary receipt
- d. Estimated Overseas Insurance Charge to be paid at actual against authentic documents and monetary receipt (In case the firm holds open insurance policy, the Insurance Certificate relating to the consignment will have to be provided).
- e. Total value showing the cost CIP/CIF at any landing air/sea/road/railway port in India and transportation and insurance upto NIT Meghalaya.
- f. As NIT Meghalaya presently does not have a clearing agent, the supplier or their Indian Agency has to take all responsibilities for clearing the equipment from the landing port in India and for door delivery at NIT Meghalaya. Reimbursement for charges incurred for the same will be made by NIT Meghalaya on production of all related original documents.

02. After Sales Service: In case of imported stores, foreign manufacturing firms should indicate facilities available for after sales service in India without which their offers are liable to be ignored. The quotation will have to clearly state the available nearest after sales service centre and contact no. in India.

03. Delivery :

- a. Delivery of goods at NIT Meghalaya, will have to be within 100 (one hundred) days from the date of issue of the Purchase Order.

- b. While transshipment will be allowed, part shipment will not be allowed.

04. Payment :

- a. **Above \$10,000.00:** By an irrevocable letter of Credit at CIP/CIF any landing air/sea/road/railway port in India value negotiable through any overseas branch of State Bank of India with unrestricted provision.
- b. **Below \$10,000.00 by FDD/Wire Transfer as given below:**
- (i) **Advance payment Against Bank Guarantee:** 90% of the price will be paid in advance against equivalent bank guarantee from a scheduled bank provided by the supplier/Indian Agent. The remaining 10% shall be released only after receipt and acceptance of materials in good condition or after satisfactory installation and commissioning of the equipment.

OR

- (ii) **100% Payment Basis:** On request by the supplier/s 100% payment by FDD will be made. In this case on receipt of your Order Acknowledgement an FDD will be established for total ordered value, thereupon, a scanned / photo copy of the FDD will be sent to you, which will enable you to send the materials. On satisfactory receipt and acceptance of the materials or satisfactory installation and commission of the equipment the Original FDD will be sent to you.

Note: Please note FDD/LoC will not be opened unless and until Letter of Acknowledgement in original is received at NIT Meghalaya, directly from the principal (Even in case of firms having subsidiary office in India). The Indian agents are therefore advised to submit quotation after consultation with their respective principals.

05. **Agency Commission:** The percentage of ex-works value to be paid to Indian agent in equivalent Indian currency as agency commission (if any) will have to be clearly stated in the quotation.
06. **Country of Origin:** While Country of Origin Certificate will not be insisted, the same however will have to be stated in the Original Invoice for payment through LoC.
07. **LoC/FDD Amendment:** LoC/FDD amendment charges due to mistake on the part of the supplier, if any, will have to be borne by the supplier.

Sd/-
Registrar

Encl.: ANNEXURE-I, ANNEXURE-II, ANNEXURE-III

Annexure –I

A. COMPLIANCE CERTIFICATE FOR NIQ TERMS
(To be enclosed in the Technical bid)

Sl. No.	NIQ Terms and Conditions	Yes/No
01	Rate quoted as per instruction	
02	AMC rate after warranty provided	
03	Validity of quoted rate for 120 days agreed	
04	EMD submitted / appropriate certificate enclosed	
05	PBG term agreed	
06	Payment term agreed	
07	Delivery terms agreed	
08	Warranty period agreed	
09	Literature: Printed Literature provided	
10	Dealership / distributorship certificate (in case of dealers/agents) provided	
11	Details of supply to other Institutes of National Importance provided	
12	Presentation of quoted equipment before Financial Bid opening agreed	
13	Equipment breakdown clause agreed	
14	Purchase Orders within last 3 years provided	
15	Training of NIT Meghalaya staff clause agreed	
16	End User list provided	
17	After Sales Service: address of after Sales Service centre in India (for imported goods)/ in the region provided	
18	Manufacturer certificate provided	
19	ISO/ ISI certification provided	
20	Applicable law terms agreed	
21	Soft copy of Technical Bid provided	

Signature with Seal:.....

Vendor: M/s.....

Annexure -I

B. COMPLIANCE CERTIFICATE FOR SPECIFICATIONS
(One for each item, must to be enclosed in the Technical bid)

Group:		Item Sl. No.	
Quoted Product:	Make:	Model No:	
Specifications as per NIQ		Quoted Item Specifications*	Complied/ Deviation
Parameter	Specification		

Signature with Seal:

Vendor: M/S

*** Vendor must quote the parameter specification of the quoted product in this column and not just copy the specification from the tender call document. Failure to do so will lead to rejection of the tender.**

Annexure -II

PERFORMANCE BANK GUARANTEE

To:
Registrar,
National Institute of Technology Meghalaya
Bijni Complex, Laitumkhrah, Shillong-793 003
Meghalaya

WHEREAS (Name of Supplier)
hereinafter called "the Supplier" has undertaken, in pursuance of Contract No..... dated,..... 20...
to supply..... (Description of Goods and Services) hereinafter
called "the order".

AND WHEREAS it has been stipulated by you in the said order that the Supplier shall furnish you with a
Bank Guarantee by a recognized bank for the sum specified therein as security for compliance with the
Supplier's performance obligations in accordance with the order.

AND WHEREAS we have agreed to give the Supplier a Guarantee:

THEREFORE WE hereby affirm that we are Guarantors and responsible to you, on behalf of the
Supplier, up to a total of (Amount of the Guarantee in
Words and Figures) and we undertake to pay you, upon your first written demand declaring the Supplier
to be in default under the order and without cavil or argument, any sum or sums within the limit of
..... (Amount of Guarantee) as aforesaid, without your needing to prove or to show
grounds or reasons for your demand or the sum specified therein.

This guarantee is valid until theday of.....20.....

Signature and Seal of Guarantors

.....
.....
.....

Date.....20....

Address:.....

.....
.....

