



**TENDER DOCUMENT**

**FOR**

**PROCUREMENT OF LAB EQUIPMENT**

**FOR**

**DEPARTMENT OF ELECTRONIC  
ENGINEERING**

**MEHRAN UNIVERSITY  
OF  
ENGINEERING AND TECHNOLOGY  
SZAB CAMPUS, KHAIRPUR MIR'S  
SINDH- PAKISTAN**

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<b>B.O.Q FOR PROCUREMENT OF LAB EQUIPMENT FOR VARIOUS LABORATORIES OF DEPARTMENT OF ELECTRONIC ENGINEERING, MUET SZAB CAMPUS, KHAIRPUR MIR'S.</b>	<b>GREEN</b>
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# MEHRAN UNIVERSITY OF ENGINEERING & TECHNOLOGY,

JAMSHORO - 76062, SINDH, PAKISTAN

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ISO 9001:2008  
CERTIFIED

**DEPUTY DIRECTOR  
(Procurement)**

**“SAY NO TO CORRUPTION”**

No. & Dated: DD(Proc.)/MUET/JAM/-370, 26-12-2017

## **NOTICE INVITING TENDER**

All the interested Contractors / firms / parties / suppliers / Manufacturers, Sole Distributors meeting eligibility criteria, viz. having registration with Federal Board of Revenue (FBR) for Income Tax, Sales Tax in case of procurement of goods, registration with the Sindh Revenue Board in case of procurement of works and services and registration with Pakistan Engineering Council as the case may be and are not black listed in any procuring agency or authority, are invited to participate in sealed percentage / item rate tender for the following works:

S #	Name of Work	Tender Fee	Completion Time	Earnest Money	Date of Purchase	Date of Submission of Bids	Purchase From
1	Procurement of Lab Equipment for various laboratories of Department of Electronic Engineering at MUET, SZAB Campus Khairpur Mir's.	3000/-	10 Months	5%	02-01-2018 To 24-01-2018	25-01-2018	Deputy Director (Procurement)
2	Procurement of Lab Equipment for various laboratories of Department of Software Engineering at MUET, SZAB Campus Khairpur Mir's.	3000/-	10 Months	5%	02-01-2018 To 24-01-2018	25-01-2018	Deputy Director (Procurement)
3	Procurement of Transmission Equipment for Campus FM Radio at MUET, Jamshoro. (Re-invited)	3000/-	4 Months	5%	02-01-2018 To 24-01-2018	25-01-2018	Deputy Director (Procurement)
4	Procurement of I.T. Equipment for Research Innovation in Public Sector Universities (RINU) Project.	3000/-	2 Months	5%	02-01-2018 To 24-01-2018	25-01-2018	Deputy Director (Procurement)

The terms and conditions are given as under:-

01. The tender documents can be had from office of the Deputy Director (Procurement) or can be downloaded from SPPRA website i.e. [www.pprasindh.gov.pk](http://www.pprasindh.gov.pk) and University website [www.muet.edu.pk/tenders-notices](http://www.muet.edu.pk/tenders-notices) on the payment noted above (non-refundable) on any working day except the day of opening of tenders. The sealed tender on prescribed proforma alongwith 5% earnest money of total bid in the form of Pay Order in favour of the Deputy Director (Procurement), MUET, Jamshoro for S. No. 1 by 25-01-2018 upto 10.00 (A.M) and same will be opened on the same day @ 10.30 (A.M), S. No. 2 by 25-01-2018 upto 10.30 (A.M) and same will be opened on the same day @ 11.00 (A.M), S. No. 3 by 25-01-2018 upto 11.00 (A.M) and same will be opened on the same day @ 11.30 (A.M) and S. No. 4 by 25-01-2018 upto 11.30 (A.M) and same will be opened on the same day @ 12.00 (Noon) in the office of the Deputy Director (Procurement), in presence of the Contractors / Suppliers / representatives, who so ever will be present at that time. In case of any unforeseen situation resulting in closure of office on the date of opening or if Government declares Holiday the tender shall be submitted / opened on the next working day at the same time & venue. Any Conditional or un-accompanied of the earnest money, tender will not be considered in the competition.

02. The Method of Procurement is Single Stage - One Envelope Procedure.
03. The Bidders should have atleast 05 years successful experience of same service of any university or large organization.
04. The Bidders should register with tax paying agency which would be verified by concerned agencies.
05. The Bidders should have atleast Rs. 10,000,000.00 annual turnover for Sr. 1 & 2 and Rs. 500,000.00 for Sr. No. 3 & 4 which would be verified by bank statement.
06. A Corporate Certificate / Competency Certificate of the Manufacturers regarding installation, testing, commissioning & training of Equipment be attached

***The Procuring Agency reserves the right to reject any or all bids subject to relevant provisions of SPP Rules, 2010 and may cancel the bidding process at any time prior to the acceptance of a bid or proposal under Rule-25” of said Rules.***

**Sd/-**  
**Deputy Director (Procurement),**  
Mehran University of Engg. & Tech. Jamshoro,  
Phone No. 022-2109010 Fax: 022-2771403  
Email: nadeem.soomro@admin.muet.edu.pk

## ARTICLES OF AGREEMENT

**This Agreement** made this \_\_\_\_\_ day of \_\_\_\_\_ 2018, by and between the Vice-Chancellor, Mehran University of Engineering and Technology, SZAB Campus located at Khairpur Mir's, Sindh, including his successors in office and Assignees / Agents, acting through the Director (Works & Strategic Planning), Mehran University of Engineering & Technology, hereinafter called the "**University**", of the one part,

**And** \_\_\_\_\_ of  
(name and designation of the authorized person), located at \_\_\_\_\_, hereinafter called the "**Contractor**" which expression shall include their successors, legal representatives of the second part.

Whereas the **University** requires Equipment at Khairpur Mir's, and whereas the **Contractor** has agreed to supply, install, put into operation and demonstrate the working of the said Equipment valued at Rs. \_\_\_\_\_ (in figures and words) in the period of \_\_\_\_\_ months, subject to the terms and conditions set forth, hereinafter, which have been accepted by the **Contractor**.

(amount in figures and words)

**Now this Agreement witnesses as follows:**

1. In this agreement words and expressions shall have the same meanings as are respectively assigned to them in the **Conditions of Contract** hereinafter referred to.
2. The following documents which, for the purpose of identification, have been signed by \_\_\_\_\_ on behalf of the **Contractor**, and by  
(name and designation of the authorized person)  
\_\_\_\_\_ on behalf of the **University**, all of  
(name and designation of the authorized person)  
which shall be deemed to form and be read and construed as a part of this **Agreement** viz:
  - a) Articles of Agreement;
  - b) Instructions to Tenderers;
  - c) Conditions of Contract;
  - d) Contractor's Offer including the relevant correspondence prior to signing of this Agreement with all Annexures duly filled in;
  - e) The specifications of the equipment; and
  - f) Bill of Quantity with prices.

3. In consideration of the payment to be made to the Contractor, the **Contractor** hereby **covenants** with the University to supply, deliver, install, put into operation and demonstrate the working of the Equipment in conformity in all respects of the Contract & the order form No. \_\_\_\_\_.
4. The **University** hereby **covenants to pay** the Contractor in consideration of the supply, delivery, installation, putting into operation and demonstration of the working of the Equipment the contact price in the manner prescribed by the Contract and approved by the University.

**In Witness Whereof** the parties have hereunto set their respective hands and seals, the day, month and year first above written.

**WITNESSES:**

University\_\_\_\_\_

Contractor\_\_\_\_\_

Witness No.1:

Witness No.1:

Signature:\_\_\_\_\_

Signature:\_\_\_\_\_

Name: \_\_\_\_\_

Name: \_\_\_\_\_

Designation: \_\_\_\_\_

Designation: \_\_\_\_\_

Witness No.2.

Witness No.2:

Signature:\_\_\_\_\_

Signature:\_\_\_\_\_

Name: \_\_\_\_\_

Name: \_\_\_\_\_

Designation: \_\_\_\_\_

Designation: \_\_\_\_\_

## INSTRUCTIONS TO TENDERERS

The Mehran University of Engineering and Technology, SZAB Campus Khairpur Mir's, Sindh, intends to purchase Equipment under the approved schemes. The purchase will be financed through the cash provided by the Government of Pakistan. This tender is issued for the supply, installation, putting into operation and demonstration of the working of the Equipment as per the Schedule of requirements given in this Tender Document.

### **PREPARATION OF TENDER.**

#### **1. Language of Tender**

The **Tender** alongwith any accompanying literature shall be prepared in **English** language only:

#### **2. Submission of Tender**

- a) The **Tender** shall be enclosed in a double cover. The outer cover shall bear the address of the Director (Works & Strategic Planning), Mehran University of Engineering and Technology, Jamshoro, Sindh, without any indication that it encloses a tender. The inner cover shall be marked with the title of the Tender, number of invitation to the Tender and the date of opening of the Tender, and **must be sealed**.
- b) The **Form for Tender**, (Annexure-A) **Tender Particulars (Annexure-B)** and **Forms of Schedule to Tender** (Annexure "C1"&"C2") enclosed herewith, shall be submitted in duplicate. The authorized person signing the tender documents must state his full name and authorized position designation underneath his signature.
- c) The **erasing and/or alterations**, if any, in the Tender shall be authenticated by the authorized person by his full signature.
- d) The **Tender** shall be accompanied with the **original quotations** from the manufacturers, in case the Tender is submitted through their authorized agents or distributors, and shall be supported by credentials establishing the experience and standing of the manufacturers and / or their authorized agents or distributors.
- e) A **Corporate Certificate / Competency Certificate of the Manufacturer** regarding installation, testing, commissioning & training of equipment be attached
- f) **Ambiguous and incorrect answers** and/or incorrect filling of Tender Documents will render the tender liable to rejection.
- g) **Quotations** through cable, telegraph, telex, fax, or e-mail will not be considered.

- h) The tenders shall not rely on any **interpretation or correction** given by any person except the written **addenda and/or corrigenda** to documents issued by the Director (Works & Strategic Planning), Mehran University of Engineering and Technology, Jamshoro, Sindh.

### 3. **Bid Bond and Contract Performance Bond**

- a) The tenderer shall enclose with his/her tender a **Bid Bond** on requisite stamp paper, as per **Annexure “D”** to this Tender Document, issued by a scheduled/commercial bank doing business in Pakistan, for an amount equivalent to **5% of the total cost** of the Lab Equipment offered as per the Tender submitted by him/her, or Rs.100,000.00 (One hundred thousand), whichever is more. The Bid Bond shall be in favor of the Vice Chancellor, Mehran University of Engineering and Technology, Jamshoro, including his successor in office and assignees acting through the Director (Works & Strategic Planning), Mehran University of Engineering and Technology. The bond so furnished shall remain **valid for a period 28 days beyond the period of validity of the Tender** or till it is revalidated/extended for a period mutually agreed upon by the tenderer and the Director (Works & Strategic Planning), Mehran University of Engineering and Technology.
- b) As soon as an award is made, the provisions in paragraphs **c), d) and e)**, hereunder, shall **operate**.
- c) If the Tender is **rejected**, the Bid Bond will be returned to the tenderer as soon as possible after rejection.
- d) The **successful bidder** shall have to give a **Contract Performance Bond**, as per **Annexure “E”** to this Tender Document, to the extent of **5% of the total value** of the contract on the same conditions as the Bid Bond. The Performance Bond shall be retained by the Director (Works & Strategic Planning), Mehran University of Engineering and Technology, till the completion of the guarantee period as per Clause 23 of the Conditions of Contract.

### 4. **Quality of Stores.**

- a) The Equipment and other relevant materials (hereinafter called **“Stores”**) quoted and supplied against this “Invitation to Tender” shall be strictly in accordance with the **Specifications** attached with this Tender Document. The Stores shall be the product of an established manufacturer shall conform to internationally accepted commercial standards, and shall be a model that has been successfully operated over a reasonable period of time in educational institutions R&D organizations, or relevant industry.
- b) In Tenderers must also warrant the use of best material in the making of the stores. by the find that the Specifications for any items of the Stores are lacking in details, they may give their own proposals with detailed specifications, preferably three alternate proposals if possible, for such items in Annexure “F”.



- c) The Stores offered by the tenders must be of a quality suitable for the purposes and operations for which they are required, and must be capable of rendering the required performance and services at site in the local conditions of extreme tropical climate, air, dust, water, power and fuel at Khairpur Mir's.
- d) The Hardware for operation of the Stores will be made available by University.
- e) The electric supply for operation of the Stores will be made available at 220 volt single phase, or 380 volt three phase, and 50 cycles.
- f) The Stores offered shall be complete with their standard accessories and must be accompanied by their normal instructions book/manual.
- g) Wherever possible or feasible, each item of Stores offered must have its own protection devices, e.g, overload protection by circuit breakers or fuses, or voltage stabilizer for electric equipment.
- h) Unless stipulated otherwise in the specifications for any item, the Stores conforming to ASA, SAE, SSI or DIN will be acceptable.
- i) The successful bidders may be asked to supply list of spares for 5 years satisfactory operation of any item of the Stores, prior to award of the contract.

5. **Literature.**

The tenderers must furnish with their bids catalogues giving full technical details of the Stores to enable the University to check their offers technically against the prescribed specifications failing which the offers will be liable to rejection.

6. **Principals Name, Certificate and Invoice.**

- a) The tenderers are required to mention in their quotations/offers the name and address of their Principals along with a certificate authorizing them (tenderers) to quote on their (Principals) behalf as under:  
"This is to certify that M/s \_\_\_\_\_ located at \_\_\_\_\_ have obtained quotations from us against tender inquiry No. \_\_\_\_\_ dated \_\_\_\_\_ from Mehran University of Engineering and Technology, Jamshoro, due for opening on \_\_\_\_\_ and have agreed to make available the Equipment on the quotations and terms and conditions of the tender".

The above condition does not apply to the manufacturers bidding directly.

- b) The tenderers must also furnish along with their offers their Principals original Proforma Invoice failing which their offers will be rejected.

7. **Country of Origin.**

The tenderers must state in his Tender the country of origin of the Stores offered.

8. **Alternative Proposal.**

If any tenderer elects to submit alternative proposal(s) complete information on the alternative items including all data relating to technical specifications in Vol. I, II & III shall be given as per Annexure "F".

9. **Prices.**

- a) **CATEGORY-‘A’**      **Stores Manufactured/Available in Pakistan without Involving Import.**

The prices quoted must be total per unit in Pakistani Rupees as shown in **Annexure “C-1”** and shall include:

- i. All charges for packing, marking, handling, insurance, inspection, guarantees, freight/transportation, agent’s commission; and all duties, taxes, levies, octrois etc; and.
- ii. The cost of installation, putting into operation and demonstration of the working of the Equipment in the laboratories of Electronic Engineering Department of the University @ SZAB Campus, Khairpur Mir’s

- b) **CATEGORY-“B”**.      **Stores Imported from approved Countries.**

The prices must be quoted for each item of Stores in **Annexure-“C2”** separately for each of the PARTS given below:

**PART-1. Payment in Foreign currency.**

The C&F prices quoted by the Principals in the currency of the country of origin.

For the purpose of comparison, the prices quoted shall be converted to equivalent prices in Pakistani Rupees on the basis of the official bank rate prevalent on the date of opening of the Tender.

**PART-2 Payment in Pakistani Rupees.**

- (i) The agent’s/supplier’s commission in Pakistani Rupees.
- (ii) The insurance charges. The insurance will be arranged by the Contractor through the University with Pakistan Insurance Corporation. The University will assist the Contractor in obtaining the insurance at concessional rates, if any, as allowed by the Government.
- (iii) The cost of installation, putting into operation and demonstration of the working of the equipment in the Laboratories of the University in Pakistani Rupees.
- (iv) All the charges pertaining to handling and clearance of the Stores at the port including all taxes, levies, octrois etc. but excluding the customs duties for the payment of which the University is exempted by the Government. However, if the customs duties are charged for any items of the Stores for which the Government the exemption, the University will make the payment.

- (v) The transportation charges for transporting the Stores from the port to the Electronic Engineering Department of the University including the charges for loading the Stores at the port and unloading the same at SZAB Campus the University at Khairpur Mir's.

For the purpose of evaluation/comparison of bids, as stated in Clause-15, the total price for the Stores under this Category shall be the sum of the amounts mentioned for Parts 1 & 2 above.

- (c) In addition to what is stated in para a) & b) above, the prices given in Annexure C1 & C2 shall also include the following for the Stores of both the Categories-A & B.
  - (i) Supply, detailing, manufacture, factory testing, export preparation and all costs incidental to shipping/transport up to the stage of installation in the Electronic Engineering Department SZAB Campus of the University.
  - (ii) Responsibility for any loss and/or damage at any stage from manufacture to installation in the Electronic Engineering Department, SZAB Campus of the University.
  - (iii) Provision for clean on boards bills of landing.
  - (iv) The cost of export taxes, fees and charges levied and out going incurred on exporting goods in the country of origin.
  - (v) The expenses on account of the certificate of origin, invoices or any other documents issued in the country or origin.

## **10. Validity of Prices/Tender**

- a) The prices quoted shall be valid for a period of at least 90 days from the date of opening of the tender.
- b) Until the final Contract is executed, the successful bidder shall be bound by the terms and conditions of this Tender Document.

## **11. Acceptance of the Terms**

- a) The submission of the tender against this tender inquiry by the tenderer means that the tenderer has read and accepted the terms and conditions relating to all the tender documents and annexures, and that he/she have thoroughly examined the specifications and particulars in the tender inquiry. Further the tender shall be deemed to be fully aware of the nature of the Stores and the purpose for which they are required and shall be bound to accept the Contract if placed with him/her on the basis of the prices and of the delivery schedule as indicated in Clause 12 hereof within the validity of his/her Tender.

- b) If the Tender is awarded in favour of Proprietor / Principals who has no authorized agent or distributor in Pakistan, he/she shall have to appoint a distributor or nominee for the purpose of successful completion of the contract and to provide after-sales service.

## **12. Delivery Period.**

### **i. Shipment of Imported Items.**

- a) The shipment of the items of Stores which are to be imported shall be started as early as possible, the shipment schedule shall be submitted to the Director (Works & Strategic Planning), Mehran University, and shall be negotiable and subject to approval by the University.
- b) The tenderer must indicate in his/her offer the port from where the Stores will be shipped.

### **ii. Delivery Period.**

- a) The entire Stores must be delivered, installed and put into operation in the Electronic Engineering Department of the University as early as possible after receiving the letter of award of the Contract.
- b) The Tenderer shall give in the offer his/her own schedule for the delivery and installation of various items of the Stores which shall be negotiable and subject to approval of the University.

### **iii. Delay in the Delivery of the Stores.**

- a) For the Stores delayed beyond the delivery period, as specified in the Contract, or as approved by the University as stated in Clause 12 ii b) above, there shall be levied liquidated damages as specified in Clause 22 of the Conditions of Contract given in this Tender Document.
- b) The liquidated damages may be waived fully or partially by the Director (Works & Strategic Planning), with the approval of the Vice Chancellor of the University, if there are reasonable grounds for such a delay.

## **13. Negotiations.**

Under no circumstances will the negotiations take place with any tenderer with regard to Specifications and Prices quoted and read out at the public opening of the tenders and with regard to the substance of the offer. The tenderers cannot revise their prices after the public opening of the tenders.

## **14. Rights of the University**

- (a) The University reserves the right to reject any or all bids without any reason whatsoever, or not waive minor irregularities or errors in any offer. If it appears to the University that such irregularities or errors must be corrected in the offer in which they occur, the same will be corrected prior to issue of the letter of intent which may be awarded thereupon.

- (b) The University is neither bound to accept the lowest or any other offer nor is it bound to assign reason for rejection of any offer.
- c) The University reserves the right to award the contract to one bidder or divide it among several bidders.
- d) The University reserves the right to increase or decrease the quantity of the Stores at its discretion without assigning any reason whatsoever.
- e) The University reserves the right to cancel the offer of the tenderer whose bid has been found / evaluated to be the lowest if it is revealed to the University that the tenderer does not have the capability or financial resources or facilities to carry out the Contract in accordance with the terms and conditions of this Tender Document.