All correspondence with reference to this guarantee shall be made at the following address:

Registrar,
National Institute of Technology Meghalaya
Bijni Complex, Laitumkhrah, Shillong-793 003
Meghalaya

ANNEXURE-III

Group A: Instrumentation

Sl No.	Item	Specification	Qty.
1	<u>Complete Transducers Kit</u>	Complete Transducers Kit Includes Transducers Kit oscilloscope DMM timer/counter and capacitance and resistance boxes Instrumentation Module Wheatstone Bridge with reference potentiometer and selectable value ratio arms. Operational Amplifier with selectable gain and differential input. Oscillator: Centre frequency 465 kHz. Frequency Discriminator: FM operation and on-board phase sensitive rectifier. Power Amplifier Unity voltage gain. Maximum output 4 W. Electro-mechanical Transducers Variable Resistor 10 kΩ, 0.5 W linear. Variable Capacitor (Area) 2.5 – 20 pF. Variable Capacitor (Distance) 15 – 40 pF. Variable Inductor 9 Ω, 23 – 81 μH. Variable Differential Transformer Primary resistance: 6.3 Ω, 140 turns. Secondary resistance: 2.5 Ω, 140 turns. Strain Gauge 2 off, 120 Ω resistance. Conductance Probe Two parallel, conductive, supported rods with flying leads. Heat Transducers Bi-metallic switch Operating temp. 45 °C. Differential 5 °C. Thermocouple Copper constantan junction approx. 50 μV/°C. Thermistor Resistance at 20 °C = 2 kΩ. Platinum resistance Resistance at 20 °C = 100 Ω. Light Transducers Photo-transistor BP X25. Photo-diode RS components. Photo-resistor RPY33. Lamp holder MBC. 14.4 V, 0.1 A. Optical Filters 9 slide-mounted. 440, 470, 490, 520, 550, 580, 600, 690, 700 nm. 1 infra-red. Power Supply External $\pm$15 V @ 1.5 A.	01

2	AC WAVE SHAPPING CIRCUITS TRAINER	•Frequency and Amplitude Adjustment is provided using Potentiometers •One LED indicator to indicate Power input. •On-board Circuits Positive/Negative/Biased Clipper Positive/Negative/Biased Clamper Integrator Differentiator •Fixed DC power supply : + 5 V/150mA •Fixed DC power supply : -5 V/150mA- - All interconnections are made using 2mm banana Patch cords. •Bare board Tested Glass Epoxy PCB is used. •Set of 2mm Patch cords for inter connections	01
3	<u>Level & flow process Control</u>	• Process Interface • Process Controller • Level Sensor Pack • Flow Sensor Pack • Digital Display Module • Contains a selection of level and flow sensors & indicators • Flow controlled by linear motorised control valve • On/Off and proportional control • P, PI and full PID control with autotune facility • Couples with Temperature Trainer for dual loop control • Modern push fittings • Water used as the process fluid • Comprehensive lab notes and ESPIAL Software	01
4	Complete Modular Servo System	Mechanical Plant specification • Open board format containing a servo mechanism and support electronics • Permanent magnet motor with armature current signal output • Tachogenerator 2.5 volts/1000 rpm • Magnetic eddy current brake • Input and output potentiometers • Two-phase incremental shaft encoder Six bit Gray code shaft encoder Power amplifier, linear and pwm • Switchable three figure LCD meter for speed or voltage Electronic Unit specification • Open printed circuit board with front panel mimic containing: • Four input error amplifier • PID analogue controller with independent gain controls • Dual time-constant integrator • Led display of encoder signals • Embedded microprocessor containing multiple control algorithms • USB2 interface • 2 channel a/d input	01

		• 2 channel analogue and pwm d/a output • 4 channel a/d instrumentation interface • Sweep function generator 0.1 Hz – 5 Hz, sine square & triangle • 2 variable attenuators • Variable d.c. signal Power Supply Specification • ± 15 volts 1.5 amps • +5 volts 0.5 amps	
5	Pressure Process Control	• Safe low pressure operation • Fully gauged for pressure and flow rate • Differential and Gauge pressure sensors • Current controlled (4-20mA) pneumatically operated control valve • Standard industrial components • Self-sealing outlets for manometer • Safety valves fitted as standard • Air used as the process fluid • Pressure safety, familiarisation and calibration • I/P converter and Pneumatic control valve operation • Controller familiarisation and calibration • Automatic control systems • Serial communication • Pressure sensor, transmitter (5-10 bar) and I/P converter- Linearity and Hysteresis • Pneumatic control valve - characteristics at different pressure ranges • System response and Air receiver • Principles of Proportioning valve and proportional process control • Study of P, PI and PID control of Pressure • Calibration of the differential pressure sensor & transmitter • Flow control in the Process rig	01

Group B: Power Electronics Laboratory

Sl No	Name	Specification	Qty
1	ACS714, 20Amp Hall Effect Current Sensor Module	• Single 5V supply operation. • Optimized Input range (IP) : ± 20Amp • Sensitivity : 66mV/Amp • Low noise analog signal path, • Stable output offset voltage • Bandwidth is set via a filter capacitor • 1.2mOhm internal copper conductor resistance • 2.1kVRMS minimum isolation voltage • Ratio metric output is possible from supply voltage	06
2	ACS714, 5Amp Hall Effect Current Sensor Module	• Single 5V supply operation. • Optimized Input range (IP) : ± 30Amp • Sensitivity : 185mV/Amp	04

		• Low noise analog signal path, • Stable output offset voltage • Bandwidth is set via a filter capacitor • 1.2mOhm internal copper conductor resistance • 2.1kVRMS minimum isolation voltage • Ratio metric output is possible from supply voltage	
3	60 V, 3A DC Power Supply (Multiple output) Make: Tektronix, Agilent, Fluke, Yokagawa	Provides total power of 375 W at three outputs • Analog front panel programming • Excellent load and line regulation ensures stable output • Provides clean output with ≤ 1 mVrms (0.5 mVrms typical) noise • Fast < 50 μsec transient response for stable testing • Dual display shows both voltage and current reading • Over-voltage and over-current protection • Security features: keypad lock and physical lock mechanism Detail Technical Specification : • No of Output : 3 • Output Ratings : 0 to 60 V, 0 – 3 A for Output 1 & 2, 5 V fixed output on Output 3 • Maximum Current: 0 – 6 A for Output 1 & 2; 3 A on Output 3 • Line & Load Regulation : CV $< 0.01\% + 2$ mV CC $< 0.02\% + 2$ mA • Ripple & Noise : CV – 0.5 mVrms CC – 1mArms • Load Transient Response Time: < 50 μs • Programming Accuracy: $< 0.25\% + 15$ mV $< 0.30\% + 15$ mA • Meter Resolution : Voltage – 10mV Current – 10mA Maximum output float voltage: ± 240 Vdc	01
4	300 V, 16A , 5000W Programmable DC Power Supply (GPIB, LAN, USB, LXI) Make: Tektronix, Agilent, Fluke, Yokagawa	Instrument should have following features: 1. Small, high density 2 U package 2. Built-in voltage and current measurement 3. Full protection from over-voltage and over-current 4. Flexible AC input voltage options 5. LAN, USB, and GPIB interfaces standard 6. Fully compliant to LXI Class C specification with web browsing capability 7. Parallel operation Up to 4 identical units can be connected in master/slave mode with single-wire current balancing 8. Series operation Up to 2 identical units can be connected with external protection diodes Detail Technical Specification : • Output Ratings :0 to 300 V, 0 – 17 A, 5100 W • No. of Output : 1 • Programming Accuracy : Voltage : $0.025\% + 225$ mV	01

		Current : 0.1% + 51 mA • Ripple and noise : Voltage :60 mV (rms), 300 mV (Pk-Pk) • Load Regulation: Voltage :50 mV : Current :17mA • Line Regulation: Voltage : 30 mV : Current : 8.5mA • Transient Recovery Time : < 2 ms • Connectivity : GPIB, USB, LAN LXI class C • AC Input : 170 - 265 VAC; 47 - 63 Hz. 3ϕ	
5	Artrix-7 FPGA board	• Xilinx Artix-7 XC7A100T-CS324 • 16Mbyte Micron Cellular RAM • 16Mbyte Quad SPI ROM • 10/100 SMSC LAN8720 Ethernet PHY • Hi-speed Digilent USB port for power, programming, and data transfers • Type-A USB port for mouse, keyboard, or memory stick • SD card socket • 12-bit VGA • 3-axis accelerometer, digital microphone, speaker AMP and temp sensor • 16 slide-switches, 16 discrete LEDs, 8-dig 7seg display, five pushbuttons • 5 Pmod ports, one connected to FPGA's internal A/D converter	01
6	Analog To Digital Module Converter Board	• two AD7476A 12-bit A/D converter chips • a 6-pin header connector • a 6-pin connector • two 2-pole Sallen-Key anti-alias filters • two simultaneous A/D conversion channels at up to one MSa per channel • very low power consumption • small form factor (0.95" x 0.80").	04
7	Digital To Analog Converter module	• Analog Devices AD5628 low power, octal, 12-bit, buffered voltage-output DAC • High-speed DSP compatible • Low power consumption • Power-down function capability • 6-pin Pmod connector with 3-wire Serial interface • 12-pin output connector	04
8	Probe amplifier Make: Tektronix, Agilent, Fluke, Yokagawa	• The Amplifier should support probe bandwidths of 15MHz and 50MHz having current ratings up to 150A and 50A respectively • Should have low current sensitivity of 25A with 50 MHz probe • Ac coupling should be <7Hz (lo pass -3dB) • Insulation 300V CATII or better • Accuracy (typical):DC: $\pm 1\%$ of reading, DC to 60 Hz, ≤ 5 A: $\pm 1\%$, 60 Hz – 5 kHz, ≤ 5 A: $\pm 1.5\%$, DC – 5 kHz,	01

		>5 A: $\pm 1.5\%$ - Operating Temperature : 0°C to +50 °C - Interface type: BNC - Power requirement: 90 V to 264 V, 47 to 440 Hz, 50W	
9	Power Module	Power measurements: True real power in watts, reactive power in VAR, powerfactor, crest factor, RMS measurements, frequency measurements Harmonics measurements: Up to the 50th harmonic, THD, individual harmonic levels display, individual harmonic phase to fundamental, RMS values. Switching loss measurements: Ton loss, Toff loss, conduction loss, total switch loss Cursors: dv/dt and di/dt Compatible oscilloscopes: Should be compatible with Power Scopes and should only be an add-on module to existing Power Scopes in the lab	01
10	Universal IC Tester	It can test more than 1500+ ICs - Tests a wide range of Digital IC's such as 74 Series, 40/45 Series of CMOS ICs - It can test Micro- processor 8085, 8086, Z80, 8051, 89c51 - It tests Peripherals like 8255, 8279, 8253, 8259, 8251, 8155, 6264, 62256, 8288, 8284 - Tests a wide range of Analog IC's such Op-amp, 555 Timers - Tests a wide range of Transistor Arrays, Analog switches - Tests a wide range of Opto- couplers - Tests a wide range of ADC, DAC, Comparators - Tests a wide range of Waveform generator, PWM IC, Sample Hold IC - Tests a wide range of Voltage Regulator, DPM IC - Tests a wide range of Frequency to Voltage converter - Tests a wide range of Latch driver, VCO IC's, PLL IC's - Cross Point Switch - It tests Seven segment display of common cathode & common anode type - It has Auto search facility of all Digital ICs - Test by: Truth table/sequence table comparison. - ZIF: 40 pin DIP ZIF sockets. - Keys: 50 cherry keys Key pad with numerical & functional keys. - Display: 16 X 2 LCD Display. - Supply Input Voltage: 230V A	01

11	Set up for three phase Dual converter circuit	Three phase dual converter power circuit:230V/2A ❖ Thyristor/SCRs based three phase dual converter power circuit consists of 12 converter grade SCR ❖ Protection for high voltage (RC snubber) & short circuit (fuse). ❖ All the terminals of the power devices are brought out to front panel. ❖ Two MCBs are provided. ❖ Housed in a metal cabinet with terminals brought to front c. Three Phase Isolation Transformer: ❖ Input: 230V single phase ❖ Output: 0-60-150-200V/2A d. Loading rheostat : 600V/5A	01
12	Set up for three phase PWM voltage source inverter	➤ IGBTs Based power circuit consists of six IGBTs. ➤ IGBTs ratings Current: 20A - I_A, Voltage: 1200V – V_{AK}. ➤ Protection for high voltage & short circuit. ➤ Six freewheeling power diode are provided. ➤ Six isolated gate signals are provided for IGBTs. ➤ Frequency of the inverter is from 20-50 Hz. ➤ One potentiometer is provided to set the frequency. ➤ Provision to run the motor in forward & in reverse rotations. ➤ Housed in a metal cabinet with terminals brought to front panel for connection of motor. b. DC Power Supply: 120V/4A c. Three-phase R-L variable load: 5 kW	01

Group C: Embedded system Laboratory

Sl No.	Item	Specification	Qty.
1	PIC based development Board	• Programmer USB connector to power the board. • With just enough RAM and Flash, PIC18F45K22 microcontroller will provide with enough power for most of the projects. • Board is equipped with power supply unit capable of supporting both 3.3 V and 5 V microcontrollers. • Tri-state DIP switches are used to enable pull-up or pull-down resistor on desired PORT pin. • Male port headers are available in each Input/output group. • Push buttons in each Input/output group enable to have digital inputs on each port pin. • On-board In-Circuit Debugger and programmer should support over 200 microcontrollers from Microchip. • Board should support One-Wire digital temperature sensor. Temperatures can be measured from -50°C to +120°C, with 0.5 °C accuracy. • LM35 to be used to measure temperatures from -55°C	01