#### **15. Evaluation of Bids.**

- a) In comparing bids the University will consider, besides the prices quoted, such other factors as compliance with specifications, relative quality of Stores, past experience of the tenderer, after-sales services facilities available in Pakistan and the tenderer's capacity to perform.
- b) The evaluation criteria specifically mentioned in the specifications will also be considered for evaluation of the bids.
- c) For the purpose of evaluation, the prices to be compared shall be the total prices inclusive of all duties, taxes, freight charges etc. as stated in clause 9 titled "Prices" above.
  - (i) For the items quoted in Annexure-C-1, the total prices as mentioned in Clause-9(b) shall be compared.
  - (ii) For comparison of the items quoted in Annexure C-1 with those quoted in Annexure C-2, the total prices as mentioned in Clause-9(a) including the charges/cost packing, making, handling, insurance, inspection guarantees, clearance, freight/transportation upto the University's Electronic Engineering Department duties, taxes, levies, octrois etc.

#### **16. Errors in the Bids.**

- (i) Any arithmetic errors found during evaluation of bids will be rectified on the following basis:
  - a) If there is a discrepancy between the unit price and the total price that is obtained by multiplying the unit price and quantity, the unit price shall prevail and the total price shall be corrected by the University.
  - b) If there is a discrepancy between the words and figures, the amount in figures shall prevail.

- c) If there is any discrepancy between the total tender price entered in the Articles of Agreement and the total shown in the Schedule of Prices, the amount stated in the Articles of Agreement shall be corrected by the University in accordance with the corrected schedule of Prices.
- (ii) If the tenderer does not accept the corrected amount of tender, his/her Tender will be rejected and the Bid Bond submitted with the tender shall be forfeited.

**17. Foreign Exchange for Items of Stores to be imported.**

For the items of Stores which are to be imported and for which the prices have been quoted on C&F basis in Annexure C-2, the University will arrange payment in the foreign currency, to the extent of the C&F amount, as stated in Clause 9(b), through its bank in Pakistan in accordance with the prevailing foreign exchange control rules/regulations of the Government of Pakistan.

## **CONDITIONS OF CONTRACT**

### **1. Scope of the Contract**

- a) The **Scope of the Contract** shall be the supply, delivery, installation, putting into operation and demonstration of the working of the Stores in the Electronic Engineering Department SZAB Campus of the University at Khairpur Mir's, Sindh, in accordance with the technical Specifications and Bill of Quantities enclosed in this Tender Document.
- b) The Contractor shall within a period of one month of the execution of the agreement furnish to the University a **detailed program** for supply and delivery of various items of the Stores for necessary approval by the University.

### **2. Definition of Terms**

In writing these Conditions of Contract, Specifications and Bill of Quantities, the following words shall have the meanings hereby indicated, unless there is some thing in the subject matter or Contract inconsistent with such constructions:

- i. **The University** shall mean the Mehran University of Engineering and Technology, SZAB Campus Khairpur Mir's, Sindh.
- ii. **The Vice Chancellor** shall mean the Vice Chancellor of Mehran University of Engineering and Technology, Jamshoro, Sindh, including his successor in office and assignees, empowered to act in all matters pertaining to the University either directly or through the Director (Works & Strategic Planning), Mehran University of Engineering and Technology, Jamshoro.
- iii. **The Contractor or Supplier** shall mean the Tenderer (Bidder) whose Bid has been accepted by the University and shall include the Bidder's executors, administrators, successors and permitted assignees.
- iv. **The Stores** shall mean and include all the Equipment, literature, materials and articles to be provided by the Contractor under the Contract.
- v. **The Contract** shall mean the agreement signed by the Contractor for the supply, delivery, installation, putting into operation and demonstration for the working of the Stores, as stated under the Scope of the Contract above.
- vi. **The Contract Price** shall mean the sum mentioned in or calculated in accordance with the provisions of the Contract, which is to be paid to the Contractor for satisfactory execution of the Contract in accordance with these Conditions of Contract.

- vii. **The Specifications** shall mean the specifications annexed to or issued, herewith, and shall include the schedule and drawings attached hereto as well as the samples and patterns if any.
- viii. **Month** shall mean the Calendar month.
- ix. **Writing** shall include any manuscript, type-written, printed or other statement reproduced in any visible form and whether under seal or under hand.

### 3. **Contract Documents.**

- a) The term **Contract Document** shall mean the following documents which shall be deemed to form an integral part of the Contract:
  - i. Articles of Agreement;
  - ii. Instructions to Tenderers;
  - iii. Conditions of Contract;
  - iv. Contractor's Proposal / Offer including the relevant correspondences prior to signing of the agreement with all Annexures duly filled in;
  - v. The Specifications of the Stores; and
  - vi. Bill of Quantities with prices.
- b) In the event of any **conflict** between the above mentioned documents, the present Articles of Agreement and Conditions of Contract shall prevail.

### 4. **Signing of the Contract Agreement**

Within 30 days of the issue of the letter of intent, the successful bidder (bidders) will be required to **sign an agreement** with the University for the supply of such quantity, in whole or in part, of the tendered Stores as will be communicated to him / her (them) in the letter of intent.

### 5. **Packing, Marking and Handling**

- a) All the Stores, whether imported or locally manufactured / available, shall be delivered to the SZAB Campus at Khairpur Mir's in **safe and secure condition** at the risk and cost of the Contractor.
- b) The packing, marking and handling shall be so arranged by the Contractor as to **prevent any loss of or damage** to the Stores.



- c) In case any of the items of the Stores are to be imported by the Contractor, the **import** shall be **arranged by the Contractor** himself / herself with such packing and marking and through such means as deemed fit by him / her for safe and secure delivery at Khairpur Mir's. The packing of the equipment shall be the usual export packing to ensure safe journey by air, sea, rail and road, as the case may be, of the Stores to destination. Each packing shall be clearly marked in English with the following:

- i. Port of Destination: KARACHI.
- ii. Name of the Ship: \_\_\_\_\_
- iii. Name of the Consignee: PROJECT DIRECTOR  
MEHRAN UNIVERSITY OF  
ENGINEERING & TECHNOLOGY,  
SZAB CAMPUS KHAIRPUR MIR'S, SINDH,

PAKISTAN

- i. Name of the Contractor: CONTRACTOR'S NAME & ADDRESS
- ii. Case Number & Contents: \_\_\_\_\_
- iii. Net Weight & Dimensions: (length, Breadth & Height)
- iv. Gross Weight: (Kg.)
- v. Number & Date of Contract: \_\_\_\_\_
- vi. Marking: MUET in a 6 in. x 4 in. rectangle

**MUET**

## 6. Transportation and Shipment

### a. For Stores to be Imported

- i. All those items of Stores which are to be imported by the Contractor shall be **shipped** by whatever means the Contractor deems fit **at his / her risk and cost**. The Contractor must keep the University informed of the shipping arrangements, schedule of shipping, arrival at the port, clearance from the port, and transportation from the port to the University.
- ii. **All costs** of loading of the Stores from the wharves at port of shipment and also the cost of ship wharf age / berthing, demurrage charges, stevedoring, handling charges and other port and river dues in respect of shipment companies' vessels at the port of shipment and all other expenditure up to the stage of placing the Stores at rest on board the ship and the freight charges shall be **borne by the Contractor**.
- iii. Similarly all costs of unloading the Stores at the wharves, wharf age / berthing, demurrage, stevedoring, handling charges and other port dues at the port of arrival in Pakistan and transportation from the port up to the stage of placing the Stores position in the Electronic Engineering Department of the University shall be borne by the **Contractor**. In order to facilitate the clearance of the Stores at the port of arrival, a clearing agent will be engaged by the University, in consultation with the Contractor, who will get the Stores cleared with the assistance of the University and the Contractor, and the clearing agent's charges shall be **borne by the Contractor**.

- iv. All things being equal, **Pakistan flag ships** should be used, as far as possible, for shipment of the Stores. If no such ship is available, such other ships may be used consistent with the execution of this Contract with economy and efficiency.
- v. The Stores must be shipped **under deck**
- vi. The Contractor shall send by air mail/courier service or personally deliver 4 (four) sets of non-negotiable shipping documents direct to the Director (Works & Strategic Planning), Mehran University of Engineering and Technology, Jamshoro, Sindh, so as to reach him at least 8(eight) days before arrival of the ship at the port in Pakistan.

**b. For Stores Manufactured / Available in Pakistan**

- i. All those items of the Stores which are to be manufactured in Pakistan, or are to be supplied from the locally available stocks (whether imported or manufactured in Pakistan), may be transported from the place of manufacture or availability to Khairpur Mir's by **any mode of transportation** as deemed convenient and suitable by the Contractor at his / her risk and cost.
- ii. **All costs** of handling, loading, transportation, unloading and placing the Stores in position in the Electronic Engineering Department of the University shall be **borne by the Contractor**.

**7. Pre-shipment and After-fabrication Inspection**

- a) The **pre-shipment inspection** and / or the inspection of the Stores Principals/Proprietor at the premises, if desired by the Contractor, shall be arranged by the Contractor at his / her own cost. The responsibility for the quality, quantity, correctness and adherence to the Specifications etc. of the Stores shall lie solely and squarely on the Contractor.
- b) The University may, at its discretion, waive pre-shipment inspection and hence issue the waiver in writing so that the Stores could be shipped under manufacturer's test certificate. This waiver shall be deemed as authorization to ship for the purpose of negotiating the letter of credit under Clause 13(b)ii.
- c) The pre-shipment inspection and/or the waiver thereof shall in no way above the Contractor of any of his obligations under this Contract.

## 8. Insurance

The **Contractor shall arrange** the insurance for the Stores in whatever way he / she deems fit at his / her risk and cost. The prices quoted in the offer of the Contractor shall include the cost of insurance. The Contractor shall have to inform the University of the Insurance Arrangements made by him / her for the Stores.

## 9. On-arrival Inspection

There shall be inspection of the Stores by the representatives of the University after arrival in the Electronic Engineering Department of the University in presence of the Contractor or his authorized representatives and the representatives of the insurance company. The **inspection report**, which, inter-alia, should indicate the condition in which each item of the Stores has been received, shall be signed by the above representatives. The Contractor shall coordinate with the Director (Works & Strategic Planning), Mehran University, and the insurance company for arranging the inspection at such date and time as is convenient to the above representatives.

## 10. Taking Over

Upon receipt of the equipment in the Electronic Engineering Department of the University and after inspection, as stated in Clause 9 above, the University will issue a **taking-over certificate** in respect of those items of Stores which are received in acceptable condition. The taking-over of the damaged items will be with-held until the same are repaired / replaced and are re-inspected and found in acceptable condition.

## 11. Installation and Demonstration of Stores

### a). Installation

- i) After inspection and taking over of the Stores, as stated in Clauses **9** and **10** above, the **Contractor shall install** those items of Stores which are to be permanently positioned in place in the laboratories of the University. For this purpose, the Contractor shall co-ordinate with the Director (Works & Strategic Planning), Mehran University, for making arrangements for the Hardware needed for the installation.
- ii) The cost of hardware **for installation** shall be borne by the University. The Contractor shall provide, alongwith his offer, the details of the hardware needed for each item of the Stores separately. The technical and other personnel needed for installation of the Stores shall be provided by the Contractor at his cost. The entire cost of installation, configuration, application except that of the needed hardware, shall be borne by the Contractor.

**b) Demonstration**

- i) After installation of the Stores, as stated in Clause **11 a)** above, the complete **working of each item** of Stores for the purpose of performing the intended Electronic Engineering Department experiments, testing of specimens and recording of the test results etc., shall be demonstrated fully to the designated staff of the University by the Contractor or his technical personnel.
- ii) The entire **cost**, including the T.A. / D.A. of the personnel involved in the demonstration, shall be **borne by the Contractor**.

**12. Completion Certificate**

After completion of the installation and demonstration, as stated in Clause **11** above, a certificate is to be obtained by the Contractor from the concerned **Head of the Department / Director of the Institute** stating that the Stores (item-wise) have been satisfactorily installed and demonstrated by the Contractor.

**13. Terms of Payment**

The Contractor shall be paid for Stores in the following manner:

- a) CATEGORY A: **Stores Manufactured/Available in Pakistan without involving import.**
  - i. For all those items of Stores for which the completion certificate has been issued by the University, as stated in Clause **12** above, the University will pay to the Contractor total price of the items quoted by the Contractor.
  - ii. The payment for those items of Stores for which the completion certificate has not been issued by the University, as stated in Clause **12** above, will be with-held and released only after the damaged items are replaced / repaired, re-inspected and found in satisfactory condition with consequent issuance of the completion certificate. The payment will be made in the same manner as stated in Clause **13 a) i** above
- b) CATEGORY-B **Stores Imported from Approved Countries.**

The payment for this category of Stores will be made in two parts as under:-

**PART-I. Payment in Foreign currency**

- i. An irrevocable **letter of credit** of one hundred percent (**100%**) of the C&F price, in the currency quoted by the Principals, will be opened in a bank in the country of origin in favor of the Principals/Contractor within 30 days after signing the Contract.

- ii. One hundred percent (**100%**) of the letter of credit amount will be paid against presentation of the shipping documents to the bank through the above letter of credit. The required shipping documents include:
- Clean on board bill of lading;
  - Contractor's detailed invoice showing description of the Stores, specifications, quantity, unit price and total price;
  - Detailed packing list;
  - Certificate of origin of the Stores' and
  - Certificate of pre-shipment/after-fabrication inspection or authorization to ship the Stores as per Clause-7.

**PART-2.      Payment in Pakistani Rupees**

The Rupee component of the price of the Stores, as stated in Clause **9 b)** of “**Instructions to Tenderers**” will be paid to the Contractor in the following manner:

- i. For all those items of Stores for which the taking over certificate has been issued by the University, as stated in Clause **10** above, the University will pay to the Contractor seventy percent (70%) of the total price of the items quoted by the Contractor, the remaining thirty percent (30%) will be paid after presentation of the completion certificate, as stated in Clause 12 above.
- ii. The payment for those items of Stores for which the completion certificate has not been issued by the University, as stated in Clause **10** above, will be withheld and released only after the damaged items are replaced/repared, re-inspected and found in satisfactory condition with consequent issuance of the completion certificate. The payment will be made in the same manner as stated in Clause **13 a)i** above

**14.      Warranty / Guaranty**

- a) The Contractor shall **warranty** that the Stores shall be fit for the purposes and operation mentioned in the relevant clauses of the “Instructions to the Tenderers” and “Conditions of Contract”, notwithstanding the fact that the entire Stores, or any item or part of the Stores, bear or are found to bear a patent or trade mark.
- b) The Contractor shall guarantee supply of good quality Stores in accordance with the Specifications and as stated in Clauses 4 and 5 of the “Instructions to the Tenderers”. Further, the Stores shall be brand new and absolutely free from all defects in material, quality and workmanship. In case of defects, the defective Stores, or the defective parts / components of the Stores thereof, shall be replaced by the Contractor free of cost to the University within reasonable time.

**15. Breach of Contract**

In case of breach of warranty /guarantee or Contract, the **damages** suffered by the University shall be **recovered from the Contractor** out of any payment due to the Contractor and / or in accordance with the terms and conditions of the Contract Performance Bond given at Annexure “E” enclosed with this Tender Document, without notice to the Contractor.

**16. Contractor’s Default Liability**

- a) The University may upon written notice of default to the Contractor **terminate the Contract** in the circumstances detailed hereunder:
  - i. If in the judgment of the University, the Contractor fails to make delivery of the Stores within the time specified in the Contract Agreement or within the period for which extension has been granted by the University; and
  - ii. If, in the judgment of the University, the Contractor fails to comply with any of the other provisions of the Contract.
- b) In the event the University terminates the Contract, in whole or in part, as provided in Clause **16 a)** above, the University reserves the right to **purchase**, on such terms and conditions as it may deem appropriate, Stores similar to the one terminated, and the Contractor will be liable to the University for any additional costs for such **similar Stores**, and / or for liquidated damages for delay, as defined in Clause **22** of the Conditions of Contract until such reasonable time as may be required for the final supply of the Stores.
- c) If the Contract is terminated, as provided in Clause **16 a)** above, the University, in addition to any other rights provided in this Clause, may require the Contractor to **transfer title** and deliver to the University under any of the following cases in the manner and as directed by the University:
  - i) Any **completed Stores**; and
  - ii) Such **partially completed Stores**, drawings, information and contract right (hereinafter called manufacturing material) as the Contractor has specifically produced or acquired for the performance of such parts of the Contract as has been terminated.
- d) The University will **pay to the Contractor** the Contract Price for the completed Stores delivered to and accepted by the University and also for the manufacturing materials delivered and accepted.
- e) In the event the University does not terminate the Contract, as provided in Clause **16 a)** above, the Contractor shall continue with the performance of his / her Contract, in which case the Contractor shall be liable to the University for **Liquidated Damages for delay** as set out in Clause 22 until the Stores are accepted.

**17. Bankruptcy**

If the **Contractor** shall become **bankrupt** or have a receiving order made against him / her or compound with his / her creditors, or being a corporation commence to be wound up, not being a voluntary winding up for the purpose of amalgamation or reconstruction, or carry on its business under a receiver for the benefit of its creditors or any of them, **the University shall** be at liberty to:

- a) **terminate the Contract** forthwith by a notice in writing to the Contractor or to the liquidator or receiver or to any person in whom the Contract may become vested, and to act in the manner provided in Clause 16 above as though the last mentioned notice has been the notice referred in such Clause and the Stores have been taken out of the Contractor's hand; and / or
- b) give such liquidator, receiver, or other person the **option of carrying out the Contract** subject to his / her providing a guarantee for the due and faithful performance of the Contract upto an amount to be determined by the University.

**18. Termination of Contract**

- a) If, for any cause as set forth in Clause **19** hereafter, the Contractor finds it impracticable to continue operation or, if owing to force majeure or to any cause beyond its control, the University finds it impossible to continue operation, then **prompt notification** in writing shall be given by the party affected to the other.
- b) If the delay or difficulties so caused cannot be expected to cease or become avoidable, or if operation cannot be resumed within six months, then either party shall have the right to terminate the Contract by giving ten **(10) days written notice** to the other.
- c) In the event of termination of the Contract under this Clause, **payment** will be made to the Contractor as follows:
  - i) The Contractor shall be paid for all the Stores for which the completion certificate has been issued, as stated in Clause 12, and for all the reimbursable expenses due and unpaid.
  - ii) The Contractor shall also be paid reasonably for any work done during the said six months period as well as for settlement of any financial commitment made in connection with proper performance of the Contract and which are not reasonably defrayed by payments under i) above.
  - iii) On termination of the contract for any cause, the Contractor shall see to the orderly suspension and termination of operations with due consideration to the interests of the University with respect to completion, safeguarding or storing of the Stores produced for the performance of the Contract and the salvage and resale thereof

**19. Force Majeure.**

**The Contractor shall not be liable** for any additional cost or for liquidated damages for delay or any failure to perform the Contract arising out of force majeure or cause beyond his / her control including acts of God, or of the public enemy, or of the Government, fires, floods, epidemic quarantine restrictions, strikes, freight embargoes and default of subcontractors due to any such cause (unless the University shall determine that the Stores to be furnished by the Contractor might reasonably have been obtained from other sources in sufficient time to allow the Contractor to meet the required time schedule), provided that the Contractor shall within ten (10) days from the beginning of such delay notify the University in writing of the **causes of the delay**. The University shall ascertain the facts and the extent of the delay and **extend the time** for completing the supplies as in its judgment the findings justify.

**20. Rejection**

- a) In the event any portion of the Stores supplied by the Contractor is found before taking over to be **defective in material or workmanship**, or otherwise not in conformity with the requirements of the Contract, the University shall have the right to either reject or require, in writing, rectification of the Stores. In the later case, the Contractor shall with utmost diligence, and at his own expense, make good the defects so specified or replace the defective Stores. If the Contractor fails to rectify or replace the rejected Stores, the University may adopt any of the following options:
  - i) **replace or rectify**, at its option, such defective Stores and charge to the Contractor the excess cost occasioned to the University plus (15%) fifteen percent; or
  - ii) acquire the said Stores **at a reduced price** considered equitable under the circumstances; or
  - iii) **terminate the Contract** as provided in Clause **18** of these Conditions of Contract.
- b) Nothing in this Clause shall affect any claim by the University under Clause **22** hereafter.