		to +150°C with 0.25°C accuracy at room temperatures. • Driving 7-segment displays and should provide 4-digit display for applications. • Board should be equipped with LCD 2x16 connector which allows to connect LCD 2x16 display and place it securely using plastic distancer. Board should provide USB-B connector necessary for writing applications that use USB communication. Connector can be routed to either PORTC or PORTA, depending on the target microcontroller. • To use other external programmer, ICD2/ICD3 compatible connector should be provided. • Requires UART communication through RS-232 connector. • FTDI chip should allow board to be connected with a PC through USB cable over UART connection. • Potentiometer should allow to adjust the contrast level of the pixels on LCD 2x16 character display. • Potentiometer should allow the adjusting the contrast level of the pixels on GLCD 128x64 display. • Touch panel controller with connector should be provided for analog resistive touch panels attached to the GLCD 128x64 to form GLCD Touch screen. • GLCD and LCD backlight can be driven with PWM signal from the microcontroller, or they can be turned on in full brightness. • With piezo buzzer, applications can be debugged. • Additional PORT header should be provided, so the desired microcontroller pins on the other side of the board too can be accessed. • 8 MHz oscillator circuit. • Separate GND pins should be available on the board for easier connection of GND reference for oscilloscope probes. • Can be stored 8x256 bytes of configuration data or other data into on-board 24AA01 Serial EEPROM with I2C interface. • Each Input/output PORT group contains LEDs with low current consumption of only 1mA.	
2	PIC24-dsPIC33 Board	• On-board USB UART module with FT232RL- An interface between a USB device and the host device. • The system can be easily configured via DIP switches. Each DIP switch configures a part of the system. • USB connector with LED indication for microcontrollers with USB facilities. • The system supports 14-, 18-, 20- and 28-pin dsPIC33 and PIC24 MCU. • 2 potentiometers should be used for testing multiple AD conversions. Inputs should be configured via	01

		jumpers. • USB or external power supply source is selected by moving a jumper. • All microcontroller pins should be connected to 2x5 connectors for further expansion. • LEDs and push buttons should be used to indicate pins' logic state and test inputs of all pins at the same time. • On-board jumpers should be used for pull-up/pull-down port configuration. These jumpers should be available for all pins. • RS-232 communication with a PC or an MCU is performed via DB9 connector. • External ICD connector should be used to connect In-circuit debugger. • On-board USB 2.0 programmer with ICD. • Temperature Sensor DS1820 to measure temperature from -55°C to 125°C. • On-board 2.4 GHz IEEE 802.15.4 Transceiver Module. • LCD Contrast Potentiometer is to be used to adjust LCD contrast in a fast and easy way. • Piezo Buzzer for emitting audio signals in frequency range between 20 Hz and 20 KHz. • CAN transceiver MCP2551 is to be used for communication with other microcontrollers. • Serial EEPROM 24AA01 can and I2C communication. • 64 Kbit Serial SRAM module 23K640 and SPI communication interface. • Touch Sense with CTMU.	
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Group D: Switchgear And Protection Laboratory

Sl No.	Item	Specification	Qty.
01	Distance Protection Trainer Kit	a. Distance Protection Relay (Make: ABB, Numerical) - 1 pc Distance Protection Zones : 05 Setting of directionality and in reach in forward and reverse direction Impedance measuring elements for the general fault criteria with advanced characteristics Event and disturbance recorder Fault recorder b. The trainer module should contain the following function modules Internal DC power supply Necessary current transformers Necessary voltage transformers Breaker simulator Digital inputs panel Output panel for communication, indications and tripping Auxiliary relays for AC and DC	01

Software: CD for installation, User's manual and technical specifications and experiment manual.

c. Auxiliary Equipments

Voltmeter : 50-250-500 V - **2 pcs**

Ammeter : 0-1-2 A - **1 pc**

0-6-12 A - **1 pc**

1-ph resistive load : 200 W, 40 ohms, 2.25 A- **1 pc**

3-ph resistive load : 230 V, 5 A – **1 pc**

Each rheostat is enclosed in a robust metal case

A scale with 100 scale divisions to show resistance setting

Highest quality with very good linearity resistance wire to be used

Optimum cooling

Series and potentiometer connection

OH line model : 40 kV(415 V) , 3-phase, 50 Hz- **1pc**

<i>Parameters</i>	<i>Real Value</i>	<i>Model Value</i>
Nominal length	40 km	40 km
Nominal voltage	40 kV	400 V
Nominal current	350 A	10 A
Positive sequence Reactance	15 ohm	$2\pi\omega \times 5.45 \text{ mH}$
Zero sequence reactance	23 ohm	2.62 ohm
Positive sequence resistance	8.4 ohm	4.7 ohm
Zero sequence resistance	16.0 ohm	0.8 ohm
Positive sequence capacitance	400 nF	1.0 μF
Zero sequence capacitance	265 nF	0.6 μF

OH line model : 220 kV(415 V) , 3-phase, 50 Hz
100 km with two sections of 50 km
- **1 pc**

<i>Parameters</i>	<i>Real Value</i>	<i>Model Value</i>
Nominal length	50 km	50 km
Nominal voltage	220 kV	400 V
Nominal current	775 A	10 A
Positive sequence reactance	18 ohm	$2\pi\omega \times 3.77 \text{ mH}$
Zero sequence reactance	24 ohm	1.57 ohm
Positive sequence resistance	17.7 ohm	0.5 ohm
Zero sequence resistance	8.0 ohm	0.8 ohm
Positive sequence capacitance	475 nF	8.9 μF

Zero sequence capacitance	315 nF	0.6 μ F
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Both line models should have

Maximum voltage : 600 V

Maximum current : 32 A for 60 sec

Cable model : 11 kV - 1 pc

PEX Cable 150 square mm Al

<i>Parameters</i>	<i>Real Value</i>	<i>Model Value</i>
Length	5 km	5 km
Nominal voltage	11 kV	400 V
Nominal current	260 A	10 A
Transmission ability	5.0 MVA	2.4 kVA
Positive sequence Capacitance	0.45 μ F	0.28 μ F
Zero sequence Capacitance	0.45 μ F	0.28 μ F
Inductance	1.8 mH	2.84 mH
Resistance	1.1 ohm	1.8 ohm
Zero sequence reactance	2.3 ohm	3.7 ohm

All line and cable models are flexible to move in lab.

Capacitor load bank : 2.8 kVAr, 50 Hz – 1 pc

Housed in a metal cabinet

Six step regulation

Electrical data and symbols on the front panel with terminals and fuses

1-phase and 3-phase

Inductive load bank : 3-phase, 0.5-3.0 kVAr, Y 400 V, Y 230 V, 50 Hz – 1 pc

Continuously variable reactor

Reactive power set by means of crank

The reactor with ten turn and 100 scale divisions for reach turn

Each winding is fitted with a fuse

Load switch : Three-pole, 16 A - 2 pc

250 V – DC, 440 V – AC

Designed in metal case

Panel show symbols & technical data

Laboratory leads : 1 set

Area: 2.5 mm² containing 650 wires of 0.07mm dia

Moulded soft PVC covering with high reliability cable anchorage

A set of 100 leads in 5 colours

<i>Colour</i>	<i>25 cm</i>	<i>50 cm</i>	<i>100 cm</i>	<i>200 cm</i>
Red	5	5	5	5
Yellow	5	5	5	5
Blue	5	5	5	5
Black	5	5	5	5

Terminal Board : 1 pc

The box has safety outlets for laboratory leads with 4 mm diameter plug pins. These outlets are connected to a 5 x

		2.5 mm² cable of 1.5 m length and cable connection for a diameter of 5.5 mm. The connection box is equipped with miniature circuit breakers for 20 A. Dimensions : 250 x 240 x 75 mm Stand for lab leads : 1 pc																									
02	Relay Tester	Application Range Testing of current, voltage-time and power relays Start-up operations Testing of current transformers Plotting of magnetization curves <table border="1"> <thead> <tr> <th>Parameter</th> <th>Specifications</th> </tr> </thead> <tbody> <tr> <td colspan="2">220 V, 50 Hz</td> </tr> <tr> <td>AC current</td> <td>0-10 A (85 V) 0-40 A (25 V) 0-100 A (10 V)</td> </tr> <tr> <td>Built in ammeters</td> <td>0-10 A, 0-100 A</td> </tr> <tr> <td>Terminal for an external Ammeter</td> <td>AC voltage:0-250 V, 3 A DC voltage:0-350 V, 2 A</td> </tr> <tr> <td colspan="2">110 V AC, 0.3 A terminal, 20-220 V DC, 0.3 A terminal, both are independently adjustable</td> </tr> <tr> <td colspan="2">Built in capacitor for testing of reactive power relays</td> </tr> <tr> <td colspan="2">Terminal for synchronous start of an external device</td> </tr> <tr> <td>Electronic timer, independent of main frequency</td> <td>0 – 999.999 sec Accuracy 0.02 % of readouts + 2ms</td> </tr> <tr> <td colspan="2">Terminal for external start and stop timer</td> </tr> <tr> <td colspan="2">Tripping circuit is equipped with a signal lamp</td> </tr> <tr> <td colspan="2">Thermal protection of the output transformer</td> </tr> </tbody> </table>	Parameter	Specifications	220 V, 50 Hz		AC current	0-10 A (85 V) 0-40 A (25 V) 0-100 A (10 V)	Built in ammeters	0-10 A, 0-100 A	Terminal for an external Ammeter	AC voltage:0-250 V, 3 A DC voltage:0-350 V, 2 A	110 V AC, 0.3 A terminal, 20-220 V DC, 0.3 A terminal, both are independently adjustable		Built in capacitor for testing of reactive power relays		Terminal for synchronous start of an external device		Electronic timer, independent of main frequency	0 – 999.999 sec Accuracy 0.02 % of readouts + 2ms	Terminal for external start and stop timer		Tripping circuit is equipped with a signal lamp		Thermal protection of the output transformer		01
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03	Digital Timer	Suitable for measuring the pick-up and drop-out times of relays The timer consists two inputs can wired to start or stop timing Timing to be started or stopped by every change at inputs The inputs to be protected from AC & DC over-voltages Measuring range: Timer 1 msec – 60 msec Counter 1 – 65000 counts 230 V DC max Accuracy ± 0.1 % of reading ± 1 digit Resolution 1 msec Supply 230 V, 50 Hz	02																								
04	Digital controller for real time harmonics and frequency estimation in	➤ Three-phase and Single-phase diode bridge rectifier module (Semikron make). Diodes ratings Current: 20A - I_A, Voltage: 1200V – V_{AK}. • Inductive load box (10 KW). • Three Phase Isolation Transformer:	01																								

	distorted power system	Input: 230V phase voltage Output: 0-60-150-200V/10 A • Loading rheostat : 600V/5A • Current sensors, for three-phase and single-phase source current measurement • Voltage transducers, for three-Phase and single-phase supply voltages measurement. • Altera FPGA with cyclone Version (latest) along with accessories and interfacing circuits. • Capable of extracting current and voltage harmonics from real time waveforms. • Custom designed control algorithm to be implemented.	
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Group E: Electrical Drives

Sl No.	Item	Specification	Qty.
1	Set up for DC Motor Control with Three Phase Dual Converter.	a. Three phase dual converter firing circuit ❖ Twelve isolated gate signals for converter power circuit. ❖ Firing angle can be varied from 0° to 180°. ❖ Housed in a metal cabinet with terminals brought to front panel. ❖ Test points are provided on the front panel for detailed study of circuit signals by the student. ❖ One potentiometer is provided to set the firing angle. ❖ One On/Off switch with indicator provided to control circuitry. b. Three phase dual converter power circuit: 230V/2A ❖ Thyristor/SCRs based three phase dual converter power circuit consists of 8 converter grade SCR, and a freewheeling diode. ❖ Protection for high voltage (RC snubber) & short circuit (fuse). ❖ All the terminals of the power devices are brought out to front panel. ❖ Two MCBs are provided. ❖ Bridge rectifier of 220V/2A is provided for the field supply. ❖ Housed in a metal cabinet with terminals brought to front c. Three Phase Isolation Transformer: Rating: 1 KVA ❖ Input: 230V single phase ❖ Output: 0-60-150-200V/2A d. DC Shunt motor: 1/2HP, 220V, 1500 rpm with loading arrangement. Make: Benn/ Kirloskar/ Crompton Greaves/Alston	01

2	Set up for PLC based DC drives	System consists of: a) INDUSTRIAL PLC TRAINER KIT Digital I/O (18 I + 12 O) + Analog I/O (2AI+1AO)) Experimentation Set-up CDPs, SEPs, Baseboard and 19 Analog & Digital SAPS and facilitated with free ladder programming for different live industrial problems. DC Motor 300W, 200V with shunt, series compound winding mounted with brake pulley and 1V/1000RPM electronic tachogenerator inclusive of 2 no. of EMT 9 Panels, Model XPO-DMSC. Make: Benn/ Kirloskar/ Crompton Greaves/Alston)	01
3	Set up for Different types of braking (regenerative, dynamic, plugging) for DC motor drives.	2.0 HP / 220 V / 220 V Separately excited / 1500 RPM DC Motor with flywheel mounted on Motor shaft. Make: Benn/ Kirloskar/ Crompton Greaves/Alston ACCESSORIES A) Control Panel Having MCB, 10 A rectifier circuit for Armature and 2 A Rectifier circuit for field, Plug to connect variac, Resistance & switch to limit plugging current, change over knife switch, Resistive load controlled in three steps for resistive braking, 2 No. DC Ammeter and 1 No. DC Voltmeter, other terminals required. (meters must be connected internally) 1 Phase / 10 A / Variac & Rheostat	01
4	Set up for Different types of braking (regenerative, dynamic, plugging) for AC motor drives.	3 HP / 415 V / 3 Phase / 1440 RPM / TEFC / Sq. Cage Induction Motor with Flywheel Make: Benn/ Kirloskar/ Crompton Greaves/Alston ACCESSORIES a) Control Panel Having 3 Phase MCB, DOL Starter, 1 No. AC Ammeter, 1 No. AC Voltmeter, 1 no. Dc Ammeter, TPST knife switch for change over for plugging, Low voltage Dc Supply for Dynamic Breaking controlled in 3 steps, required indicators & terminals. (meters will be connected internally) b) 3 Phase / 8 A / Variac c) VFD Control Panel : Control Panel for AC Motor having 3 Phase MCB, 1 No. Voltmeter, 1 No. Ammeter, VFD Drive to control AC Motor Speed, Frequency variation from 0 to 60 Hz., inbuilt digital frequency indication, inbuilt soft starter, 3 Phase 415 V input supply, all other required switches and indicators.	01