**21. Extension of Time**

If the completion of the Contract is delayed due to reason beyond the control of the Contractor, the Contractor shall without delay request the University, in writing, of his **claim** for an extension of time. The University on receipt of such request may agree to **extend the completion date** as may be reasonable in the circumstances of the case but without prejudice to other terms and conditions of the Contract.



## 22. Delay in Delivery - Liquidated Damages

- a) Should the **progress** of the Contract at any time be **lagging behind** the program agreed between the University and the Contractor, the University will notify the Contractor in writing and the Contractor shall there upon take such steps as he / she may deem fit to **expedite the progress** of the Contract. Non-issuance of this notice by the University shall not in any way absolve the Contractor of the liquidated damages as stated in Clause **22 b)** below.
- b) If the Contractor **fails to complete the Contract**, in full or part, within the time laid down in the Contract Agreement or any extension thereof, there shall be deducted from the Contract Price, as **liquidated damages**, a sum of one half of one percent **(0.5%) of the Contract price** of each unit of the delayed Stores for each calendar week of delay subject to the maximum of five percent (5%) of the Contract Price of the unit or units so delayed, and such deduction shall be in full satisfaction of the Contractor's liability for the said failure.

## 23. Period of Guarantee

- a) The term **period of guarantee** shall mean the period of twelve **(12) months** from the date on which the Stores have been put into operation and demonstrated to University staff. In any case this period shall not exceed eighteen (18) months from the date of taking-over certificate.
- b) During the period of guarantee, the Contractor shall **remedy**, at his / her expense, **all defects** in design, materials, and workmanship that may develop or are revealed under normal use of the said Stores upon receiving written notice from the University; the notice shall indicate in what respect the Stores are faulty.
- c) The provisions of this Clause include all the **expenses** that the Contractor may have to incur for delivery and installation of such replacement parts, material, and equipment as are needed for satisfactory operation of the Stores at the University premises.

## 24. Non-assignment

The Contractor shall **not have the right to assign or transfer** without the prior approval of the University the benefit and obligations of the Contract or any part thereof.

## 25. Expenditure Under Contract

The Contractor shall not make any expenditure for the purpose of this Contract in any **country not authorized** by the Government of Pakistan

**26. Certificate Not to Affect the Rights of the University or the Contractor**

No certificate of the University on account nor any sum paid on account by the University nor any extension of time for the delivery of the Stores pursuant to Clause 19 shall affect or **prejudice the rights of the University** against the Contractor nor relieve the Contractor of his obligation for due performance of the Contract or be interpreted as approval of the Stores supplied, and no certificate shall create liability of the University to pay for the alterations, amendments, variations etc. not ordered in writing by the University or discharge the Contractor for the payment of damages or of any sum against the payment of which he / she is bound to indemnify the University nor shall such certificate nor the acceptance by him / her of any sum paid affect or **prejudice the rights of the Contractor** against the University.

**27. Payments Due from the Contractor**

**All costs**, ascertained damages or expenses for which under the Contract the Contractor is liable to the University may be deducted by the University from any money due or may become due to the Contractor under the Contract or may be recovered by action of law or other wise from the Contractor.

**28. Legal Proceedings**

The Contract and the Tender Documents are governed by the **laws of Pakistan** and no proceedings to or arising out of any of them shall be instituted in any courts other than those situated at Hyderabad and Karachi, Sindh Pakistan..

**29. Dispute**

Should any question or dispute arise as to the material, design, construction or delay in the supply of the Stores or the purpose or the performance for which they are required or are warranted, the University shall nominate an independent **certifier / expert** having knowledge of Equipment, etc., who will, after affording the parties to the dispute an opportunity to present their contention, and after having tests made as the certifier deems fit, certify whether there has been any breach of Contract or warranty and, if so, what sum shall be paid to the University in diminution or extinction of price, and such certificates shall be final and binding and shall not be questioned and shall be acted upon in arbitral or other legal proceedings. The award of the costs of the certifier will be within his / her own discretion and shall be recoverable from the party against which the costs are awarded.

**30. Arbitration**

All disputes and matters of difference whatsoever (other than those relating to the certificate of expert certifier) between the University and the Contractor relating to and arising out of the Contract and Tender Documents shall be referred to arbitration under the arbitration act 1940 with amendments and re-amendments thereof, each party nominating its own arbitrator. The umpire will be nominated by the arbitrators within the first three arbitral hearings. The **award of the arbitrators or of the umpire shall be final and binding** upon the parties. The arbitral proceedings shall be held at Khairpur Mir's, Sindh Pakistan.

**FORM OF TENDER**  
(LETTER OF OFFER)

Tender Reference No. \_\_\_\_\_ Dated \_\_\_\_\_

Name of Contract: **Supply, Installation, Putting into Operation and Demonstration of Equipment at laboratories of Electronic Engineering Department of Mehran University of Engineering & Technology, SZAB Campus Khairpur Mir's, Sindh**

The Director (Works & Strategic Planning)  
Mehran University of Engineering & Technology  
JAMSHORO, SINDH

Dear Sir,

1. Having examined the Tender Documents including Instructions to Tenderers, Conditions of Contract, Specifications, Drawings, Schedule of Prices and Addenda Nos. \_\_\_\_\_ for the execution of the above-named Contract, we, the undersigned, being a company doing business under the name and address \_\_\_\_\_ and being duly incorporated under the laws of Pakistan hereby offer to execute and complete such Contract and remedy any defects therein in conformity with the said Documents including Addenda thereto for the Total Tender Price of Rs. \_\_\_\_\_ (in figures and words) or such other sum as may be ascertained in accordance with the said Documents.
2. We understand that all the Schedules attached hereto form part of this Tender.
3. As security for due performance of the undertakings and obligations of this Tender, we submit herewith a Bid Bond referred to in Clause 3 of the Instructions Tenderers and as per Annexure “D”, in the amount of Rs. \_\_\_\_\_ (in words and figures) drawn in favor of or made payable to Mehran University of Engineering and Technology, Khairpur Mir's, and valid for a period of 28 days beyond the period of validity of this Tender.
4. We undertake, if our Tender is accepted, to complete the whole of the work comprised in the above-named Contract within the time stated in Clause 12 of the Instructions to Tenderers.
5. We agree to abide by this Tender for the period of 90 days beyond the date of opening of the Tender, and it shall remain binding upon us and may be accepted at any time before the expiration of this period.
6. Unless and until a formal Contract Agreement is signed, this Tender, together with your acceptance thereof, shall constitute a binding contract between us.
7. We undertake, if our Tender is accepted, to execute the Contract Performance Bond referred to in Clause 3 of the Instructions to Tenderers and as per Annexure “E” for the due performance of the Contract.

8. We understand that you are not bound to accept the lowest or any Tender you may receive.
9. We do hereby declare that this Tender is made without any collusion, comparison of figures or arrangement with any other person or persons making a Tender for the above-named Contract.
10. We confirm, if our Tender is accepted, that all partners of the joint venture shall be liable jointly and severally for the execution of the Contract and the composition or the constitution of the joint venture shall not be altered without the prior consent of the Vice Chancellor, Mehran University of Engineering and Technology, Jamshoro. (Please delete this clause in case of Tender from a single firm)

Dated this \_\_\_\_\_ day of \_\_\_\_\_ 2018

Signature \_\_\_\_\_ in the capacity of \_\_\_\_\_ duly authorized

to sign Tender for and on behalf of \_\_\_\_\_  
(Name of Tenderer in Block Capitals)

Address: \_\_\_\_\_  
\_\_\_\_\_

**Witness:**

Name: \_\_\_\_\_

Address: \_\_\_\_\_  
\_\_\_\_\_

Occupation: \_\_\_\_\_

**TENDER PARTICULARS**

**THE TENDERERS MUST SUPPLY THE FOLLOWING SPECIFIC INFORMATION FOR EACH ITEM OR GROUP OF ITEMS OF THE STORES:**

**1. Conformation of Stores:**

Whether the Stores offered conform to the particulars specified in the Schedules; if not, details of deviations must be stated in Annexure "F".

**2. Manufacturing Details:**

- (i) Brand of Equipment.
- (ii) Name and address of Manufacturer; and
- (iii) Country of origin of Stores.

**3. Delivery Schedule: `**

- (i) Earliest date by which delivery can be affected;
- (ii) Complete schedule of delivery; and
- (iii) If the delivery period is different for different items, it must be indicated item wise.

**4. Packing Specification:**

Whether the specifications for packing given in the Tender Documents will be adhered to.

ANNEXURE "C1"

**FORM OF SCHEDULE TO TENDER FOR STORES MANUFACTURED/AVAILABLE  
IN PAKISTAN WITHOUT INVOLVING IMPORT.**

Due by \_\_\_\_\_ hours on \_\_\_\_\_  
(time) (date) (month) (year)

SCHEDULE TO TENDER NO. \_\_\_\_\_ DATED \_\_\_\_\_

The Tender will be opened at \_\_\_\_\_ hours on \_\_\_\_\_  
(time) (date) (month) (year)

Delivery on or before \_\_\_\_\_  
(date) (month) (year)

**Rates and amount to be quoted in Pakistani Rupees**

S.No.	Code/ Item No.	Description Of Stores	Detailed Specifications Of Stores with Model No.	Quantity Of Stores.	Unit	Rate Per Unit	Total Price.
1	2	3	4	5	6	7	8

**It is certifies that:**

- The Stores offered above conform in all respects with the particulars/specifications given in the Tender Documents' and
- All the terms and conditions of the Tender Documents are acceptable to us.

\_\_\_\_\_  
(signature of the authorized person)

\_\_\_\_\_  
(name of the authorized person)

**SEAL**

\_\_\_\_\_  
(name of the Tenderer)

ANNEXURE “C2”

**FORM OF SCHEDULE TO TENDER FOR STORES**  
**IMPORTED FROM APPROVED COUNTRIES.**

Due by \_\_\_\_\_ hours on \_\_\_\_\_  
(time) (date) (month) (year)

SCHEDULE TO TENDER NO. \_\_\_\_\_ DATED \_\_\_\_\_

The Tender will be opened at \_\_\_\_\_ hours on \_\_\_\_\_  
(time) (date) (month) (year)

Delivery on or before \_\_\_\_\_  
(date) (month) (year)

**PART 1.** The rates quoted in the Table below must be on C&F basis.

S. No.	Code/ Item No.	Description Of Stores	Detailed Specifications Of Stores with Model No.	Quantity Of Stores.	Unit	Rate Per Unit	Currency	Total C&F Price	Country of Origin
1	2	3	4	5	6	7	8	9	10

**PART 2.** The rates quoted in the Table below must be in Pakistani Rupees

S.No.	Code/ Item No.	Description of Stores	Quantity Of Stores.	Unit	Rate Per Unit	Total Price.
1	2	3	5	6	7	8

(Continued on the next page)

## ANNEXURE “C2”

### NOTE:

In the Table below, the columns 1 to 5 and 8 are to be filled in by the Tenderer before submitting the Tender, while the columns 6,7 and 9 are to be filled in jointly by the Director (Works & Strategic Planning), Mehran University of Engineering and Technology, or his representative, and the Tenderer, or his representative, after opening of the Tender.

S. No.	Code/ Item No.	Description of Stores	Total C&F Price for Part 1	Currency	Exchange Rate	Total Price for Part 1 (Rs.)	Total Price for Part II (Rs.)	Total Cost (Rs.)
1	2	3	4	5	6	7	8	9

### It is certified that:

- i) The Stores offered above conform in all respects with the particulars/specifications given in the Tender Documents; and
- ii) All the terms and conditions of the Tender Documents are acceptable to us.

\_\_\_\_\_  
(name of the Tenderer)

\_\_\_\_\_  
(signature of the authorized person)

\_\_\_\_\_  
(name of the authorized person)

**SEAL**



## BID BOND

(Bank Guarantee)

Guarantee No \_\_\_\_\_

Executed on \_\_\_\_\_

Expiry date \_\_\_\_\_

### Letter by the Guarantor (Bank) to the Employer (University)

Name of Guarantor (Bank) with address: \_\_\_\_\_

\_\_\_\_\_

Name of Principal (Tenderer) with address: \_\_\_\_\_

\_\_\_\_\_

Penal sum of Security (Bond),(in figures and words): \_\_\_\_\_

\_\_\_\_\_

Tender Reference No. \_\_\_\_\_ Date of Tender \_\_\_\_\_

KNOW ALL MEN BY THESE PRESENTS, that in pursuance of the terms of the Tender and at the request of the said Principal (Tenderer), we the Guarantor above-named are held and firmly bound unto the Vice Chancellor, Mehran University of Engineering and Technology, Jamshoro, acting through the Director (Works & Strategic Planning), Mehran University of Engineering and Technology, {hereinafter called The “Employer” (“University”)} in the sum stated above, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the Principal (Tenderer) has submitted the accompanying Tender numbered and dated as above for supply, installation, putting into operation and demonstration of equipment in the laboratories of Mehran University of Engineering and Technology, SZAB Campus Khairpur Mir’s, to the said Employer (University); and

WHEREAS, the Employer (University) has required as a condition for considering the said Tender that the Principal (Tenderer) furnish a Bid Bond in the above said sum to the Employer (University), conditioned as under:

- 1) that the Bid Bond shall remain valid for a period of 28 days beyond the period of validity of the Tender;

2) that in the event of;

- a) the Principal (Tenderer) withdraws his Tender during the period of validity of the Tender;
- b) the Principal (Tenderer) does not accept the correction of his Tender Price, pursuant to Clause 16 of “Instructions to Tenderers”; or
- c) failure of the successful Tenderer to:
  - i) furnish the required Contract Performance Bond, in accordance with Clause 3 of “Instructions to Tenderers”; or
  - ii) sign the proposed Contract Agreement, in accordance with Clause 4 of the “Conditions of Contract”;

then the entire sum be paid immediately to the said Employer (University) as liquidated damages and not as penalty for the successful Tenderer’s failure to perform.

NOW THEREFORE, if the successful tenderer shall, within the period specified therefore, on the prescribed form presented to him for signature enter into a formal Contract with the said Employer (University) in accordance with his Tender as accepted and furnish within twenty eight (28) days of his being required to do so, a Contract Performance Bond with good and sufficient surety, as may be required, upon the form prescribed by the said Employer (University) for the faithful performance and proper fulfillment of the said Contract or in the event of rejection of the said Tender by the Employer (University) within the time specified then this obligation shall be void and of no effect, but otherwise to remain in full force and effect.

PROVIDED THAT, the Guarantor shall forthwith pay to the Employer (University) the said sum stated above upon first written demand of the Employer (University) without cavil or argument and without requiring the Employer (University) to prove or to show grounds or reasons for such demand notice of which shall be sent by the Employer (University) by registered post duly addressed to the Guarantor at its address given above.

PROVIDED ALSO THAT, the Employer (University) shall be the sole and final judge for deciding whether the Principal (Tenderer) has duly performed his / her obligations to sign the Contract Agreement and to furnish the required Contract Performance Bond within the time stated above, or has defaulted in fulfilling the said requirements and the Guarantor shall pay without objection the sum stated above upon first written demand from the Employer (University) forthwith and without reference to the Principal (Tenderer) or any other person.

IN WITNESS WHEREOF, the above bounden Guarantor has executed the instrument under its seal on the date indicated above, the name and seal of the Guarantor being hereto affixed and these presents duly signed by its undersigned representative pursuant to the authority of its governing body.

\_\_\_\_\_  
Guarantor (Bank)

**Witness:**

1. \_\_\_\_\_  
(Signature)

\_\_\_\_\_  
(Signature)

\_\_\_\_\_  
(Name, Title, Address and Seal)

\_\_\_\_\_  
(Name)

2. \_\_\_\_\_  
(Signature)

\_\_\_\_\_  
(Title)

\_\_\_\_\_  
(Name, Title, Address and Seal)

\_\_\_\_\_  
(Corporate Guarantor Seal)

**CONTRACT PERFORMANCE BOND**  
(Bank Guarantee)

Guarantee No. \_\_\_\_\_  
Executed on \_\_\_\_\_  
Expiry Date \_\_\_\_\_

**Letter by the Guarantor (Bank) to the Employer (University)**

Name of Guarantor (Bank) with Address: \_\_\_\_\_  
\_\_\_\_\_

Name of Principal (Contractor) with address: \_\_\_\_\_  
\_\_\_\_\_

Penal Sum of Security (Bond), (in words and figures) \_\_\_\_\_  
\_\_\_\_\_

Letter of Acceptance No. \_\_\_\_\_ Dated \_\_\_\_\_

KNOW ALL MEN BY THESE PRESENTS, that in pursuance of the Tender Documents and above said Letter of Acceptance (hereinafter called the Documents) and at the request of the said Principal (Contractor) we, the Guarantor above named, are held and firmly bound unto the Vice Chancellor, Mehran University of Engineering and Technology, Jamshoro, Sindh, acting through the Director (Works & Strategic Planning), Mehran University of Engineering and Technology {hereinafter called the Employer (University)} in the penal sum of amount stated above for the payment of which sum well and truly to be made to the said Employer (University), we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the Principal (Contractor) has accepted the Employer's (University's) above said Letter of Acceptance for the supply, installation, putting into operation and demonstration of Equipment of Laboratories of Mehran University of Engineering and Technology, SZAB Campus Khairpur Mir's, Sindh.

NOW THEREFORE, if the Principal (Contractor) shall well and truly perform and fulfill all the undertakings, covenants, terms and conditions of the said Documents during the original terms of the said Documents and any extensions thereof that may be granted by the Employer (University), with or without notice to the Guarantor, which notice is hereby waived and shall also well and truly perform and fulfill all the undertakings, covenants, terms and conditions of the Contract and of any and all modifications of the said Documents that may hereafter be made, notice of which modifications to the Guarantor being hereby waived, then, this obligation to be void; otherwise to remain in full force and virtue till the expiry of the guaranty period as per Clause 23 of the Conditions of Contract.

Our total liability under this Guarantee is limited to the sum stated above and it is a condition of any liability attaching to us under this Guarantee that the claim for payment in writing shall be received by us within the validity period of this Guarantee, failing which we shall be discharged of our liability, if any, under this Guarantee.

We, \_\_\_\_\_ (the Guarantor), waiving all objections and defenses under the Contract, do hereby irrevocably and independently guarantee to pay to the Employer (University) without delay upon the Employer's (University's) first written demand without cavil or arguments and without requiring the Employer (University) to prove or to show grounds or reasons for such demand any sum or sums up to the amount stated above, against the Employer's (University's) written declaration that the Principal (Contractor) has refused or failed to perform the obligations under the Contract which payment will be effected by the Guarantor to the Employer's (University's) designated Bank and Account Number.

PROVIDED ALSO THAT the Employer (University) shall be the sole and final judge for deciding whether the Principal (Contractor) has duly performed his obligations under the Contract or has defaulted in fulfilling the said obligations, and the Guarantor shall pay without objection any sum or sums up to the amount stated above upon first written demand from the Employer (University) forthwith and without any reference to the Principal (Contractor) or any other person.