Group F: Measuring Instruments

Sl No.	Item	Specification	Qty.
1	DSO Make: Tektronix, Agilent, Fluke, Yokagawa	• 200 MHz Bandwidth • Sample Rates up to 2 GS/s Real Time • 4 Fully Isolated and Floating Channels, plus Isolated External Trigger	01

		• More than 6 hours Hours of Continuous Battery Operation • Standard FFT analysis • Quick Setup and Operation with Auto set Menu, Auto range, Waveform and Setup Memories, and Built-in, Context-sensitive Help • Backlit Menu Buttons for High Visibility • 2.5 K points record length • Color display(1/4 VGA LCD) • Vertical resolution: 8 bits (normal or with average) • Vertical sensitivity: 2 mV to 5 V/div on all models with calibrated fine adjustment • 3 % DC vertical accuracy • Vertically and horizontally expand or compress a live or stop waveform • Maximum input voltage(1 Mohm) 300 Vrms CAT II at BNC signal to BNC shell • Float voltage 600 Vrms CATII • ± 5 div linear dynamic range • 5 ns to 50 s/div time base range • 50 ppm time be accuracy • Input impedance: 1 Mohm $\pm$ 2% in parallel with 20 pF • Input coupling: AC, DC, GND • Standard RS-232, Centronics parallel ports • Standard PC connectivity • Standard integrated compact flash mass storage • Dedicated 4 voltage probe	
2	DSO Make: Tektronix, Agilent, Fluke, Yokagawa	• 50 MHz Bandwidth • Sample Rates up to 2 GS/s Real Time • 2 Fully Isolated and Floating Channels, plus Isolated External Trigger • More than 6 Hours of Continuous Battery Operation • Standard FFT analysis • Quick Setup and Operation with Auto set Menu, Auto range, Waveform and Setup Memories, and Built-in, Context-sensitive Help • Backlit Menu Buttons for High Visibility • 2.5 K points record length • Color display(1/4 VGA LCD) • Vertical resolution: 8 bits (normal or with average) • Vertical sensitivity: 2 mV to 5 V/div on all models with calibrated fine adjustment • 3 % DC vertical accuracy • Vertically and horizontally expand or compress a live or stop waveform • Maximum input voltage(1 Mohm) 300 Vrms CAT II at BNC signal to BNC shell • Float voltage 600 Vrms CATII • ± 5 div linear dynamic range • 5 ns to 50 s/div time base range • 50 ppm time be accuracy	02

		• Input impedance: 1 Mohm $\pm$ 2% in parallel with 20 pF • Input coupling: AC, DC, GND • Standard RS-232, Centronics parallel ports • Standard PC connectivity • Standard integrated compact flash mass storage • Dedicated 4 voltage probe	
3	CURRENT PROBE (For DSO)	PROBE, AC/DC CURRENT, 100A, 100KHZ • Test Probe Type: Clamp • Test Probe Functions: Current • Compatible with DSO-Model: TPS2000, THS3000, TBS1000, TDS2000 • SVHC: Bis (2-ethylhexyl)phthalate (DEHP)	01
4	PCB Prototyping machine Make:LPKF Laser and Electronics/ MITS Electronics/ Accurate CNC	Prototyping Machine required for drilling, milling and routing of Bare PCBs with following • System should have USB plug and play connection. • System should have Automatic tools changer. • System should have facility of automatic milling width adjustment. • System should have solder paste dispensing facility. • System should be upgradable to higher spindle speed. • Machine should be capable to make polyamid stencil, and processes special films, aluminium panel engraving in addition to FR4, FR3, RT/Duroid, Kapton, LTCC (unfired) etc. • System should have camera system for Fiducial recognition for front-to-back alignment. • Machine should be capable to process single sided, double sided circuits. • Machine should be supplied in acoustic cabinet. • Vacuum table to be quoted, to hold the substrate firmly. • Dust extraction system to be quoted, to run the machine Machine should be capable of making the PCBs with : Minimum track width : 0.1mm (4 mils) Minimum isolation width : 0.1mm (4 mils) Minimum drill hole diameter : 0.15mm Working area (X/Y/Z) : 229mm X 305mm X 35/22 mm Resolution : 0.02mil Milling motor rpm : atleast 50,000rpm, software controlled Tool change : Automatic tool change, should have min 10 tools position at a time to feed Travel speed : atleast 100mm per second Drilling speed : atleast 100 strokes per minutes Automatic X/Y positioning system and motorized Z drive Power supply : 240V, 50Hz	01