IN WITNESS WHEREOF, the above bounden Guarantor has executed this Instrument under its seal on the date indicated above, the name and corporate seal of the Guarantor being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body

**Witness:**

1. \_\_\_\_\_  
(Signature)

\_\_\_\_\_  
Name, Title and Address (Seal)

2. \_\_\_\_\_  
(Signature)

\_\_\_\_\_  
Name, Title and Address (Seal)

\_\_\_\_\_  
Guarantor (Bank)

\_\_\_\_\_  
(Signature)

\_\_\_\_\_  
(Name)

\_\_\_\_\_  
(Title)

\_\_\_\_\_  
Corporate Guarantor (Seal)

**ANNEXURE “F”**

**Statement Describing Deviation from Specifications.**

<b>S.No.</b>	<b>Code No.</b>	<b>Description of Stores</b>	<b>Statement of Variation from Specifications</b>	<b>Reasons for Variations.</b>
1	2	3	4	5

\_\_\_\_\_  
(signature of the authorized person)

\_\_\_\_\_  
(name of the authorized person)

**SEAL**

**On behalf of**

\_\_\_\_\_  
(name and address of the Tenderer)

**BILL OF QUANTITIES FOR**

**LAB EQUIPMENT**

**FOR**

**DEPARTMENT OF ELECTRONIC**

**ENGINEERING**

**ITEM CODE**

**ES/AEDAL, ES/DEML, ES/IARL, ES/SPFL**

# DEPARTMENT OF ELECTRONIC ENGINEERING

## 1. ADVANCED ELECTRONICS DESIGN & APPLICATION LAB

Item Code	Description	Qty	Unit Rate	Total Amount
<b>ES/AEDAL-01</b>	<b>Advance Electronics Measurement System</b> Radically practical approach to benchtop instrumentation. Five essential instruments for teaching DLD and MP concepts, one device, and an intuitive software interface. Too practical to ignore: <ul style="list-style-type: none"> <li>• <b>Digital I/O</b> (8 DIO channels, 5 V compatible LVTTTL input, 3.3 V LVTTTL output)</li> <li>• <b>Mixed-signal oscilloscope</b> (Bandwidth 100 MHz, 2 Analog Channels, 34 Digital Channels, Sampling rate 1 GS/s (single channel), 500 MS/s/ch (dual channel))</li> <li>• <b>Function Generator</b> (1 channel, max Frequency 20 Mhz sine, 5 MHz square, waveform types are sine, square, ramp, triangle, DC)</li> <li>• <b>Digital Multimeter</b> (Resolution 5 ½ digits, max Voltage 300V, max Current 10A, measurement functions are VDC, VAC, IDC, IAC, continuity, resistance, diode)</li> <li>• <b>Programmable DC Power Supply</b> (3 Channels, 0 to +6 V/0 to 1 A, 0 to +25 V/0 to 0.5 A, 0 to -25 V/0 to 0.5 A)</li> </ul>	<b>5</b>		
<b>ES/AEDAL-02</b>	<b>Probe Set</b> <b>Current Probes</b> <ul style="list-style-type: none"> <li>• RP1001C</li> <li>• DC-300 kHz</li> <li>• Can measure up to 100 A peak</li> </ul> <b>High Voltage Differential Probes</b> <ul style="list-style-type: none"> <li>• RP1025D</li> <li>• DC-25 MHz</li> <li>• Can measure up to 1400 Vpp.</li> </ul>	<b>2</b>		



Item Code	Description	Qty	Unit Rate	Total Amount
<b>ES/AEDAL-03</b>	<p><b>NI sbRIO GPIC Inverter Control Academic Kit</b></p> <p>The Single-Board RIO General-Purpose Inverter Controller (GPIC) embedded control and acquisition device integrates a real-time processor, a user-configurable FPGA, a full set of I/O for power electronics control, and communication I/O in a small form factor to give you the freedom to design a multifunctional, embedded power electronics control system. It combines an sbRIO-9606 embedded controller, featuring a 400 MHz industrial processor and a Xilinx Spartan-6 LX45 FPGA, with an 9683 mezzanine card that has a complete set of analog and digital I/O for power electronics control. The 9683 is connected to the embedded controller card through a RIO Mezzanine Card connector, which is a high-speed, high-bandwidth connector that provides direct access to the processor and 96 3.3 V digital I/O FPGA lines.</p> <ul style="list-style-type: none"> <li>· Deployment-ready commercial embedded system</li> <li>· 400 MHz processor, 512 MB nonvolatile storage, 256 MB DRAM for deterministic control and analysis</li> <li>· Reconfigurable Xilinx Spartan-6 LX45 FPGA for custom timing, inline processing, and control</li> <li>· Full set of analog and digital I/O for power electronics control</li> <li>· Integrated 10/100BASE-T Ethernet, RS232 serial, CAN, and USB ports- Possibility of : insertion/editing data in RAM- editing registers- I/O port control ×continuous program.</li> </ul> <p>The kit should be equipped withal necessary base boards, interfacing boards, connectors, power supply modules, reference manuals, software availability , interfacing cables and programmers, computers (if needed).</p>	<b>5</b>		
<b>ES/AEDAL-04</b>	<p><b>VLSI Development Platform with Wireless Communication</b></p> <p>VLSI Development Platform should be designed to educate wireless control application. Students should be able to know how VLSI is widely used in today's wireless application.</p> <p>On board peripherals &amp; IOs should be included to help students to build their own IP.</p> <p><b>Features:</b></p> <p>Two Xilinx Spartan2 (XC2S200) FPGA board</p> <p>On board 2.4GHz wireless trans-receiver</p> <p>8 Logic Input &amp; output, 6 Digit 7 segment Display</p> <p>On board 8 channel ADC &amp; Memory interface</p> <p>Configuration PROM socket for FPGA backup</p> <p>26 Pin &amp; 40 pin Connector for external I/Os</p> <p>On board Peripherals includes: RS232,PS2, Parallel port, VGA</p> <p>Customized software for wireless chatting.</p>	<b>5</b>		

Item Code	Description	Qty	Unit Rate	Total Amount
	<p><b>Scope of Learning</b> Applications that can be performed Basic Digital Logic, Multiplexer / Demultiplexer, Counter, Register, Encoder / Decoder, ALU, Memory, Address Decoder, Controller IP, RISC Processor IP, Serial Port IP, Parallel Port IP etc</p> <p><b>Applications include</b> Wireless Control Applications Wireless Communication Wireless Industrial Automation etc Power Supply : 110-220V 10%, 50 / 60 Hz</p> <p><b>Technical Specifications:</b> Xilinx Family: SPARTAN 2, XC2S200PQ208 Device Density :200K gates, 5,292 Logic Cells On board, 2 Crystal 8MHz &amp; 25MHz. Master Reset key for hardware reset Program Key for FPGA reconfiguration Onboard PROM(1Mb size) Socket in a PLCC package for FPGA backup Configuration Methods: IEEE 1149.1 JTAG Interface, Slave Serial Interface, PROM Interface</p> <p><b>Memory</b> : 1MB( 128K X 8 ) memory interface</p> <p><b>Digital I/O's</b> : 8 Logic Input, 8 Logic Output, 6 Digit Seven Segment Display.</p> <p><b>Peripherals</b> : Channel 1 IEEE RS232 Serial Interface Channel 2 IEEE RS232 Serial Interface IEEE PS2 Interface for Keyboard, IEEE VGA Interface for Monitor 26 pin Connector for external I/O interface</p> <p><b>List of Accessories :</b> Sciencetech 101 board RS232 Cable Parallel Cable Omni Directional Antenna JTAG Cable Power Supply for Sciencetech 101 Learning material (CD) Xilinx ISE Webpack</p>			

Item Code	Description	Qty	Unit Rate	Total Amount
ES/AEDAL-05	<p><b>Advance Electronics IC and System Characterization Platform (SMU and LCR Meter)</b></p> <p>System should consists of following components:</p> <p><b>4-Slot 3U PXI Express Chassis - 3 GB/s</b></p> <ul style="list-style-type: none"> <li>· 3 hybrid slots</li> <li>· 230 W total power available from 0 to 50 °C</li> <li>· High performance - up to 1 GB/s per-slot dedicated bandwidth and 3 GB/s system bandwidth</li> <li>· Compact and lightweight PXI chassis, 13.1 lb (5.94 kg)</li> <li>· Compatibility with PXI, PXI Express, CompactPCI, and CompactPCI Express modules</li> </ul> <p><b>2.2 GHz Dual-Core PXI Express Controller</b></p> <ul style="list-style-type: none"> <li>· 2.2 GHz dual-core Intel Celeron 1020E processor</li> <li>· Up to 1 GB/s system bandwidth and 250 MB/s slot bandwidth (<b>four x1 PCI Express links</b>)</li> <li>· 2 GB 1333 MHz DDR3L RAM standard, 8 GB maximum</li> <li>· 250GB (or greater) 5400 RPM hard drive standard</li> <li>· 1 Gigabit Ethernet, 4 Hi-Speed USB, serial, and other I/O</li> <li>· Windows OS and drivers already installed; hard-drive-based recovery</li> </ul> <p><b>Source Measure Unit (SMU)</b></p> <ul style="list-style-type: none"> <li>· ±20 V, 2 A, isolated output</li> <li>· 4-quadrant operation - up to 10 W sinking</li> <li>· Remote (4-wire) sense</li> <li>· 5 current ranges - 2 A to 200 µA</li> <li>· 1 nA measurement resolution on the 200 µA range</li> <li>· Additional utility channel for programmable source and measure at up to 6 V, 1 A</li> </ul> <p><b>PXI-4072 FlexDMM and LCR Meter</b></p> <ul style="list-style-type: none"> <li>· Measurements of voltages and currents up ±300 VDC and ±1 ADC</li> <li>· Superior measurement rates -- 6½ digits at 100 S/s, 5½ digits at 3 kS/s</li> <li>· Precision capacitance and inductance measurement capability</li> <li>· 1.8 MS/s isolated, high-voltage waveform acquisition</li> <li>· 10 to 23-bit flexible resolution</li> <li>· 20 built-in measurement functions</li> <li>· DMM Probe Set with Alligator Clips, Spade Connectors, and Spring Hooks included</li> </ul>	1		

Item Code	Description	Qty	Unit Rate	Total Amount
<b>ES/AEDAL-06</b>	<b>Mechatronic Systems Add on Board</b> The system should be with following features: 5 bar parallel SCARA robot High resolution optical encoders Low powered serial camera for embedded imaging applications Dynamic LEDs for path planning task ELVIS RIO Control Module included System should include following topics: State machines and line following Image processing Manipulator control Path planning Inverse kinematics PID position control Forward kinematics Pattern recognition Blob detection Thresholding PWM generation Encoder decoding The system must be provided with all required accessories, data cables, power cables and interfacing devices.	<b>5</b>		
<b>ES/AEDAL-07</b>	<b>Base Platform for Mechatronics and Robotics</b> Board should be an integrated suite of instruments Oscilloscope, DMM, Function Generator, Variable Power Supply, Bode Analyzer, Dynamic Signal Analyzer, Arbitrary Waveform Generator, DIO, Impedance Analyzer, Two Wire Current Voltage Analyzer, Three Wire Current Voltage Analyzer Board should include Basic Breadboard Area specific power cord should be included.	<b>10</b>		
<b>ES/AEDAL-08</b>	<b>Robotics Kit with embedded controller</b> Kit should be Fully programmable with embedded design device which features Xilinx FPGA and dual-core ARM Cortex-A9 processor. <b>Accessories:</b> It should include mechanical components for building assemblies and Motor Board to connect all included sensors and actuators with ease. 10-Cell AA NiMH Battery Pack Battery Charger Sensors and actuators: Standard Servo, 2 DC Motors, Ambient Light Sensor, Gyro Sensor, IR Rangefinder Ability to connect to robot sensors and actuators Obstacle avoidance, mapping, and path planning Inverse kinematics, JAUS, and simulation capabilities. Kit should be supplied with all necessary accessories like base boards, power supplies, connectors, reference manuals and computers (if needed).	<b>5</b>		

Item Code	Description	Qty	Unit Rate	Total Amount
<b>ES/AEDAL-09</b>	<b>NI Embedded Design Device</b> <b>NI myRIO</b> <ul style="list-style-type: none"> <li>Affordable tool to teach and implement multiple design concepts with one device</li> <li>10 analog inputs, 6 analog outputs, 40 digital I/O lines</li> <li>Wireless, LEDs, push button, accelerometer onboard</li> <li>Xilinx FPGA and dual-core ARM Cortex-A9 processor</li> <li>Programmable with LabVIEW or C; adaptable for different programming levels</li> </ul> Box Contents <ul style="list-style-type: none"> <li>Driver and software evaluation DVDs</li> <li>USB cable</li> <li>Power supply with international adapters</li> <li>1 MXP protoboard accessory</li> <li>NI screwdriver and MSP screw-terminal connector</li> </ul>	<b>5</b>		
<b>ES/AEDAL-10</b>	<b>NI myRIO Starter Accessory Kit</b> Includes sensors and components needed for basic projects Devices covered in the online version of the NI myRIO Project Essentials Guide Power connector with leads for connection to stand-alone power supplies Consists of <ul style="list-style-type: none"> <li>Barrel connector with leads</li> <li>Assorted capacitors</li> <li>Diodes</li> <li>7-segment display</li> <li>Mechanical rotary encoder</li> <li>Photo interruptor (light sensor with LED)</li> <li>Assorted op-amps</li> <li>Assorted LEDs</li> <li>Small DC motor (1 VDC to 3 VDC, no load speed: 6600 rpm)</li> <li>Microphone with audio jack</li> <li>MXP Breadboard Accessory</li> <li>Potentiometer (500 k<math>\Omega</math>)</li> <li>Relay</li> <li>Assorted resistors</li> <li>Piezoelectric sensor</li> <li>Photocell</li> <li>2 Hall effect sensors (latch and switch)</li> <li>Buzzer</li> <li>Assorted switches (DIP, slide, and rotary)</li> <li>Thermistor (NTC: 10 k<math>\Omega</math>, 25 degrees)</li> <li>Assorted transistors</li> <li>Force sensing resistor</li> <li>Wire kit</li> </ul>	<b>5</b>		

Item Code	Description	Qty	Unit Rate	Total Amount
<b>ES/AEDAL-11</b>	<b>NI myRIO Embedded Systems Accessory Kit</b> <ul style="list-style-type: none"> <li>Includes sensors, devices, and a display for teaching and implementing embedded systems concepts</li> <li>Designed as an add-on to the NI myRIO Starter Kit</li> <li>Contains components with a variety of digital interfaces (SPI, I2C, UART)</li> <li>Devices covered in the online version of the NI myRIO Project Essentials Guide</li> <li>Consists of <ul style="list-style-type: none"> <li>Keypad</li> <li>Digital temperature sensor (I2C)</li> <li>Character LCD (I2C, SPI, and UART)</li> <li>Digital potentiometer (SPI)</li> <li>Bluetooth interface (UART)</li> <li>EEPROM (SPI)</li> <li>LED matrix</li> </ul> </li> </ul>	<b>10</b>		
<b>ES/AEDAL-12</b>	<b>NI System on Module Development Kit</b> <p>The NI System on Module (SOM) Development Kit includes a fully featured reference carrier board to assist in the development of your embedded application. The reference board saves development effort by offering design files, including schematics and gerbers, for all of the onboard peripherals, such as Gigabit Ethernet, USB Host, USB Device, SD, Serial, and CAN for reuse in a design</p> <ul style="list-style-type: none"> <li>Reference carrier board to assist with board development and I/O integration</li> <li>Reference designs available for Gigabit Ethernet, USB Host, USB Device, SD, Serial, and CAN</li> <li>PMOD connectors to support various I/O modules for quick integration</li> <li>Digital prototyping area with a selectable voltage level for custom I/O integration</li> <li>Heat sink included for a quick desktop thermal solution</li> <li>Prototype with the CompactRIO platform before development to accelerate the design process</li> </ul>	<b>5</b>		
<b>ES/AEDAL-13</b>	<b>4.3 in. WQVGA, Resistive Touch Display, GEMstudio License</b> <ul style="list-style-type: none"> <li>4.3 in. WQVGA TFT LCD touch screen with LED backlight</li> <li>Amulet GEM Graphical OS Chip</li> <li>Connectivity through mini USB or mass terminal port</li> <li>-20 °C to 70 °C operating temperature range</li> <li>Open frame design</li> <li>GEMstudio license</li> </ul>	<b>5</b>		
<b>ES/AEDAL-14</b>	<b>Amulet Technology Power RS-232 Interface Board</b>	<b>5</b>		

Item Code	Description	Qty	Unit Rate	Total Amount
<b>ES/AEDAL-15</b>	<p><b>CCNA Routing &amp; Switching Standard Lab Kit</b></p> <p>This Lab Kit should include :</p> <p>one 2811 router and two 2801 routers all running version 15.1 IOS; with 2 Fast Ethernet ports, USB, console and AUX ports, 2 HWIC 2 VWIC(2811) and 4 WIC/VWIC/VIC (2801) slots and the 2811 has 1 NM/NME network module slot too, with 256 megabytes DRAM &amp; 128MB (2811) 64 (2801) megabytes of flash RAM.</p> <p><b>Topics:</b></p> <p>Network Fundamentals</p> <p>Compare and contrast OSI and TCP/IP models</p> <p>Compare and contrast TCP and UDP protocols</p> <p>Compare and contrast network topologies</p> <p>Star</p> <p>Mesh</p> <p>Hybrid</p> <p>Configure, verify, and troubleshoot IPv4 addressing and subnetting</p> <p>Compare and contrast IPv4 address types</p> <p>LAN Switching Technologies</p> <p>IPv6 address types etc</p> <p>Kits should be equipped with all the necessary base stations, power supply modules, connectors, reference manuals, software and hardware connector cables , computers (if needed).</p>	<b>5</b>		
<b>ES/AEDAL-16</b>	<p><b>CCNA Voice Basic Lab Kit</b></p> <p>Kit should include:</p> <p>Cisco 2801 Router with 256MB-D/128MB-F RAM, IOS -c2801-adventerprisek9-mz.151-4.M8.bin</p> <p>1 Cisco 3550 PoE Switch with 64MB-D/8MB-F RAM, IOS -c3550-ipservicesk9-mz.122-44.SE6.bin</p> <p>1 PVDM2-16 Digital Signal Processor Module</p> <p>1 Cisco VIC2-2FXO PSTN Interface Card</p> <p>2 Cisco 7940 VoIP Phones</p> <p>4 7ft Ethernet Cat 5e Cables (blue)</p> <p>4 7ft Ethernet Cat 5e Cables (yellow)</p> <p>1 7ft Phone Patch Cable (silver)</p> <p>1 Cisco Console Cable (light blue)</p> <p>2 Power Cables</p> <p>Brent Seiling's CCNA Voice Lab Manual ebook (old exam 640-641)</p> <p><b>Topics:</b></p> <p><b>Voice Concepts</b></p> <p><b>Cisco Unified Communications Manager Express (CUCME)</b></p> <p>Establishing Network Connectivity and Understanding IP Phone Registration</p> <p>Managing Services, Phones, and Users etc</p> <p>Kits should be equipped with all the necessary base stations, power supply modules, connectors, reference manuals, software and hardware connector cables , computers (if needed).</p>	<b>5</b>		

Item Code	Description	Qty	Unit Rate	Total Amount
ES/AEDAL-17	<b>FPGA based Embedded Instrumentation Design Device</b> Affordable tool to teach and implement multiple design concepts with one device 10 analog inputs, 6 analog outputs, 40 digital I/O lines Wireless, LEDs, push button, accelerometer onboard Xilinx FPGA and dual-core ARM Cortex-A9 processor Fully programmable with LabVIEW or C; adaptable for different programming levels Onsite Training by OEM <b>Accessories :</b> Driver and software evaluation DVDs USB cable Power supply with international adapters 1 MXP protoboard accessory screwdriver and MSP screw-terminal connector <b>Sensors and Actuators Kit</b> Barrel connector with leads Assorted capacitors Diodes 7-segment display Mechanical rotary encoder Photo interruptor (light sensor with LED) Assorted op-amps Assorted LEDs Small DC motor (1 VDC to 3 VDC, no load speed: 6600 rpm) Microphone with audio jack MXP Breadboard Accessory Piezoelectric sensor Photocell 2 Hall effect sensors (latch and switch) Buzzer Assorted switches (DIP, slide, and rotary) Thermistor (NTC: 10 k $\Omega$ , 25 degrees) Keypad Digital temperature sensor (I2C) Bluetooth interface (UART) EEPROM (SPI) Servo motor: standard (215 degrees rotation) I2C) Infrared proximity sensor (10 cm to 80 cm)	5		