		Machine should be supplied with easy to use Software to operate, software should have the following capabilities: • Software should be able to import format: Gerber Standard (RS-274-D), Extended Gerber (RS-274-X), Excellon NC Drill (Version 1 and 2), Sieb & Meier NC Drill, HPGL™, DPF, Auto-CAD™ DXF, ODB ++R. • The software should be able to support the shapes like Circle, square, rectangle (also rounded or angled), octagon, oval, step, special (arbitrary definable). • The software should be able to export the file formats: Gerber Standard, Gerber Extended (RS-274-X), Excellon NC Drill, HP-GL™, DXF, Bitmap, JPEG. • The software should have the Editing functions: Original modification, relocating, duplicating, rotating, mirroring, erasing, extending/severing lines, line/ path extension/shortening, line path/segment parallel shifting, line path/object polygon conversion (Fill), curve linking/closing. • The software should have some Special functions for Routing path generator with breakout tabs, joining/separating objects, step & repeat (multiple PCB), polygon cutout, ground plane generation with defined clearance. • Marker functions for Single element, total layer, all layers, pad groups, selection and limiting to specific layers possible for lines/ polygons/ circles/ rectangles/ pads/ holes (multiple choice and restriction to specific layers possible) should be present in the Software. • The Graphic functions for Lines (open/closed), circle, polygon, rectangle, pad, hole, text (TTF, TTC) should be present in the software • The measuring function should be for measuring & design rule check • The software should have an Insulation methods for Single, insulation method, additional multiple insulation of pads, removal of residual copper spikes (spike option),milling out of large insulation areas (rub-out), concentric or in serpentine maintaining minimum insulation spaces, inverse insulation • Hard-/software requirements Microsoft Windows 2000 or higher, 1.2 GHz Processor or better, min. 512 MB RAM, screen resolution. min. XGA Accessories should be supplied with the prototyping machine: - Necessary drilling, milling and cutting tools in various diameter. - Provision for PISM and legend printing should be provided	
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		along with its systems and accessories. -Provision of making holes by automatic drilling.	
5	Digital Multimeter Make: Aplab, Agilent, Tektronix, Fluke, Proteck, Yokagawa	Basic Accuracy 0.25% of measured value Voltage DC 10micro(μ)Volt to 1000V & AC 1mV to 1000V Current: DC 300 μ A to 10 Amp & AC : 3mA to 10 Amp both range Fuse Protected Resistance :30 Ohms (10m Ω resolution) to 30.00Meg ohms Capacitance: 30nF to 30 μ Farad. Frequency : 300 Hz (0.1 Hz resolution)) – 100 KHz Diode continuity, % Duty Cycle measurement Temperature measurement using optional Pt 100 / Pt 1000. Bandwidth in Volts (3-300Volts) : 1 KHz	05
6	Digital Multimeter Make: Aplab, Agilent, Tektronix, Fluke, Yokagawa	Basic Accuracy 0.05% of measured value DC Voltage measurement: 10 microvolt (300.0 mV FSD) to 1000V AC Voltage measurement: 10 micro Volt (300.0 mV FSD) to 1000V DC Current :10 MicroAmp (300microA FSD) to 10 Amp range Fuse Protected AC Current : 10 MicroAmp (300microA FSD) to 10 Amp range Fuse Protected Resistance measurement : 10 milli Ω (30.0 Ω FSD) to 30.0 M Ω Capacitance : 300nF (1pF resolution) to 10,000 micro Farad Frequency : 300 Hz fsd (0.01Hz resolution) – 100 K Hz Stop watch Facility dB Measurement, Event Counting, event duration, Bandwidth of 20KHz or better in AC milli Volt Range. Temperature measurement using optional Pt 1001Pt 1000 Diode, continuity, % Duty Cycle measurement. Bandwidth in Volts (3-300Volts) : 20 KHz	05
7	Digital Multimeter Make:Fluke, Agilent,Tektronix, Yokagawa	4000 count digital multimeter with temperature and frequency measurement Voltage measurement – 1000V AC/DC Current measurement – 10A AC/DC CAT-III 300 V safety rating Frequency up to 100kHz, temperature and relative mode With resistance and capacitance measurement functions Data hold, continuity and diode test with beeper functions	05
8	Digital Multi meter Make: rp Electronics, Agilent, , Tektronix, Yokagawa	AC VOLTAGE Range:200m, 2, 20, 200, 700V Max Resolution: 0.1V DC VOLTAGE Range:200m, 2, 20, 200, 1000V Max Resolution:0.1mV AC CURRENT Range:2m, 20m, 200m, 10A Max Resolution:1 μ A DC CURRENT Range:2m, 20m, 200m, 10A Max Resolution:0.1 μ A	05

		RESISTANCE Range:200, 2K, 20K, 200K, 2M, 20M, 200M Ohms Max Resolution:0.1 Ω CAPACITANCE Range:2n, 20n, 200n, 2 μ , 20 μ F Max Resolution :1pF FREQUENCY Range:20K Max Resolution :10Hz TEMPERATURE Range:20 $^{\circ}$ C to 1000 $^{\circ}$ C A Max Resolution :1 $^{\circ}$ C	
9	Digital Multimeter Make: Aligent / Fluke / Yokagawa / Voltcraft	Measurement: DC/AC voltage, DC /AC current, resistance, capacitance, continuity check, diode test, etc Volts DC Ranges(5) : 0 to 1000V Accuracy : $\pm 1.5\%$ Rdg + 2D Best Resolution : 0.1 mV Maximum Input Volt : 1000V DC - Volts AC Ranges(5) : 0 to 750V Accuracy : $\pm 1.5\%$ Rdg +5d(50Hz to 500Hz) Best Resolution : 0.1 mV Maximum Input Volt : 750V AC RMS	05
10	LCR meter Make: Scientific, Tektronix, Yokogawa, Fluke, Circutor	Portable Type Versatile , portable , compact LCR Meter for L-Q , C-D , R-Q, Z -Q measurements Measurement frequencies 100 Hz, 120 Hz and 1 kHz Basic accuracy : 0.3% Dual display , display main and sub parameters simultaneously Micro controller based , advance power saving featuring Auto Power off Zero correction	01
11	Power analyser Make: Tektronix, Yokogawa ,Fluke, Circutor	Input: Number: 4 voltage and current (3 phases + neutral) Maximum voltage: 1000 Vrms (6 kV peak) Maximum sampling speed: 200 kS/s on each channel simultaneously <u>Volt/Amps/Hertz:</u> Vrms (AC + DC) Measurement range: 1 ... 1000 V Accuracy: 0.1% of Vnom Vpeak Measurement range: 1 ... 1400 V Accuracy: 5% of Vnom Crest factor, voltage Measurement range: 1.0 ... > 2.8 Accuracy: $\pm 5\%$ Arms (AC + DC) Measurement range: 0 ... 20 kA Accuracy: $\pm 0.5\% \pm 5$ counts Apeak Measurement range: 1.4x rms value Accuracy: 5% Crest factor, A Measurement range: 1 ... 10 Accuracy: $\pm 5\%$ Hz 50 Hz nominal Measurement range: 40 ... 70 Hz Accuracy: ± 0.01 Hz <u>Power and energy:</u> Watt, VA, VAR Measurement range: 1.0 ... 20.00 MVA ¹ Accuracy: $\pm 1\% \pm$ counts kWh, kVAh, kVARh Measurement range: 00.00 ... 200.0 GVAh ¹ Accuracy: $\pm 1.5\% \pm 10$ counts Power Factor/ Cos Φ /	01

		DPF Measurement range: 0...1 Accuracy: ± 0.03 Harmonic (interharmonic) (n) Measurement range: DC, 1..50; (Off, 1..49) measured according to IEC 61000-4-7 Vrms Measurement range: 0.0 ... 1000 V Accuracy: $\pm 0.05\%$ of nominal voltage Arms Measurement range: 0.0 ... 4000 mV x clamp scaling Accuracy: $\pm 5\% \pm 5$ counts Watts Measurement range: Depends on clamp scaling and voltage Accuracy: $\pm 5\% \pm n \times 2\%$ or reading, ± 10 counts DC voltage Measurement range: 0.0 ... 1000 V Accuracy: $\pm 0.2\%$ of nominal voltage THD Measurement range: 0.0 ... 100.0% Accuracy: $\pm 2.5\%$ V and A ($\pm 5\%$ Watt) Hz Measurement range: 0 ... 3500 Hz Accuracy: ± 1 Hz Phase angle Measurement range: $-360^\circ \dots +360^\circ$ Accuracy: $\pm n \times 1.5^\circ$	
11	Power analyser Make: Tektronix, Yokogawa ,Fluke, Circutor	Input: 1 to 4 Input Modules allows several configurations to match require application. Voltage ranges 2000 V_{peak}, 1000 V_{peak}, 500 V_{peak}, 200 V_{peak}, 100 V_{peak}, 50 V_{peak}, 20 V_{peak}, 10 V_{peak}, 5 V_{peak}, 2 V_{peak} Current ranges (30 A shunt) 200 A_{peak}, 100 A_{peak}, 50 A_{peak}, 20 A_{peak}, 10 A_{peak}, 5 A_{peak}, 2 A_{peak}, 1 A_{peak}, 0.5 A_{peak}, 0.2 A_{peak}, 0.1 A_{peak} Current ranges (1 A shunt) 5 A_{peak}, 2.5 A_{peak}, 1.25 A_{peak}, 0.5 A_{peak}, 0.25 A_{peak}, 0.125 A_{peak}, 0.05 A_{peak}, 0.025 A_{peak}, 0.0125 A_{peak}, 0.005 A_{peak}, 0.0025 A_{peak} Current ranges (external shunt) 3 V_{peak}, 1.5 V_{peak}, 0.75 V_{peak}, 0.3 V_{peak}, 0.15 V_{peak}, 0.075 V_{peak}, 0.03 V_{peak}, 0.015 V_{peak}, 0.0075 V_{peak}, 0.003 V_{peak}, 0.0015 V_{peak} Voltage accuracy, V_{RMS} (45 Hz - 850 Hz)¹ $\pm 0.01\%$ of Reading $\pm 0.04\%$ of Range Voltage accuracy, V_{RMS} (10 Hz - 45 Hz, 850 Hz - 1 MHz) $\pm 0.05\%$ of Reading $\pm 0.05\%$ of Range $\pm (0.02 \times F)\%$ of	01