Item Code	Description	Qty	Unit Rate	Total Amount
ES/AEDAL-18	<p><b>Mobile Robotics Kit with embedded controller</b></p> <ul style="list-style-type: none"> <li>Ability to connect to robot sensors and actuators</li> <li>Obstacle avoidance, mapping, and path planning</li> <li>Inverse kinematics, JAUS, and simulation capabilities</li> </ul> <p>Includes all the necessary mechanical and electrical parts as well as instructions to construct 3 robot models directly out of the box.</p> <ul style="list-style-type: none"> <li>Segway (inverted pendulum control problem)</li> <li>Ball Balancer</li> <li>Rover (ground vehicle)</li> </ul> <p>After building these models, students will have gained the skills to implement their own designs by re-purposing the same pieces. The kit is based on the new TETRIX PRIME technology from Pitsco. This is a metal design kit that is tool-less but can be strengthened by tightening screws with tools for a more rugged design.</p> <ul style="list-style-type: none"> <li>Embedded controller</li> <li>10 analog inputs, 6 analog outputs, 40 digital I/O lines</li> <li>Wireless, LEDs, push button, accelerometer onboard</li> <li>Xilinx FPGA and dual-core ARM Cortex-A9 processor</li> <li>Programmable with LabVIEW or C; adaptable for different programming levels.</li> </ul>	5		
ES/AEDAL-19	<p><b>Autonomous Ground Robot</b></p> <p>Innovative open-architecture autonomous ground robot built on a Kobuki platform. Equipped with built-in sensors, a Microsoft® Kinect vision system, and accompanied by extensive courseware, the QBot 2 is ideally suited for teaching undergraduate and advanced robotics and mechatronics courses. The open-architecture control structure allows users to add other off-the-shelf sensors and customize the QBot 2 for their research in areas such as:</p> <p>Vehicle navigation and control  Autonomous vehicles control  Machine learning and computer vision  Artificial intelligence  High-level control architecture of mobile robots  Swarm robotics and more.</p> <p><b>Curriculum Topics Covered</b></p> <ul style="list-style-type: none"> <li>Differential drive kinematics</li> <li>Forward and inverse kinematics</li> <li>Dead reckoning and odometric localization</li> <li>Path planning and obstacle avoidance</li> <li>2D mapping and occupancy grid map</li> <li>Image acquisition, processing and reasoning</li> <li>Simultaneous localization and mapping (SLAM)</li> <li>High level control architecture of mobile robots</li> <li>Vision-guided vehicle control</li> <li>The QBot 2 can be also used to teach other topics not included in the Quanser-developed courseware</li> </ul>	4		

Item Code	Description	Qty	Unit Rate	Total Amount
ES/AEDAL-20	<p><b>Human Artificial Intelligence System (e.g Brain Study)</b></p> <ul style="list-style-type: none"> <li>· It is a 24 Channel Recorder for measuring 19 channels of EEG, two Bio Potential Channels, a GSR Channel and an Event Marker simultaneously from a single human subject.</li> <li>· The EEG is recorded using a 10-20 system EEG cap with Silver-SilverChloride electrodes.</li> <li>· The recorder is furnished with Software with the EEG Analysis Module and connects directly to a USB port on either a Macintosh or Windows computer.</li> <li>· The EEG and GSR electrodes are connected to the subject by snap-leads to pre-gelled Ag/AgCl electrodes.</li> </ul> <p><b>PCIe X Series Data Acquisition Module - 6341</b></p> <ul style="list-style-type: none"> <li>· 16 analog inputs, 500 kS/s, 16-bit resolution, <math>\pm 10</math> V</li> <li>· Two analog outputs, 900 kS/s, 16-bit resolution, <math>\pm 10</math> V</li> <li>· 24 digital I/O lines (8 hardware-timed up to 1 MHz)</li> <li>· Four 32-bit counter/timers for PWM, encoder, frequency, event counting, and more</li> </ul> <p>Advanced timing and triggering with NI-STC3 timing and synchronization technology</p> <ul style="list-style-type: none"> <li>· Support for Windows 7/Vista/XP/2000</li> </ul>	4		
ES/AEDAL-21	<p><b>Programmable WSN Gateway with accessories</b></p> <p>The WSN controller, should be programmable with the LabVIEW Real-Time Module, it should communicate with wireless sensor network (WSN) devices as well as other hardware through a variety of open communication standards.</p> <p><b>Features:</b></p> <p>533 MHz processor and a 2.4 GHz IEEE 802.15.4 radio to communicate with 8 WSN end nodes (star topology) or up to 36 distributed WSN nodes (in a mesh topology).</p> <p>Dual Ethernet ports to provide flexible connectivity to other devices in measurement system, such as enterprise-level networks or wired I/O systems.</p> <p>Flexible to create a complete wired and wireless measurement solution</p> <p>Target and programmable with LabVIEW Real-Time to collect, analyze, and present data from wireless measurements.</p> <p>2 GB of onboard storage well-suited for embedded data-logging applications</p> <p>Hi-Speed USB host port to connect external USB-based storage media for embedded logging applications requiring more data storage.</p> <p>fault-tolerant file system that provides increased reliability for data logging. integrated Web (HTTP) and file (FTP)</p> <p>10/100 Mb/s and 10/100/1000 Mb/s Ethernet and serial ports, can be communicated via TCP/IP, UDP, Modbus/TCP, and serial protocols.</p> <p>LabVIEW Real-Time embedded controller</p> <p>Hi-Speed USB host port, RS232 serial port, and dual 9 to 35 VDC supply inputs</p> <ul style="list-style-type: none"> <li>· -40 to 70 °C operating temperature range.</li> </ul> <p>Other accessories include:</p> <p>4 Ch, Quarter-/Half-/Full-Bridge and Strain Gage Node with accessories</p> <p>4 Ch, 24-Bit, Programmable Thermocouple Input Node with accessories</p> <p>4 Ch, 20-Bit, Programmable Voltage/RTD Combination Node - NI WSN-3226</p> <p>Programmable 1-Port RS232 Serial Node - NI WSN-3230</p> <p>Programmable 1-Port RS485 Serial Node with accessories</p> <p>NI LabVIEW Wireless Sensor Network (WSN) Module</p>	5		

Item Code	Description	Qty	Unit Rate	Total Amount
ES/AEDAL-22	<p><b>Two Level Tank Control System</b></p> <p>The system should be able to convey the control concepts and theories related to fluid dynamics, pressure and time delays, encountered in real world industrial applications. The item must provide learning regarding: Designing of the transfer function based mathematical model of the coupled tank system using basic techniques of the control engineering. linearize the obtained non-linear equation of motion about the quiescent point of operation</p> <p>Controller designing using PID and other techniques like pole placement and LQR in order to meet the required design specifications for various possible configurations of the coupled tank system.</p> <p>Comparative performance analysis for the system when controlled with different types of controller at different operating configurations.</p> <p>The system must be flexible enough to implement the advance control techniques for research purpose.</p> <p>The workstation must be provided complete with all additional components required for proper operation with MATLAB and Lab View.</p> <p>Hands on training must be provided for all item on both Mat Lab and Lab View Platforms</p> <p><b>Technical Specifications:</b></p> <p>Device mass upto 10 kg</p> <p>Frame dimensions – H × W × L 300 mm × 300 mm × 920 mm</p> <p>Pressure sensor sensitivity 61 mm/V</p> <p>Pressure sensor range 0 to 7 kPa</p> <p>Tank height upto 500 mm</p> <p>The system must be provided with the supporting interfacing devices, accessories and all necessary cables &amp; connectors.</p>	4		
ES/AEDAL-23	<p><b>DC Motor Control System</b></p> <p>The DC Motor controller System should be a servo system designed to teach and demonstrate the fundamentals of motor servo control in a variety of ways. The system can easily be configured to control motor position and speed. Students must learn how to:</p> <p>model a DC motor experimentally</p> <p>design and implement a proportional-integral (PI) controller to control the speed of a motor</p> <p>design and implement a proportional-derivative (PD) controller to control the position of a motor</p> <p>design and implement a proportional-integral-derivative (PID) controller for tracking error and disturbance rejection.</p> <p>The workstation must be provided complete with all additional components required for proper operation with MATLAB and Lab View.</p> <p>Hands on training must be provided for all item on both Mat Lab and Lab View Platforms</p>	4		

Item Code	Description	Qty	Unit Rate	Total Amount
	<b>Technical Specification:</b> Motor nominal input voltage upto 24.0 V Motor nominal speed around 3000 RPM Motor torque constant 0.042 Nm/A Encoder line count 512 lines/rev Encoder line count in quadrature 2048 lines/rev Encoder resolution (in quadrature) 0.2 deg/count Amplifier type PWM Amplifier output voltage $\pm 24$ V The system must be provided with the supporting interfacing devices, accessories and all necessary cables & connectors.			
ES/AEDAL-24	<b>Heating, Ventilation &amp; Air Conditioning System</b> The Heating, Ventilation and Air Conditioning (HVAC) must be suitable to teach and demonstrate the fundamentals of climate control. The system could easily be configured to control the temperature in a chamber using a variety of control methods. Students must learn how to: model a system design and implement a relay feedback controller to control the temperature in the chamber design and implement a proportional-integral (PI) controller to control the temperature in the chamber. The workstation must be provided complete with all additional components required for proper operation with MATLAB and Lab View. Hands on training must be provided for all item on both Mat Lab and Lab View Platforms <b>Technical Specifications:</b> Heating element maximum power output upto 20 W Amplifier type PWM Amplifier output voltage $\pm 24$ V with 100 % duty cycle Fan rated voltage 5 V Multi speed fan running around 3x3000 rpm The system must be provided with the supporting interfacing devices, accessories and all necessary cables & connectors.	4		
ES/AEDAL-25	<b>Basic Rotary Pendulum Control System</b> This basic Rotary Pendulum system must be suited to teach and demonstrate the fundamentals of inverted pendulum balance and control. The system could easily be configured to teach hybrid swing-up and LQR control fundamentals. Students must learn how to: model a pendulum design and implement a state-feedback controller to balance the pendulum in the upright position design and implement a controller to swing up the pendulum	4		

Item Code	Description	Qty	Unit Rate	Total Amount
	<p>The workstation must be provided complete with all additional components required for proper operation with MATLAB and Lab View.</p> <p>Hands on training must be provided for all item on both Mat Lab and Lab View Platforms</p> <p><b>Technical Specifications:</b></p> <p>Rotary pendulum link mass upto 25 g</p> <p>Rotary pendulum link length 130 mm</p> <p>Motor nominal input voltage 15 to 24 V</p> <p>Motor nominal speed around 3000 rpm</p> <p>Encoder line count 512 lines/rev</p> <p>Encoder line count in quadrature 2048 lines/rev</p> <p>Encoder resolution (in quadrature) 0.2 deg/count Amplifier type PWM</p> <p>Amplifier output voltage <math>\pm 24</math> V</p> <p>The system must be provided with the supporting interfacing devices, accessories and all necessary cables &amp; connectors.</p>			
<b>ES/AEDAL-26</b>	<p><b>Auto Storage and Retrieval System</b></p> <p>Auto storage system trainer should help to understand digital input and output for delivery of goods from a warehouse and storage in warehouse and warehouse system. The trainer must be equipped with indication lights to display sensors, operation which is for delivery of goods from a warehouse and storage in warehouse is operated by a 3 axis gripper.</p> <p>Must be with Software for simulation.</p> <p>System must be equipped with all the necessary accessories like base stations, software, hardware connectors, power supply modules, reference manuals, computers (if needed).</p>	<b>10</b>		
<b>ES/AEDAL-27</b>	<p><b>Wireless Sensor Network (WSN) Starter Kit</b></p> <p>Kit should Contain everything needed to evaluate wireless sensor networks. Should Include WSN Ethernet gateway and programmable <math>\pm 10</math> V analog input and thermocouple input nodes.</p> <p><b>Features:</b></p> <p>Power supplies, sensors, -WSN and LabVIEW evaluation software, and getting started guide.</p> <p>The Ethernet Gateway Device should include a 2.4 GHz, IEEE 802.15.4 radio based on ZigBee technology to collect measurement data from the sensor network and a 10/100 Mbits/s Ethernet port to deliver flexible connectivity to a Windows or LabVIEW/MATLAB Real-Time OS host controller.</p> <p>The software must be included with the Ethernet Gateway Device to help quickly configure sensor network and extract, analyze, and present measurement data.</p>	<b>5</b>		

Item Code	Description	Qty	Unit Rate	Total Amount
	<p>Items Include:</p> <p>Ethernet gateway</p> <p>±10 V programmable analog input node</p> <p>Desktop power supply for WSN</p> <p>Two sets of 4 AA batteries for WSN measurement nodes</p> <p>Programmable thermocouple input node •</p> <p>Ethernet cable</p> <p>J-type thermocouple (quantity 2)</p> <p>Potentiometer (voltage sensor)</p> <p>Screwdriver</p>			
<b>ES/AEDAL-28</b>	<p><b>Actuators and Motors Add on Board for Base Platform</b></p> <p>The Mechatronic Actuators Board must be:</p> <p>Ideally suited to introduce a variety of actuators that are commonly used in mechatronic systems today.</p> <p>Developed exclusively for Test and Measurement platform and LabVIEW/MATLAB software, the system should teach students about the fundamentals of each actuator, their design considerations, common specifications, interfacing and operation.</p> <p>Students must be able to learn principles of electromagnetic actuation, linear and PWM actuators, brushed and brushless DC motors, stepper motors and servos.</p> <p><b>Features.</b></p> <p>Compact rotary servo system for ELVIS II</p> <p>Plug-and-play design for quick and easy lab setup</p> <p>Two brushed DC motors with gears to compare linear versus PWM amplifier technology</p> <p>Brushless DC motor</p> <p>Stepper motor</p> <p>Hobby servo motor</p> <p>Solenoid for coupling two brushed DC motors</p> <p>Separate photomicrosensors for each motor</p> <p>Built-in PWM amplifier</p> <p>Built-in linear amplifier</p> <p>Visualization of internal actuator mechanisms animated by hardware motion</p> <p>Fully compatible with LabVIEW™</p> <p>Fully documented system models and parameters provided for LabVIEW™ Readymade Curriculum</p> <p><b>Topics</b></p> <p>Principles of electromagnetic actuation:</p> <p>Magnetic fields of coiled conductors</p> <p>Implementation of electromagnetic field theory in solenoids</p> <p>Principles of linear and pulse width modulation (PWM) amplifiers</p> <p>Actuator dead-band measurement and compensation Linearity of an amplifier</p> <p>Principles of brushed and brushless DC motors</p> <p>Principles of stepper motors</p> <p>Stepper motor control and excitation modes</p> <p>Introduction to servo motor position control</p>	<b>4</b>		

Item Code	Description	Qty	Unit Rate	Total Amount
<b>ES/AEDAL-29</b>	<p><b>2 DOF Robot</b></p> <p>Robot should be designed to introduce Fundamental Principles of Robotics.</p> <p>It should be used to demonstrate real-world control challenges, such as pick-and place robots used in manufacturing lines. Concepts such as forward and inverse kinematics and workspace control should be learnt.</p> <p>Designs include :</p> <p>Design PD-based control to position the robot joint angles</p> <p>Simulate the joint space control and ensure it meets the given specifications.</p> <p>Run the joint space control on the actual 2 DOF Robot system.</p> <p>Find direct (or forward) kinematics and inverse kinematics of a 2 DOF pantograph type robot.</p> <p>Simulate the closed-loop X-Y positioning of the end effector using the two PD control loops on the servos with the kinematics.</p> <p>The workspace controller on the 2 DOF Robot system.</p> <p>Allow for mounting of the 2 DOF Inverted Pendulum module for additional experiments.</p> <p>Easy-connect cables and connectors.</p> <p>Open architecture design, allowing users to design their own controller.</p> <p>All necessary accessories like supply modules, base stations, connectors, reference manuals, documentations and computers (if needed) should be supplied.</p>	<b>5</b>		
<b>ES/AEDAL-30</b>	<p><b>Signals and Systems Trainer</b></p> <ul style="list-style-type: none"> <li>The trainer should teach concepts such as characterizing linear and nonlinear signals, understanding convolution, using poles and zeros in the Laplace domain, and sampling and aliasing with a hands-on experimental approach so students can understand the theory that they learn in the classroom.</li> <li>The lab manual includes step-by-step instructions on each topic as well as references to topics in six of the top textbooks for signals and systems classes. The add-on features all of the required cables and accessories to make it easy for educators to set up and teach the concepts.</li> <li>Hands-on approach to learning signals and systems</li> <li>Covers signals and systems concepts from six top textbooks</li> <li>Complete integration LabVIEW/MATLAB software</li> <li>Includes printed lab manual of atleast 14 experiments</li> </ul>	<b>5</b>		

Item Code	Description	Qty	Unit Rate	Total Amount
	<b>Courseware</b> Special signals – characteristics and applications <ul style="list-style-type: none"> <li>• Pulse sequence speed throttled by inertia</li> <li>• Isolated step response of a system</li> <li>• Isolated pulse response of a system</li> <li>• Sinewave input</li> <li>• Clipping</li> </ul> Systems: Linear and non-linear <ul style="list-style-type: none"> <li>• Conditions for linearity</li> <li>• The VCO as a system</li> <li>• A feedback system</li> <li>• Testing for additivity</li> <li>• Frequency response</li> </ul> Unraveling convolution <ul style="list-style-type: none"> <li>• Unit pulse response</li> <li>• The superposition sum</li> <li>• A rectified sinewave at input</li> <li>• A sinewave input</li> <li>• Mystery applications</li> </ul> Integration, correlation & matched filters <ul style="list-style-type: none"> <li>• Auto-correlation function of PRBS sequences</li> <li>• Cross-correlation function of PRBS sequences</li> <li>• ACF &amp; matched filtering</li> <li>• Determining impulse response using input/output correlation</li> <li>• Matched filtering using “integrate &amp; dump” circuitry</li> </ul> Exploring complex numbers and exponentials <ul style="list-style-type: none"> <li>• Complex numbers and complex functions</li> <li>• Exponential functions</li> </ul> Build a Fourier series analyzer <ul style="list-style-type: none"> <li>• Constructing waveforms from sine &amp; cosine</li> <li>• Computing Fourier coefficient</li> <li>• Build a manually swept spectrum analyzer</li> <li>• Analyzing a square wave</li> </ul> Spectrum analysis of various signal types <ul style="list-style-type: none"> <li>• Spectrum of impulse trains</li> <li>• Spectrum of filtered impulse trains</li> <li>• Duty cycle &amp; sampling</li> <li>• Sync pulse train</li> <li>• Spectrum of PN sequences</li> <li>• Analog noise generation (AWGN)</li> <li>• Non-linear processes</li> </ul> Time domain analysis of an RC circuit <ul style="list-style-type: none"> <li>• Step response of the RC</li> <li>• Impulse response of the RC</li> <li>• Exponential pulse response of the RC</li> <li>• Synthesising transfer functions</li> </ul> Poles and zeros in the Laplace domain <ul style="list-style-type: none"> <li>• System with feedback only – allpole</li> <li>• Impulse response of LTIC systems</li> </ul>			



Item Code	Description	Qty	Unit Rate	Total Amount
	<ul style="list-style-type: none"> <li>• Feedback and feedforward – poles &amp; zeros</li> <li>• Allpass circuit</li> <li>• Critical damping &amp; maximal flatness Sampling and Aliasing</li> <li>• Through the time domain – PAM, Sample &amp; Hold</li> <li>• Through the frequency domain</li> <li>• Aliasing and the Nyquist rate</li> <li>• Multi-frequency impulse spectrum</li> <li>• Uses of undersampling in Software Defined Radio</li> </ul> Getting started with analog-digital conversion <ul style="list-style-type: none"> <li>• PCM encoding &amp; quantization</li> <li>• PCM decoding &amp; reconstruction</li> <li>• Frame synchronisation &amp; quantization noise</li> </ul> Discrete-time filters with FIR systems <ul style="list-style-type: none"> <li>• Graphical plotting of response from poles &amp; zeros</li> <li>• Notch filter creation using two-delay FIR</li> </ul> Poles and zeros in the z plane with IIR systems <ul style="list-style-type: none"> <li>• Relating roots to coefficients in the quadratic polynomial</li> <li>• IIR without feedforward – a second order resonator</li> <li>• IIR with feedforward – second order filters</li> <li>• Viewing spectrum with broadband noise &amp; FFT</li> <li>• Dynamically varying the poles &amp; zeros</li> <li>• Using the “Digital Filter Design” toolkit</li> <li>• Discrete-time filters – practical applications</li> <li>• Dynamic range at internal nodes</li> <li>• Transposed Direct form 2 IIR</li> <li>• Implementations with high sampling rates</li> </ul>			
<b>ES/AEDAL-31</b>	<b>Bluetooth Trainer</b> Bluetooth trainer must provide the basic concepts of Bluetooth technology with following features and specifications: Large LCD Display. Control Buttons: Five push buttons. USB connector to PC. Serial port connector to the Bluetooth Dongle. Bluetooth Power class 2: Communication range up to 10 meters. Low power transmitter: +4 dBm. High sensibility receiver: -87 to -93 dBm. External Bluetooth antenna: Omnidirectional antenna (1/2 wavelength dipole antenna). Antenna Centre Frequency: 2.45GHz. Gain: 2 dBi. Bluetooth Dongle: 2 Status LEDs. USB connector to PC. Serial port connector to Bluetooth device interface. Bluetooth Power class 2: Communication range up to 10 meters. Low power transmitter: +4 dBm. High sensibility receiver: -87 to -93 dBm. Programmable as master device or Bluetooth packet sniffer through the serial cable. External Bluetooth antenna: Omnidirectional antenna (1/2 wavelength dipole antenna). Antenna Centre Frequency: 2.45GHz. Gain: 2.20 dBi	<b>5</b>		

Item Code	Description	Qty	Unit Rate	Total Amount
ES/AEDAL-32	<p><b>Electronics Circuit Application with Fault Finding Trainer:</b></p> <p>The base console for primary platform for electronic experiments performed in Computer Assisted Instruction or text based curriculum.</p> <p><u>Features Required:</u></p> <p>Should be fully automatic operation in Computer Assisted Instructions mode through student computer serial port. Should Support automatic, manual, remote, and multiple fault insertion. Must have Built-in and auxiliary connections allow signal input/transfer between card positions. Multifunctional keypad controls for manual operation mode.</p> <p>Automatic alarm sounds if malfunction is detected and display panel indicates symptom. Built-in speaker for tone and radio signal recognition. 20X4 character backlit liquid crystal display shows selected mode, keypad input signals, and trainer status. Self-cleaning contacts to ensure a proper connection with each experiment card installation.</p>	5		
ES/AEDAL-33	<p><b>Ball &amp; Beam Control System.</b></p> <p>The control system must consist of a base module ideally suited to introduce basic control concepts and theories relevant to real world applications of servomotors, from cruise control in automobiles to high-precision robotics manipulators used in industry. In addition to teaching control concepts, the control unit should be flexible enough to be used for research in various areas, including nonlinear control, optimal control, time delay, and dynamic inversion. The Base Unit must be a geared servo-mechanism system equipped with an optical encoder and a potentiometer to measure the output shaft position, and a tachometer to measure the speed of the motor. The base unit must be flexible enough to add additional modules to perform experiments to demonstrate real-world control challenges such as aircraft roll control, guidance of sea vessels, aircraft and submarines or in satellite navigation.</p> <p><b>Students must be able to:</b></p> <ul style="list-style-type: none"> <li>design a proportional-velocity compensator to control the servo load shaft</li> <li>design a cascade control to stabilize the Ball &amp; Beam control system.</li> <li>design a PID-based controller that maintains the direction of the gyroscope module</li> <li>implement the controllers and evaluate the performance of the system</li> </ul> <p>The workstation must be provided complete with all additional components required for proper operation with MATLAB and Lab View.</p>	5		

Item Code	Description	Qty	Unit Rate	Total Amount
	<b>Technical Specifications:</b> Base dimensions not more than $\leq 600\text{mm} \times 300\text{mm}$ (L x W) Beam length not more than $\leq 500\text{mm}$ Ball mass not more than $\leq 100\text{g}$ Ball and Beam module mass not more than $\leq 700\text{g}$ Total Assembly mass not more than $\leq 3000\text{g}$ Ball position sensor measurement range $\pm 5\text{ V}$ Motor Nominal Voltage =12V Motor Armature Inertia $> 1.4 \times 10^{-6} \text{ kg.m}^2$ Flywheel Radius $\geq 50\text{mm}$ Flywheel Inertia about Spin Axis $\geq 1\text{kgm}^2$ Motor Maximum Speed 6000 R.P.M Tachometer Measurement Range $\pm 5\text{ V}$ Tachometer Sensitivity $> 0.001\text{V}$ Encoder Resolution $\geq 4096$ Gear Ratio 70			
<b>ES/AEDAL-34</b>	<b>AC &amp; DC Power Supply</b> Bench top power supply module must be able to supply continuous variable voltages of 0-400 Vac (three-phase) / 0-220 Vac (single-phase), with rated current of 5 -15A. Three-phase Bridge rectified DC variable output of 0-600 V 0-25 A for high load application and intermittent to continuous operation. Programmable power supplies which provide real time voltage, current and power values with high setting and read back resolution and independently adjustable overvoltage protection (OVP) along with advanced parallel and serial operation. Must have output provided with Floating, overload and short circuit-proof outputs with range of at least 0 V to $\geq 32\text{ V}$ / 0 A to $\geq 10\text{ A}$ ( $\geq 500\text{W}$ ). The provided item must have Low residual ripple, high output power, and excellent regulation to provide protection of sensitive loads by current limit or electronic fuse.	<b>10</b>		
<b>ES/AEDAL-35</b>	<b>Oscilloscope</b> 60 MHZ Digital Storage Features 60MHz Bandwidths 1GSa/s Real-Time Sample Rates Maximum, 25GSa/s Equivalent-Time 2Mega Point Record Length 2mV~10V Vertical Scale up to 600V peak input 1ns~50s Horizontal Range Up to 27 Automatic Measurements Versatile Math Functions + , - , x, FFT, FFTrms 5.6" TFT LCD Display USB Interface & SD Card Supported Multi-Language Support on Operation Menu & On-Screen Help	<b>10</b>		

Item Code	Description	Qty	Unit Rate	Total Amount
<b>ES/AEDAL-36</b>	<b>Function Generator</b> Advanced Direct Digital Synthesis (DDS) technology, 2 output channels, built-in counter, 20MHz maximum output frequency (5 MHz max square) wave.	<b>10</b>		
<b>ES/AEDAL-37</b>	<b>Digital Multimeter</b> Digital multimeter required in the lab to perform the following parameters with defined specification range as: DC voltage: 1000V AC voltage: 1000V DC current: 10A (20 A for 30 seconds maximum) AC current: 10A (20 A for 30 seconds maximum) Max: resistance: 50M-Ohm Capacitance: 9,999μF Frequency: 200kHz Max duty cycle: 99.9% Temperature measurement feature (temperature probes) Maximum conductance: 60.00ns Diode range: 3V	<b>10</b>		
<b>ES/AEDAL-38</b>	<b>Virtual Measuring Instruments</b> 16 Analog inputs (1 block with 12 voltage channels and 1 block with 2 current channels (4 connections)). Sampling velocity 1,250,000 samples per second for EDAS/VIS 1.25 Version. Sampling velocity 250,000 samples per second for EDAS/VIS 0.25 Version. 2 Analog outputs. 24 Digital inputs/outputs, configurable as inputs or outputs, with 24 state led indicators. These digital inputs/outputs are grouped in three ports of eight channels (P0, P1 and P3). 4 Digital signal switches 0-5V. 2 Analog signal potentiometers 12V  <b>Oscilloscope:</b> Channels: 12 simultaneous. Maximum input voltage: 10V. All 12 input channels could be scaled to compare signal with different voltage levels. "Math Menu" with operations as Addition, Subtraction, Multiplication and Division, between any of the 12 oscilloscope channels. –  <b>Function Generator:</b> Channels: 2 (allowing working simultaneously). Maximum output voltage: 10V. It includes a graph where an output signal for each channel is shown. - Spectrum Analyzer: Channels: 12 (simultaneous). Max. voltage: 10V.  <b>Digital spectrum analyzer:</b> Based on the FFT.			

Item Code	Description	Qty	Unit Rate	Total Amount
	<p><b>Multimeter:</b>  Voltmeter Channels: 12 (simultaneous). Maximum voltage: 10V RMS).  Ammeter (Channels: 2 (simultaneous). Max. Ampere: 500 mA rms per channel).  Transient Analyzer.</p> <p><b>Logic Analyzer:</b>  Number of Input channels: 8. TTL Voltage Level. Clock Source: 3 different sources. This instrument allows receiving as far as 8 digital signal simultaneously at 1 or 8 Mbps (depending of the version).</p> <p><b>Logic Generator:</b>  Number of transmission channels: 8. TTL voltage level. This instrument allows generating up to 8 digital simultaneous signals of 1 or 8 Mbps (depending of the version).</p>			
ES/AEDAL-39	<p><b>Bluetooth Trainer</b>  The Bluetooth Trainer “EBL” operates in conjunction with a computer, which is connected with the Bluetooth Dongle that allows communicating and programming the Bluetooth Devices to perform a simple Bluetooth network. The two Bluetooth Devices (included in the supply) have a LCD display that shows the current state of the devices (linking status, input messages, output messages, etc). The “EBL” allows to perform a complete Bluetooth link between the computer and the Bluetooth Devices and to get familiar with all the procedure involved in the configuration of a Bluetooth link (configuring the link, scanning new devices, configuring the communication parameters, programming the Bluetooth Devices, encrypting the communication, etc).  Bluetooth Device 1 and 2: Each one includes: Large LCD Display. Control Buttons: Five push buttons. USB connector to PC. Serial port connector to the Bluetooth Dongle. Bluetooth Power class 2: Communication range up to 10 meters. Low power transmitter: +4 dBm. High sensibility receiver: -87 to -93 dBm. External Bluetooth antenna: Omnidirectional antenna (1/2 wavelength dipole antenna). Antenna Centre Frequency: 2.45GHz. Gain: 2 dBi. Bluetooth Dongle: 2 Status LEDs. USB connector to PC. Serial port connector to Bluetooth device interface. Bluetooth Power class 2: Communication range up to 10 meters. Low power transmitter: +4 dBm. High sensibility receiver: -87 to -93 dBm. Programmable as master device or Bluetooth packet sniffer through the serial cable. External Bluetooth antenna: Omnidirectional antenna (1/2 wavelength dipole antenna). Antenna Centre Frequency: 2.45GHz. Gain: 2.20 dBi</p>			

Item Code	Description	Qty	Unit Rate	Total Amount
<b>ES/AEDAL-40</b>	<b>Multimedia Solutions</b> Specifications Short Through Multimedia Projector Resolution: 1280 x 800 / Higher Projection Method Front/rear/ceiling mount Engine Type LCD with Optical Zoom Brightness 3200 ANSI lumens / Higher Inputs: HDMI, VGA, USB (Plug n Play) Audio in: RCA x 1 (White/Red) Screen: Gaylord Tripod Projection Screen 6' x 6' along Vendor – Channel Warranty Wall Mount Screen: Gaylord 6' x 6' Wall Mount Screen Suspended ceiling mount projector kit	<b>1</b>		

## 2. DIGITAL ELECTRONICS AND MICROPROCESSOR LAB

Item Code	Description	Qty	Unit Rate	Total Amount
ES/DEML-01	<p><b>Digital Electronics Trainers with Power Supply Modules</b></p> <p>The trainers must have assembly of following components: AND (2,3,4 - input), NAND (2,3,4 - input), NAND TRIGGER (2,3,4 - input), OR (2,3,4 - input), NOR (2,3,4 - input), EX- OR (2,3,4 - input), inverters, AOI (2 and 3 input), silicon diodes, resistances, JK/MS flip- flop, D flip- flop, BCD synchronous counter, binary 4 bit synchronous counter up/down, BCD asynchronous counter, binary 4 bit asynchronous counter, monostable multivibrators, shift registers, 8- bit SI- SO, BCD 7- segment decoders, 7- segment displays, BCD rotating switches, capacitors, linear potentiometers, Buffers with three- state output, 8- bit latch register (type D), 4- to 10 line decoder, RAM 1024 x 4, hexadecimal keypad, coder for hexadecimal keypad, 8- bit digital- to- analogue converter, 8- bit analogue- to- digital converter, 4- bit comparator, adders (4- bit), Multiplexer 4 channels, Demultiplexer 4 channels, Shift register (4- bit) bi- directional, ALU, inverters, Schmitt triggers, Antivalence and equivalence gates, EEPROM, AD/DA converter 8- bit.</p> <ul style="list-style-type: none"> <li>The kits must allow the study of the following subjects:</li> </ul> <p>Electrical characteristics of the integrated circuits of the various logic families: ECL, CMOS, HCT, laws and principles for the assembling of interface circuits among the families, logic gates, multiplexed counters, programmable shift registers, bidirectional transmission gates, level translators Basic logic circuits Schmitt triggers Bistable multivibrators, Monostable multivibrators Code converters, coders, Arithmetic circuits, Counting circuits, Register circuits, Multiplex mode Arithmetic Logic Unit, Memory circuits, Analog- Digital converters, Digital- Analog converters, Memory classification, Terminology and main characteristics, Elementary memory cells, Structure and operating principles, ROM memory , RAM memory, Sequential memory, Dynamic Transfer Characteristics of TTL and CMOS – Static Control of a Data Bus – Dynamic Control of a Data Bus – Troubleshooting Basics – Troubleshooting Digital Circuits.</p> <p>The kits must be quoted with all necessary accessories including power supplies, base units, necessary power cables, data cables, connecting leads, softwares (if any) and computers (if required)</p>	10		

Item Code	Description	Qty	Unit Rate	Total Amount
<b>ES/DEML-02</b>	<p><b>Logic Families and Interfaces</b> Analog to digital and digital to analog converters, programmable logic devices, Serial to USB interface (RS-232, RS45).</p> <p>Logic analyzer should be user friendly and must be compatible with both TTL and CMOS logic levels with following specifications: Multi-use (Analog &amp; digital), digital sample rate of 500 MS/s and analog sample rate 50MS/s, compatible with RS-232, 422/3. Logic analyzer must include test lead set, test clips 8-pack, USB cable and additional accessories as required. Must be able to interface ICs among different logic families: TTL, CMOS, HCT, ECL etc.</p> <p>The necessary accessories like power supply, cables &amp; connectors and display must be provided with the equipment.</p>	<b>10</b>		
<b>ES/DEML-03</b>	<p><b>32- BIT Microprocess Trainer</b> Courseware: exhaustive theoretical / experimental Manual. Should be in English language and should cover, at least, the following subjects:</p> <ul style="list-style-type: none"> <li>- The hardware structure of a 32-bit mP system: the buses Data, Address and Control bus</li> <li>- Memory devices (RAM-EEPROM)</li> <li>- Serial and parallel interfaces to external devices</li> <li>- A/D and D/A converters Keyboard and LCD display</li> <li>- The 32-bit mP systems programming: maskable and non-maskable interruptions Etc.</li> </ul> <p>Required technical characteristics:</p> <ul style="list-style-type: none"> <li>- the board should be made on a unique PCB with silk screen diagram of the components on the front.</li> <li>- power supply : from the power supply (see item ACT1)</li> <li>- dimensions of the board: to be mechanically fixed into the Board Holder Unit (see item ACT1). No electrical or electronic connectors should be used for fixing the board to the board holder.</li> <li>- The board will have on board all the facilities to perform and test the digital circuits in an easy and fast way.</li> </ul> <p>CPU: 32-bit mP.</p> <ul style="list-style-type: none"> <li>- Memories: 32 KB static RAM +16 KB EPROM</li> <li>- Interfaces: 8-bit parallel interface+ RS-232 serial interface.</li> </ul> <p>I/O devices: Keyboard with hexadecimal keys and function keys-LCD Display</p> <ul style="list-style-type: none"> <li>- A/D and D/A converters</li> <li>- Possibility of: insertion/editing data in RAM- editing registers- I/O port control ×continuous program.</li> </ul>	<b>5</b>		



Item Code	Description	Qty	Unit Rate	Total Amount
<b>ES/DEML-04</b>	<b>Power Supply Boards Elvis or Equivalent</b> <ul style="list-style-type: none"> <li>Integrated suite of 12 instruments</li> <li>Oscilloscope, DMM , Function Generator, Variable Power Supply, Bode Analyzer, Dynamic Signal Analyzer, Arbitrary Waveform Generator, DIO, Impedance Analyzer, Two Wire Current Voltage Analyzer, Three Wire Current Voltage Analyzer</li> <li>Includes Basic Breadboard for Circuits and Electronics</li> <li>Area specific power cord must be included</li> </ul>	<b>10</b>		
<b>ES/DEML-05</b>	<b>Microprocessor Application Boards</b> Microprocessor application trainer board should be compatible with 8-bit microprocessors including Intel (8085), Motorola (6800) and Zilog (Z-80). The board should be versatile to get interface with all 8-bit microprocessors. Application board must teach: <ul style="list-style-type: none"> <li>Microprocessor assembly language programming.</li> <li>Interfacing of microprocessors with input and output devices</li> <li>A/D and D/A conversion</li> <li>Timing and event counting</li> <li>Keypad, LCD, stepper motor, washing machine, IR sensors interface and data transmission modes.</li> <li>Dc motor speed and direction controller, Temperature transducers to control the temperature.</li> </ul> Microprocessor training board must be supplied with all the required accessories including software tools, personal computer, debugging tools, interfacing cables, power supplies, power and power cables.	<b>10</b>		
<b>ES/DEML-06</b>	<b>Interface Lab</b> <ul style="list-style-type: none"> <li>USB to serial converters (RS-232, RS-422 and RS-485). USB to Serial converter must convert from USB to RS-232, RS-422/485 and must have following features: Compatible with USB 2.0/3.0, USB data rate of 12 Mbps or higher, 921.6 kbps or higher baud-rate for super-fast data transmission, Mini DB9 female to terminal block adapter for easy wiring, LEDs for indicating USB and TxD/RxD activity, 2 kV electrical isolation and also drivers for Windows, WinCE, and Linux.</li> <li>Serial interfacing protocol devices: The interfacing device must be able to support the SPI (Serial Peripheral Interface), I2C, GPIO and Ethernet protocols and Interfacing device must at least 10/100 Mbps Ethernet, up to 921.6 kbps serial baud-rate or more. Device must consumes small amount of power.</li> <li>USB Interface Comply with high speed USB 2.0 specification Support four transfer types: Isochronous, Bulk, Control, Interrupt Provide debugging and development environment-Keil C compiler Directly download firmware via USB interface for supporting software operation and eliminating the requirements of external program memory or Mask ROM</li> </ul>	<b>10</b>		

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<b>ES/DEML-07</b>	<p><b>8-bit Microprocessor Trainer</b></p> <p>The trainer should cover the introductory course for 8-bit microprocessor (8085 Intel, 6800 Motorola and Z-80 Zilog). Students should learn: Interfacing of microprocessor with RAM and ROM.</p> <ul style="list-style-type: none"> <li>• Direct Memory Access functionality.</li> <li>• Instruction set using assembly language and C language</li> <li>• Serial &amp; parallel interface</li> <li>• Program downloading using keypad and verification via display</li> <li>• Troubleshooting in Microprocessor programs</li> <li>• Interfacing with digital and analog devices.</li> </ul> <p>The trainer board must include on-board EPROM Programmer, printer port, RS-232 port, USB port and must be compatible for interfacing with PC for editing, compiling, linking and serial transmission of program. User and experiment manuals covered must be supplied.</p> <p>Microprocessor trainer board must be supplied with all the required accessories including software tools, personal computer, debugging tools, interfacing cables, power supply modules and power cables</p>	<b>10</b>		
<b>ES/DEML-08</b>	<p><b>16-bit Microprocessor Trainer</b></p> <ol style="list-style-type: none"> <li>1. RS-232C Communication. (Terminal mode and Host mode)</li> <li>2. Download and Upload function.</li> <li>3. Program trace function.</li> <li>4. Program/Data memory content modification and dump function.</li> <li>5. ROM writer function. (2764~27512)</li> <li>6. I/O experiment.</li> <li>7. Include parallel port.</li> <li>8. Dot matrix (3 Color) experiment.</li> </ol>	<b>10</b>		
<b>ES/DEML-09</b>	<p><b>AVR Trainer</b></p> <p>The Educational Practice Board for AVR microcontroller should be a High-performance, Low-power AVR 8-bit Microcontroller target board. The board must provide the option to enable the users to download the test programs to the flash memory using USB and the board must also have all the GPIO lines on 20-pin connectors. The trainer board may have the following features:</p> <ul style="list-style-type: none"> <li>• High-performance, Low-power AVR 8-bit Microcontroller</li> <li>• General Purpose study card to learn, test and apply AVR ATmega.</li> </ul>	<b>10</b>		