		Reading ± 0.02 V (typical) Voltage accuracy, DC $\pm 0.05\%$ of Reading $\pm 0.1\%$ of Range ± 0.05 V Voltage accuracy, V_{rnn} $\pm 0.2\%$ of Reading $\pm 0.1\%$ of Range ± 0.1 V Effect of common mode (typical) 1000 V, 60 Hz < 10 mV 100 V, 100 kHz < 50 mV Current accuracy, A_{RMS} (45 Hz - 850 Hz)¹ $\pm 0.01\%$ of Reading $\pm 0.04\%$ of Range Current accuracy, A_{RMS} (10 Hz - 45 Hz, 850 Hz - 1 MHz) $\pm 0.05\%$ of Reading $\pm 0.05\%$ of Range $\pm (0.02 * F)\%$ of Reading $\pm (20 \mu\text{V} / Z_{\text{ext}})$ (typical) Current accuracy, DC $\pm 0.05\%$ of Reading $\pm 0.1\%$ of Range $\pm (50 \mu\text{V} / Z_{\text{ext}})$ Current accuracy, A_{rnn} $\pm 0.2\%$ of Reading $\pm 0.1\%$ of Range $\pm (100 \mu\text{V} / Z_{\text{ext}})$ <u>Measurement accuracy - Harmonic magnitude and phase</u> Voltage harmonics (45 Hz - 850 Hz) (typical for 10 Hz to 45 Hz and 850 Hz to 1 MHz) $\pm 0.08\%$ of Reading $\pm 0.08\%$ of Range $\pm (0.02 * F)\%$ of Reading ± 0.02 V Voltage harmonics phase (45 Hz - 850 Hz) (typical for 10 Hz to 45 Hz and 850 Hz to 1 MHz) $\pm 0.025 \pm [0.005 * V_{\text{range}} / V_{\text{reading}}] \pm (0.1 / V_{\text{range}}) \pm (0.002 * F)$ Current harmonics (45 Hz - 850 Hz) (typical for 10 Hz to 45 Hz and 850 Hz to 1 MHz) $\pm 0.08\%$ of Reading $\pm 0.08\%$ of Range $\pm (0.02 * F)\%$ of Reading $\pm (20 \mu\text{V} / Z_{\text{ext}})$ Current harmonics phase (45 Hz - 850 Hz) (typical for 10 Hz to 45 Hz and 850 Hz to 1 MHz) $\pm 0.025 \pm [0.005 * A_{\text{range}} / A_{\text{reading}}] \pm (0.001 / A_{\text{range}} * Z_{\text{ext}}) \pm (0.002 * F)$	
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Group G: Components, Accessories and Miscellaneous Items

Item No	Name	Specification	Qty
1	Capacitor	1 μ F, 450 V, Aluminium Electrolytic 3300 μ F, 10 V, Aluminium Electrolytic	10 each 5 each
2	IC SOCKET, DIP, 8POS, TH	- Connector Type: DIP Socket - No. of Contacts: 8 - Pitch Spacing: 2.54mm - Row Pitch: 7.62mm - Contact Material: Phosphor Bronze - Contact Plating: Tin - Connector Mounting Orientation: PC Board - Contact Termination: Through Hole Vertical	20

		• Contact Termination Type: Through Hole • External Length / Height: 4.8mm • Insulation Resistance: 10000Mohm • Lead Spacing: 2.54mm • Pin Format: DIP	
3	IC SOCKET, DIP,16 POS, TH	• Connector Type: DIP Socket • No. of Contacts: 16 • Pitch Spacing: 2.54mm • Row Pitch: 7.62mm • Contact Material: Phosphor Bronze • Contact Plating: Tin • Connector Mounting Orientation: PC Board • Contact Termination: Through Hole Vertical • Contact Termination Type: Through Hole • External Length / Height: 4.8mm • Insulation Resistance: 10000Mohm • Lead Spacing: 2.54mm • Pin Format: DIP	20
4	IC SOCKET, DIP, 14 POS, TH	• Connector Type: DIP Socket • No. of Contacts: 14 • Pitch Spacing: 2.54mm • Row Pitch: 7.62mm • Contact Material: Phosphor Bronze • Contact Plating: Tin • Connector Mounting Orientation: PC Board • Contact Termination: Through Hole Vertical • Contact Termination Type: Through Hole • External Length / Height: 4.8mm • Insulation Resistance: 10000Mohm • Lead Spacing: 2.54mm • Pin Format: DIP	20
5	Automatic Wire Stripper	• Stripping Range: 0.5 -2.5mm² • Stripping diameter can be adjusted automatically for different wire cross sections • Precise blade design without damaging the conductor cores • During stripping, the wire is held firm by clamping jaws • With adjustable length stop • With a spring returns the stripper to the starting position, Long lifetime design. • Length: 170mm • Weight: 0.22Kg	02
6	Soldering tool Kit	This soldering set consists of • Electronic 30W (230V) soldering iron • Insulated soldering stand with cleaning sponge • Solder • Desoldering pump	02

		• Power supply 230Vac, 50Hz • Lead length 1.18m • Power 30W	
7	Glass fuse	2 mA, 230 V 500 mA, 230 V 750 mA, 230 V 1 A, 230 V 2 A, 230 V 5 A, 230 V 16 A, 230 V 10 A, 230 V	20 each
8	Passive voltage probe (Crocodile jack)	☐ 1x/10x attenuation ☐ 200 MHz bandwidth ☐ 1.5 m length ☐ UL3111-1, CSA1010.1, EN61010-1, EN61010-2-031, and IEC61010-2-031	05
9	Batteries	Hi-Watt 6F22 (9Volt) Zinc Chloride battery	50pc