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	<ul style="list-style-type: none"> <li>On-board In-circuit programming facility eliminating the need of a separate programmer.</li> <li>Flash programming using on board USB</li> <li>Dual power options: DC input and USB</li> <li>32 K on chip Flash program memory</li> <li>Pin connector for GPIO interfacing</li> <li>One 20 pin header for 7 channels 10 bit ADC interfacing</li> <li>USART connector</li> <li>External interrupt connector</li> <li>On-board I2C, SPI, USB, UART connectors</li> <li>Low cost &amp; ideal for project development work</li> </ul> <p>The board must have the different interfaces based on AVR microcontroller to cover the wide range of applications &amp; projects which includes: LCD &amp; Matrix keyboard interface, Relay interfaces, I2C interfaces, different sensor &amp; actuator interfaces, DC motor &amp; stepper motor interfaces.</p> <p>The board must be provided with its assembler and debug software. User and experiment manuals covered must be supplied.</p> <p>The discrete components of 8-bit AVR microcontrollers &amp; MCU reset circuitry must be included.</p> <p>The board/kits must be quoted with all necessary accessories including power supplies, base units, necessary power cables, data cables, connecting leads, software's (if any) and computers (if required).</p>			
<b>ES/DEML-10</b>	<b>PIC Development &amp; Training System</b> <ol style="list-style-type: none"> <li>Support MCU Writer Tool.</li> <li>LED and PUSH, and Toggle Switch</li> <li>DOT Matrix(32×16Dots)</li> <li>Graphic LCD(128×64Dots)</li> <li>Text LCD(16×2Line)</li> <li>7'Segment</li> <li>Volume, CDS, Thermo meter, Hygrometer</li> <li>Stepping Motor</li> </ol>	<b>10</b>		
<b>ES/DEML-11</b>	<b>Microcontroller</b> <p>The 8051 8-bit Micro-controller unit Development Kit should include advanced debug features enabling the user to fully develop and integrate hardware and software design. The development kit supports the debugging features like:</p> <ul style="list-style-type: none"> <li>Run, halt and single-step</li> <li>Set hardware breakpoints</li> <li>Inspect/Modify memory and registers</li> <li>Download program memory</li> </ul>	<b>10</b>		

Item Code	Description	Qty	Unit Rate	Total Amount
	<p>The development kit must include:</p> <ul style="list-style-type: none"> <li>• 8051 MCU board</li> <li>• Startup guide</li> <li>• Development kit software tool</li> <li>• Universal power supply</li> <li>• USB debug adapter</li> <li>• USB cable.</li> </ul> <p>The board must have the different applications based on Atmel 8051 8-bit microcontroller to cover the wide range of applications &amp; projects which includes: Parallel &amp; serial data input &amp; output, microcontroller interrupts using buttons &amp; LEDs, stepper motor controller, dc motor control using PWM, square wave generator, interfacing Keyboard &amp; LCDs, interfacing of seven segment display, ADC &amp; DAC processing, controlling of analog devices &amp; SPI Interfaces. The board must be provided with its assembler and debug software. User and experiment manuals covered must be supplied.</p> <p>The discrete components of 8-bit Atmel &amp; MCU reset circuitry must also be included.</p> <p>The board/kits must be quoted with all necessary accessories including power supplies, base units, necessary power cables, data cables, connecting leads, software's (if any) and computers (if required).</p>			
<b>ES/DEML-12</b>	<p><b>Modular MCU Development Kits</b></p> <p>The MCU development kit should be open source firmware kit that helps students to prototype the IoT products. Development kit features should include open-source, interactive learning, easily programmable, simple and smart, wifi enabled, radio frequency enabled, USB to serial UART adapter. The open firmware MCU development board must be enable to deploy the IoTs using GSM cellular connectivity, GPS Tracking, GPRS functionality with user friendly environment.</p> <p>Apart from above mentioned features, Arduino based Microcontroller board with specifications as follows: 14 digital input/output pins, 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button should also be included.</p> <p>Also The Raspberry Pi board for the development of embedded projects with following features and specifications: 1GB RAM, 4 USB ports, 40 GPIO pins, HDMI port and Ethernet port, audio and video jacks, Bluetooth feature, camera interface, 802.11n wireless protocol compatibility.</p>	<b>10</b>		

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<b>ES/DEML-13</b>	<b>AC &amp; DC Power supply</b> Bench top power supply module must be able to supply continuous variable voltages of 0-400 Vac (three-phase) / 0-220 Vac (single-phase), with rated current of 5 -15A. Three-phase Bridge rectified DC variable output of 0-600 V 0-25 A for high load application and intermittent to continuous operation. Programmable power supplies which provide real time voltage, current and power values with high setting and read back resolution and independently adjustable overvoltage protection (OVP) along with advanced parallel and serial operation. Must have output provided with Floating, overload and short circuit-proof outputs with range of at least 0 V to $\geq 32$ V/0 A to $\geq 10$ A ( $\geq 500$ W). The provided item must have Low residual ripple, high output power, and excellent regulation to provide protection of sensitive loads by current limit or electronic fuse.	<b>10</b>		
<b>ES/DEML-14</b>	<b>Oscilloscope</b> 60 MHZ Digital Storage <u>Features</u> 60MHz Bandwidths 1GSa/s Real-Time Sample Rates Maximum, 25GSa/s Equivalent-Time 2Mega Point Record Length 2mV~10V Vertical Scale up to 600V peak input 1ns~50s Horizontal Range Up to 27 Automatic Measurements Versatile Math Functions + , -, x, FFT, FFTrms 5.6" TFT LCD Display USB Interface & SD Card Supported Multi-Language Support on Operation Menu & On-Screen Help	<b>10</b>		
<b>ES/DEML-15</b>	<b>Function Generator</b> Advanced Direct Digital Synthesis (DDS) technology, 2 output channels, built-in counter, 20MHz maximum output frequency (5 MHz max square) wave.	<b>10</b>		
<b>ES/DEML-16</b>	<b>Digital Multimeter</b> Digital multimeter required in the lab to perform the following parameters with defined specification range as: DC voltage: 1000V AC voltage: 1000V DC current: 10A (20 A for 30 seconds maximum) AC current: 10A (20 A for 30 seconds maximum) Max: resistance: 50M-Ohm Capacitance: 9,999 $\mu$ F Frequency: 200kHz Max duty cycle: 99.9% Temperature measurement feature (temperature probes) Maximum conductance: 60.00ns Diode range: 3V	<b>10</b>		

Item Code	Description	Qty	Unit Rate	Total Amount
ES/DEML-17	<p><b>Complete Analog and Digital Trainer</b></p> <p>The Trainer Courseware provides students with theoretical concepts that are immediately reinforced by experiments. In-depth topics include:</p> <p>Analog Circuit, Digital Circuit, breadboard, Logic Circuit, AND Gates, NAND Gates, OR Gates, NOR Gates, Inverters and Buffers, Exclusive OR Gates, Decimal Encoder, Binary Decoder, 4 Bit Comparator, Clock Pulsar, Clock Generator, RS Flip-Flop (NOR), Type D Flip-Flop, J-K Flip-Flop, Serial Counter 4 Bit Flip-Flop Reg., Adder, Subtractor, Number Systems, R-S Flip-Flop (NAND) Up Counter, Down Counter, Data Selector, Data Distributor, Master Slave F/F, 555 Timer, Shift Register, Bilateral Switch, Memory, D/A Conversion, A/D Conversion, Diodes, Rectifier/Filter, Bridge Rectifier/Filter, Zener Reference Regulator, Voltage Regulator, Voltage Doubler, Transistor Operation, Transistor Bias, Common Emitter, Emitter Follower, Common Base, RC Coupled Amps, Complementary Symmetry, Hartley Oscillator, Colpitts Oscillator, RC Phase Shift Oscillator, Blocking Oscillator, Sawtooth Generator, Astable Multivibrator, Bistable Multivibrator, Monostable Multivibrator, Schmitt Trigger, FET Operation, Crystal Generator, UJT Oscillator, SCR Control Circuit, DC, SCR Control Circuit, AC, Operational Amplifier, Low Voltage Power Supply, Limiters, Clampers, Triacs, Diacs &amp; 4 Layer Diodes &amp; Experimental Breadboard.</p> <p><b>Base Console required for operation</b></p> <p>The 130E serves as a current limited power supply for Nida 130 Series printed circuit boards (experiment cards). Discrete voltages are used to activate the experiment cards allowing students to check, align, and troubleshoot operational electronic circuits using standard laboratory test equipment.</p> <p>Primary Power: 115 VAC (0.6A max) or 220 VAC (0.3A max), 50/60 Hz switched controlled &amp; primary fuse protection. DC Power Sources: 0 to -24 volts DC with selectable voltages and current up to 1 ampere. 0 to +24 volts DC with selectable voltages and current up to 1 ampere. DC power supply meter ranging from 0 to 25 volts. AC Power Sources: Dual 12 VAC at 1 ampere maximum. Communications Link: USB or Serial (9600 baud rate with stop bit and parity check). Display: 20X4 backlit liquid crystal display (LCD). Operating Temperature: 10 degrees to 40 degrees Celsius ambient. Construction: Sheet metal covered by flat panel matte finish.</p>	10		

Item Code	Description	Qty	Unit Rate	Total Amount
<b>ES/DEML-17</b>	<b>Multimedia Solutions</b> Specifications Short Through Multimedia Projector Resolution: 1280 x 800 / Higher Projection Method Front/rear/ceiling mount Engine Type LCD with Optical Zoom Brightness 3200 ANSI lumens / Higher Inputs: HDMI, VGA, USB (Plug n Play) Audio in: RCA x 1 (White/Red) Screen: Gaylord Tripod Projection Screen 6' x 6'along Vendor – Channel Warranty Wall Mount Screen: Gaylord 6' x 6' Wall Mount Screen Suspended ceiling mount projector kit	<b>1</b>		

### 3. INDUSTRIAL AUTOMATION AND ROBOTIC LAB

Item Code	Description	Qty	Unit Rate	Total Amount
<b>ES/IARL-01</b>	<p><b>Computer Controlled System Process Control System With SCADA &amp; PID Control</b></p> <p>Study of all the automatic closed loop blocks: sensors and transducers, summing block, PID controller, final stage, process etc.</p> <ul style="list-style-type: none"> <li>- The effect of disturbances, non-linearities, hysteresis etc.</li> <li>- The empirical methods for setting-up a PID controller (Ziegler, Nichols and Janssen-Offereins), the frequency and time response analysis of the open-loop and closed-loop systems, the errors in transient and steady-state operation etc.</li> </ul> <p>Required technical features are: the board should be made on a unique PCB with silk screen diagram of the components on the front.</p> <ul style="list-style-type: none"> <li>· Power supply : from the power supply (see item ACT1)</li> </ul> <p>Dimensions of the board: to be mechanically fixed into the Board Holder Unit (see item ACT1). No electrical or electronic connectors should be used for fixing the board to the board holder.</p>	<b>10</b>		
<b>ES/IARL-02</b>	<p><b>Transducer &amp; Instrumentation Trainer Board</b></p> <p>The transducer &amp; instrumentation trainer should cover the variety of analog &amp; digital transducers both input &amp; output with suitable instrumentation and signal conditioning circuits. The trainer must have in house proper and suitable power supplies. The input transducers to be covered: Input Transducers: Resistance Transducers for applications in angular or linear position: Linearly sliding potentiometer. Rotary carbon-track potentiometer. Rotary coil potentiometer. Precision servo-potentiometer. The Wheatstone Bridge circuit.</p> <p>Applications of temperature: NTC (Negative Temperature Coefficient) Thermistors. RTD Sensor (Platinum Transducer with Temperature dependent Resistance). Temperature sensor IC “Integrated Circuit LM 335”.Type “K” Thermocouples.</p> <p>Applications of light: Photovoltaic Cell. Phototransistor. Photodiode PIN. Photoconductive Cell.</p> <p>Linear position and force: Linear Variable Differential Transformer LVDT. Extension metric Transducer.</p> <p>Environmental measurements: Air flow Sensor. Air pressure Sensor. Humidity sensor.</p> <p>Rotational speed and position control: Slotted optoelectronic Sensor. Opto- reflective Sensor. Inductive sensor. Hall effect Sensor. Permanent D.C. magnet tachogenerator.</p> <p>Sound measurements: Dynamical microphone. Ultrasonic receiver.</p>	<b>10</b>		



Item Code	Description	Qty	Unit Rate	Total Amount
	<p>Visualization Devices: Timing device/ counter with LED display. Graphic bar visualizer. Mobile coil voltmeter.</p> <p>Output Transducers: Electrical Resistance. Incandescent Lamp.</p> <p>Applications for the sound output: Buzzing (Buzzer). Mobile coil loud speaker. Ultrasonic transmitter.</p> <p>Applications of linear or angular motion: D.C. Solenoid. D.C. Relay. Solenoid Valve. Permanent Magnet D.C. Motor.</p> <p>Signal Conditioners:</p> <p>D.C. Amplifiers. A.C. Amplifier. Power Amplifier. Current Amplifier. Buffers. Inverting Amplifier.</p> <p>Differential amplifier. V/F and F/V Converters. V/I and I/V Converters. Full Wave Rectifier. Hysteresis convertible Comparator. Electronic switch. Oscillator 40 kHz. Filter 40 kHz. Time-constant convertible Low Pass Filter.</p> <p>Circuit with Mathematical Operation: Adding amplifier. Integrator with different time constants. Differentiator with different time constants. Instrumentation Amplifier. Circuit SAMPLE &amp; HOLD. Amplifiers with gain control and offset.</p> <ul style="list-style-type: none"> <li>The kits must be quoted with all necessary accessories including power supplies, base units, necessary power cables, data cables, connecting leads, data acquisition cards, softwares (if any) and computers (if required).</li> </ul> <p>The trainer/board must also include the lab manuals, exercises and solutions of the mentioned experiments.</p>			
<b>ES/IARL-03</b>	<p><b>Computer Controlled Process Control System</b></p> <p><b>Base Unit:</b></p> <p>The Bench-top unit should be common for all sets for Process Control type with following specifications:</p> <p>Anodized aluminium structure and panels in painted steel. Main metallic elements in stainless steel. Diagram in the front panel with similar distribution to the elements in the real unit. A transparent main tank and collector with an orifice in the central dividing wall (2 x 25 dm<sup>3</sup>), and drainage in both compartments. A transparent dual process tank (2 x 10 dm<sup>3</sup>), interconnected through an orifice and a ball valve and an overflow in the dividing wall; a graduate scale and a threaded drain of adjustable level with bypass. 2 Centrifugal pumps, range: 0-10 l/min. 2 Variable area flow meters (0.2-2 l/min, and 0.2-10 l/min), and with a manual valve. Line of on/off regulation valves (solenoid). Usually one is normally opened, and the other two are normally closed, and manual drainage valves of the upper tank. Proportional valve: a motorized control valve: Brass valve G ½": Pmax. 4 bar. 24 volts. Control 12-24 V. 200-1000 mA. Temperature: -10 to 60°C. Dimensions (approx.): 500 x 1000 x 1000 mm. Weight: 40 Kg.</p> <p>Any Set for Process Control type should be plugged easily in the base unit for ready to work.</p>	<b>5</b>		

Item Code	Description	Qty	Unit Rate	Total Amount
	<p><b>Set for Temperature Process Control:</b>  The temperature set should be supplied with the following specifications:  a) Sensor and elements:  Temperature sensor “J type”, range: -40 to 750°C. Electric resistor (0.5 KW), with thermostat (70°C). Helix agitator, range: 0-300 r.p.m. On/off level switch; safety element that permits the resistance to operate just when the level of water is sufficient.  b) Computer Control Software:  Computer Control + Data Acquisition + Data Management Software for Temperature Process Control. Should be compatible with actual Windows operating systems, Graphic and intuitive simulation of the process in screen and also must be compatible with the industry standards.  The temperature set must be controlled with Analog and digital PID control.</p> <p><b>Set for Flow Process Control:</b>  The flow process control set should be supplied and installed in the Base Unit and should be ready to work directly, it must includes:  a) Sensor and elements:  Turbine type flow sensor, range: 0.25-6.5 l./min.  b) Computer Control Software:  Computer Control + Data Acquisition + Data Management Software for Flow Process Control. Should be compatible with actual Windows operating systems, graphic and intuitive simulation of the process in screen and must also be compatible with the industry standards.  Registration and visualization of all process variables in an automatic and simultaneously way.  Flexible and open software, developed with actual windows graphic systems, acting simultaneously on all process parameters.  The flow process control set must be controlled with Analog and digital PID control. Menu for PID and set point selection required in the whole work range.</p> <p><b>Set for Level Process Control:</b>  The level process control set should be supplied and installed in the Base Unit and and should be ready to work directly, it must includes:  a) Sensor and elements:  0-300mm level sensor (of capacitive immersion, 4-20mA), made with tephlon to avoid any corrosion.  b) Computer Control Software:  Computer Control + Data Acquisition + Data Management Software for Level Process Control. Should be compatible with actual Windows operating systems, graphic and intuitive simulation of the process in screen and must be compatible with the industry standards. The level process control must be controlled with analog and digital PID control. Menu for PID and set point selection required in the whole work range.</p>			

Item Code	Description	Qty	Unit Rate	Total Amount
	<p><b>Set for Pressure Process Control:</b></p> <p>The Set should be supplied and installed in the Base Unit and must be ready to use directly. It must include:</p> <p>a) Sensor and elements: Pressure sensor, range: 0-1 psi.</p> <p>b) Computer Control Software: Computer Control + Data Acquisition + Data Management Software for Pressure Process Control. Should be compatible with actual Windows operating systems, graphic and intuitive simulation of the process in screen and must be compatible with the industry standards. Registration and visualization of all process variables in an automatic and simultaneously way must be encountered. The pressure process control set must be controlled with analog and digital PID control.</p> <ul style="list-style-type: none"> <li>The kits must be quoted with all necessary accessories including power supplies, base units, necessary power cables, data cables, connecting leads, data acquisition cards, softwares (if any) and computers (if required).</li> </ul> <p>The trainer/board must also include the lab manuals, exercises and solutions of the mentioned experiments</p>			
<b>ES/IARL-04</b>	<p><b>Industrial automation Process Control Trainer along with HMI</b></p> <p>Computer based Process Trainer should be able to teach level, flow, temperature, and pressure Measurement &amp; Control. Must include all required sensors to measure different process variables.</p> <p>Trainer should cover:</p> <ul style="list-style-type: none"> <li>On/Off Control</li> <li>PID Feedback Control</li> <li>Setpoint Profile Generation</li> <li>Lead-Lag Compensation</li> <li>Feedback/Feedforward Control</li> <li>Multiloop Cascade Control</li> <li>Ratio Control</li> <li>Flow Meters Comparison (with option)</li> </ul> <p>Programmable Automation Controller should also be with Analog Input, Analog Output, Digital Input, Digital output Modules along with HMI with following specifications:</p> <ul style="list-style-type: none"> <li>1 Gigabit Ethernet, 1 USB device, 1 USB Hi-Speed host, and 1 serial port for connectivity.</li> <li>-20 °C to 55 °C operating temperature range.</li> <li>±20 mA, Current Analog Input, 200 kS/s, 8 Ch Module.</li> <li>±10 V, Analog Output, 100 kS/s, 4 Ch Module.</li> <li>24 V, Sinking Digital Input, 8 Ch Module</li> <li>24 V, Sourcing Digital Output, 8 Ch Module.</li> </ul> <p>HMI should have following specifications:</p> <ul style="list-style-type: none"> <li>6 in. Touch Panel Computer With Windows Embedded.</li> <li>1.33 GHz Intel Atom processor with 1 GB DDR2 SDRAM.</li> </ul>	<b>5</b>		

Item Code	Description	Qty	Unit Rate	Total Amount
	<ul style="list-style-type: none"> <li>Windows Embedded Standard 7 (WES7) on a 16 GB CF card or Windows XP Embedded (XPe) on a 4 GB CF card.</li> <li>5.7 in. VGA TFT LCD touch screen with LED backlight.</li> <li>Connectivity through 2 Gigabit Ethernet ports, 2 HiSpeed USB ports, and 2 serial ports.</li> <li>-20 °C to 60 °C operating temperature range and NEMA4/IP65-compliant front panel</li> </ul> <p>The trainer should have MATLAB or Lab view software based interface.</p>			
<b>ES/IARL-05</b>	<p><b>Magnetic Levitation for Industrial applications and Process Control</b></p> <p>The open architecture single degree of freedom Magnetic Levitation (MAGLEV) system, the classic electro-mechanical experiment with interesting nonlinear dynamics and control challenges should be ideal for teaching modeling, linearization, current control, position control, and using multiple loops (i.e. cascade control). Using the system, students must learn how to:</p> <ul style="list-style-type: none"> <li>Model the system from first principles in order to obtain the two open-loop transfer functions characterizing the system, in the Laplace domain</li> <li>linearize the obtained non-linear equation of motion about the quiescent point of operation</li> <li>use pole placement to design a proportional-plus-integral (PI) controller for the MAGLEV electromagnet current</li> <li>use pole placement to design a proportional-plusintegral-plus-velocity (PIV) controller with feed-forward action for the MAGLEV levitated ball position</li> <li>implement the controllers in real-time and evaluate their actual performances</li> <li>numerically determine the system's actual closed-loop poles, by considering the coil current control system's dynamics.</li> </ul> <p>System should be fully compatible with MATLAB®/ Simulink® and LabVIEW™ and must be supplied with supporting interfacing devices.</p>	<b>5</b>		
<b>ES/IARL-06</b>	<p><b>Automatic Control: Speed And Position</b></p> <p>Required technical features are:</p> <ul style="list-style-type: none"> <li>the control system should be made on a unique PCB with silk screen diagram of the components on the front.</li> <li>power supply : from the power supply (see item ACT1)</li> <li>dimensions of the board: to be mechanically fixed into the Board Holder Unit (see item ACT1). No electrical or electronic connectors should be used for fixing the board to the board holder.</li> <li>The board will have on board all the facilities to perform and test the circuits in an easy and fast way.</li> </ul> <p>The required circuits configurations should be performed by using 2 mm. Dia cables (a set of cables should be supplied with each board).</p> <p>PC interface through specific card (see item ACT9.4).</p> <p>speed range: <math>\pm 4000</math> r.p.m.</p> <p>position range: <math>360^\circ</math></p> <p>external unit: metal base, little DC motor (permanent magnets) with coaxial tachogenerator and braking device, optoelectronic sensor, transparent disk for optoelectronic transducer, potentiometric transducer.</p>	<b>6</b>		

Item Code	Description	Qty	Unit Rate	Total Amount
<b>ES/IARL-07</b>	<p><b>Automatic Control: Multi-Variable Process Control</b> Should include devices and instruments typical of industrial processes in a single structure. Process, including: three tanks, a main glass tank, an auxiliary one (containing a solution) and a secondary tank; a control system for the liquid flow across the two tanks; a system for liquid weight measurement of the secondary tank; a level control system for the liquid in the secondary tank; a heat exchanger for cooling the liquid flowing back from the secondary to the main tank with temperature control; a cooling fan speed. Control system. Process variables Transducers: temperature, flow and level, weight, speed. Process Actuators: electrical pumps, pneumatic valves, AC and DC motors, heating resistors. Control: dual microprocessor controller for the separate control of flow and level- cascade control dual microprocessor controller for the temperature and speed. Supervisory software for : display the silk screen printed diagram with updated variables on the screen- set the on-line parameters- display and control the alarms- real time graphs- historical trends, etc</p>	<b>5</b>		
<b>ES/IARL-08</b>	<p><b>Training ROBOT</b> This unit should enable the students to acquire the basic knowledge relative to the use and applications of robots. The exhaustive theoretical / experimental courseware should cover, and include practical experiences, at least, on the following subjects (should be in English language): Robots: different types and uses. Typical movements of a robot (the movement degrees) study of the components of a robot: stepper motors, pneumatic elements Robot-PC interfaces. Required Technical characteristics Should be small, table top size. Should have 6 degrees of movement, controlled by stepper motors for movements of the base, shoulder, arm, wrist and hand. base: to contain the entire electrical section- 230° rotation. shoulder: rotating on the base, supporting the motors and the gears of the other axes- 140° rotation. arm: to be connected to the shoulder on a horizontal axis- 120° rotation. wrist: 2 movement axes to allow vertical rotation (180°) and hand rotation (160°) hand: opening and closing Others: microprocessor control- resolution: 0.35 mm- load capacity: approx. 500 gr- speed: 10 mm/sec. max.- parallel, 8 bits interface- Control software: at least, should provide: keyboard control - automatic storage on disk of the learning sequences- search for zero position.</p>	<b>4</b>		

Item Code	Description	Qty	Unit Rate	Total Amount
ES/IARL-09	<p><b>PLC Trainer with Emulators and Sensors</b></p> <p>The PLC Unit should be of following specifications:  Steel box. Power supply 110-240Vac. ON/OFF power switch. Power supply connector. 5A Fuse for protection. RS232 cable to communicate with PC. SUB-D connector to communicate with the PLCE applications.  The key features should be: Ultra-high processing speed. Large Program Capacity of 16 Kstep. Independent Comment Memory. Maximum number of I/O points should be available.  Must have 3 different I/O modules with following specifications: 1) Digital I/O module: Inputs: Number of inputs: 16. Voltage: 24Vdc. Outputs: Number of outputs: 14. Output type: relay. Output capacity:2A. 8 On/off switches. 8 Push-buttons.  2) Analog I/O module: Inputs: Number: 8. Input Range: 0 to +10V. Outputs: Number: 4. Output Range: -10V to +10V. Resolution: 12bits. 6 Adjustable analog signals: Range: 0 to +10V.  3) Touch screen:  Graphics: Straight lines, continuous straight lines, squares, circles, ovals, arcs, elliptic arcs, fan shapes, elliptic fan shapes, beveled squares, bitmaps.Number of screens: approx. 160 screens. Part functions: messages, lamps, switches, data, bar graphs, keyboard. Contrast adjustment.  The PLCE Unit should be flexible to be used with other PLCs: Siemens, Mitsubishi, Allen Bradley, Omron, etc.  PLC Process Emulators:  PLC process emulator that emulates different process, systems, machines, etc, must be controlled with PLCE unit to give the concept of distributed control of processes. The emulator must include and should have following features &amp; specifications:  Metallic box. Diagram or drawing of the simulated application. Fuse protection. D-SUB connector to communicate with PLCE. LEDs and different displays as indicators. Switches and push-buttons.  Potentiometers. Switches, push buttons and LEDs to emulate common elements such as motors, detectors, sensors, pumps, valves, conveyors, etc.  Dimensions: 410 x 298 x 107 mm. approx. Weight: 2 Kg. approx.</p>	5		

Item Code	Description	Qty	Unit Rate	Total Amount
	<p>The following PLC emulators of must be included to cover variety of PLC process control systems:</p> <ul style="list-style-type: none"> <li>• Traffic Signal Control</li> <li>• Car Parking</li> <li>• Elevator Control</li> <li>• Hot Drinks Machine</li> <li>• Embossing Machine</li> <li>• Pump System (Pressure)</li> <li>• Automatic Filling System</li> <li>• Conveyor Belts System</li> <li>• Canalization System</li> <li>• Automatic Stamping Press</li> <li>• Compressed Air Network</li> <li>• Packing Line and Bottling Plant</li> <li>• Fire Control</li> <li>• Level and Flow Control</li> <li>• Position Control</li> <li>• Heating System Control</li> <li>• Automatic washing machine control</li> <li>• The kits must be quoted with all necessary accessories including power supplies, base units, necessary power cables, data cables, connecting leads, data acquisition cards, softwares (if any) and computers (if required).</li> <li>• The trainer/board must also include the lab manuals, exercises and solutions of the mentioned experiments</li> </ul>			
<b>ES/IARL-10</b>	<p><b>LEGO Mind Storm Kits</b> For Control &amp; Robotic Application or Equivalent</p>	<b>10</b>		
<b>ES/IARL-11</b>	<p><b>Automatic Control System Using Compact RIO</b> OR Equivalent having Embedded Control &amp; Data Accusation Features</p>	<b>10</b>		
<b>ES/IARL-12</b>	<p><b>AC &amp; DC Power Supply</b> Bench top power supply module must be able to supply continuous variable voltages of 0-400 Vac (three-phase) / 0-220 Vac (single-phase), with rated current of 5 -15A. Three-phase Bridge rectified DC variable output of 0-600 V 0-25 A for high load application and intermittent to continuous operation. Programmable power supplies which provide real time voltage, current and power values with high setting and read back resolution and independently adjustable overvoltage protection (OVP) along with advanced parallel and serial operation. Must have output provided with Floating, overload and short circuit-proof outputs with range of at least 0 V to <math>\geq 32</math> V/0 A to <math>\geq 10</math> A (<math>\geq 500</math>W). The provided item must have Low residual ripple, high output power, and excellent regulation to provide protection of sensitive loads by current limit or electronic fuse.</p>	<b>10</b>		

Item Code	Description	Qty	Unit Rate	Total Amount
<b>ES/IARL-13</b>	<b>Oscilloscope</b> 60 MHZ Digital Storage Features 60MHz Bandwidths 1GSa/s Real-Time Sample Rates Maximum, 25GSa/s Equivalent-Time 2Mega Point Record Length 2mV~10V Vertical Scale up to 600V peak input 1ns~50s Horizontal Range Up to 27 Automatic Measurements Versatile Math Functions + , -, x, FFT, FFTrms 5.6" TFT LCD Display USB Interface & SD Card Supported Multi-Language Support on Operation Menu & On-Screen Help	<b>10</b>		
<b>ES/IARL-14</b>	<b>Function Generator</b> (Advanced Direct Digital Synthesis (DDS) technology, 2 output channels, built-in counter, 20MHz maximum output frequency (5 MHz max square) wave)	<b>10</b>		
<b>ES/IARL-15</b>	<b>Digital Multimeter</b> Digital multimeter required in the lab to perform the following parameters with defined specification range as: DC voltage: 1000V AC voltage: 1000V DC current: 10A (20 A for 30 seconds maximum) AC current: 10A (20 A for 30 seconds maximum) Max: resistance: 50M-Ohm Capacitance: 9,999µF Frequency: 200kHz Max duty cycle: 99.9% Temperature measurement feature (temperature probes) Maximum conductance: 60.00ns Diode range: 3V	<b>10</b>		
<b>ES/IARL-16</b>	<b>The Computer Controlled Teaching Unit for the Study of Regulation and Control</b> Computer Controlled Teaching Unit “RYC”, allows the students to simulate an integrator system, a first order system and a second order system and regulate them with a PID controller or Lead & Lag compensator. The unit also allows to simulate perturbations and offsets to analyze the response of the system. A wide range of applications: DC Servo Motor Module, Ball and Beam Module, etc. for working with the “RYC” unit are available to study a real control systems response to complement the Study of regulation and control in real time.	<b>5</b>		



Item Code	Description	Qty	Unit Rate	Total Amount
	<p>This Computer Controlled Unit is supplied with the EDIBON Computer Control System (SCADA), and includes: The unit itself + a Control Interface Box + a Data Acquisition Board + Computer Control, Data Acquisition and Data Management Software Packages, for controlling the process and all parameters involved in the process</p> <p>Reference signals module: This module allows to generate four different types of signals: step, square, ramp and sine. The frequency and amplitude of the signals can be adjusted through the computer. Step output. Square output. Ramp output. Sine output. Step: amplitude: 0 V to 5 V, frequency: 0Hz to 200 Hz. Square: amplitude: <math>\pm 10</math> V, frequency: 0Hz to 200 Hz. Ramp: amplitude: <math>\pm 10</math> V, frequency: 0Hz to 200 Hz. Sine: amplitude: <math>\pm 10</math> V, frequency: 0Hz to 200 Hz. Frequency sweep: this module performs a frequency sweep needed for calculating the Bode plot. PID controller module: This module is subdivided into proportional, integrative and derivative blocks. The module allows to adjust each parameter independently from the computer: P controller: Kc: -10 to +10. I controller: Ti: 0 to 100 s. D controller: Td: 0 to 100 s. Sample time: 0.1 to 100 ms. Lead/Lag compensator: This module represents a compensator system in the Laplace domain. The system allows to modify the zero, the pole and the gain of the compensator through the computer: K lead: 1 to 100 s. K lag: 1 to 100 s. Gain: 1 to 10. Sample time: 0.1 to 100 ms. Integrator system: This module represents an integrator system in the Laplace domain. The system allows to modify the gain and the saturation value of the system through the computer: Gain: -10 to 10. Saturation: -10 to 10. First order system: This module represents a first order system in the Laplace domain. The system allows to modify the time constant of the system through the computer. The gain can be also adjusted using the computer: Gain: 0 to 10. Time constant T: 0 to 100 s. Second order system: This module represents a second order system in Laplace domain. The system allows to modify through the computer the three parameters of the system: gain, damping coefficient and the natural frequency: Gain: 1 to 10. Damping coefficient <math>\zeta</math>: 0 to 1.5 in steps of 0.1. Natural frequency (<math>\omega_n</math>): 1Hz to 200 rad/s (100 Hz). Perturbation module: This module allows to insert disturbances in the systems. The perturbation can be inserted in different places of the control loop: Perturbation value: -10 to 10. Offset module: This module allows to add an offset to the input signal. Offset value: -10 to 10. Analog Inputs: This module is provided with 4 analog inputs. The inputs are used to visualize different signals in the computer. Connector to computer. Control Interface included.</p> <p>The Temperature module consists of two main components: the apparatus and the interface box. The apparatus contains all the sensors and actuators such as temperature sensor, flow meter, pressure sensor, level sensor, Magnetic Levitation Control etc and the interface box contains all necessary components for power supplying, signal conditioning.</p>			

Item Code	Description	Qty	Unit Rate	Total Amount
ES/IARL-17	<b>Multimedia Solution</b> Specifications Short Through Multimedia Projector Resolution: 1280 x 800 / Higher Projection Method Front/rear/ceiling mount Engine Type LCD with Optical Zoom Brightness 3200 ANSI lumens / Higher Inputs: HDMI, VGA, USB (Plug n Play) Audio in: RCA x 1 (White/Red) Screen: Gaylord Tripod Projection Screen 6' x 6'along Vendor – Channel Warranty Wall Mount Screen: Gaylord 6' x 6' Wall Mount Screen Suspended ceiling mount projector kit	1		

#### 4. SIGNAL PROCESSING AND FGPA LAB

Item Code	Description	Qty	Unit Rate	Total Amount
<b>ES/SPFL-01</b>	<b>Power Supply Boards Elvis or Equivalent</b> Computer based Test & Measurement Academic Platform <ul style="list-style-type: none"> <li>• Oscilloscope, DMM, Function Generator, Variable Power Supply, Bode Analyzer, Dynamic Signal Analyzer, Arbitrary Waveform Generator, DIO, Impedance Analyzer, Two Wire Current Voltage Analyzer, Three Wire Current Voltage Analyzer</li> <li>• Includes Basic Breadboard for Circuits and Electronics</li> <li>• Area specific power cord must be included</li> <li>• The Equipment must be quoted with all necessary accessories including power supplies, base units, necessary power cables, data cables, connecting leads, operating softwares, Programmers and computers (if required).</li> </ul>	<b>10</b>		
<b>ES/SPFL-02</b>	<b>FPGA BOARD</b> Board should be an Affordable tool to teach and implement multiple design concepts with one device 10 analog inputs, 6 analog outputs, 40 digital I/O lines Wireless, LEDs, push button, accelerometer onboard Xilinx FPGA and dual-core ARM Cortex-A9 processor Fully programmable with LabVIEW or C; adaptable for different programming levels Onsite Training by OEM <b>Accessories include:</b> Driver and software evaluation DVDs USB cable , Power supply with international adapters 1 MXP protoboard accessory screwdriver and MSP screw-terminal connector Sensors and Actuators Kit Barrel connector with leads, Assorted capacitors Diodes ,7-segment display Mechanical rotary encoder Photo interruptor (light sensor with LED) Assorted op-amps & Assorted LEDs Small DC motor (1 VDC to 3 VDC, no load speed: 6600 rpm) Microphone with audio jack MXP Breadboard Accessory ,potentiometer (500 kΩ) Relay , Assorted resistors Piezoelectric sensor Photocell ,2 Hall effect sensors (latch and switch) Buzzer , Assorted switches (DIP, slide, and rotary Thermistor (NTC: 10 kΩ, 25 degrees) Force sensing resistor Wire kit, Keypad	<b>10</b>		

Item Code	Description	Qty	Unit Rate	Total Amount
	Digital temperature sensor (I2C) Character LCD (I2C, SPI, and UART) Digital potentiometer (SPI) Bluetooth interface (UART) , EEPROM (SPI) LED matrix , Compass Geared motor 19:1 (includes encoder for rotation and speed, 12 V) Ultrasonic range finder Servo motor: standard (215 degrees rotation) Accelerometer (3 axis, digital - SPI and I2C) Servo motor: continuous rotation H-bridge driver (compatible with gear motor) Gyroscope (3 axis, digital - SPI and I2C). Infrared proximity sensor, Ambient light sensor (SPI) clips 8-pack, USB cable and additional accessories as required. Must be able to interface ICs among different logic families: TTL, CMOS, HCT, ECL etc. The FPGA kits must be quoted with all necessary accessories including power supplies, base units, necessary power cables, data cables, connecting leads, operating softwares, Programmers and computers (if required)			
<b>ES/SPFL-03</b>	<b>DSP, Interface Base Board</b> Equipment should consist of a multifunction DAQ device and a DSP board <b>Multifunction DAQ device</b> Compact, portable, and USB-powered educational device for use anywhere, anytime. Oscilloscope, DMM, Function Generator, DIO Variable Power Supply, Bode Analyzer, Dynamic Signal Analyzer, Arbitrary Waveform Generator, Data acquisition engine with analog I/O and digital lines ,Extend capabilities by programming with LabVIEW software Fully compatible with LabVIEW Onsite Training by OEM <b>DSP Board</b> Entry-level teaching tool for hands-on learning of digital filters Teach digital filter design, calculate coefficients, and observe poles and zeros 50 MHz microchip DSP with anti-aliasing filters and reconstruction filters on the output 32-bit precision to create filters up to the 10th order. The kits must be quoted with all necessary accessories including power supplies, base units, necessary power cables, data cables, connecting leads, operating softwares, Programmers and computers (if required).	<b>10</b>		

Item Code	Description	Qty	Unit Rate	Total Amount
<b>ES/SPFL-04</b>	<p><b>DSP TRAINER</b>  MS320C52 Processor@40 MHz  32K Bytes EPROM &amp; 64K Bytes RAM  RS-232 C serial I/F for PC  14 bit A/D &amp; D/A Converter  Four 7 segment displays  12 keys keypad  Experiments should include the following topics:  Sampling &amp; Reconstruction  IIR Filter  FIR Filter  FFT  DFT  ASK  FSK  ttPSK  Delta/PCM Modulation  DTMF Generation  Option modules include:  (1) DC Servo PWM Control  (2) Step Motor Control  (3) Temperature Control  (4) OCL amplifier  (5) PLC I/O Interface Control</p> <p>The Trainer kits must be quoted with all necessary accessories including power supplies, base units, necessary power cables, data cables, connecting leads, operating softwares, Programmers and computers (if required).</p>	<b>10</b>		
<b>ES/SPFL-05</b>	<p><b>CPLD Trainer</b>  Scientech 105 CPLD Development Platform featuring the Xilinx CPLD XC95108PC84  <b>Features should include:</b>  108 macrocells with 2400 usable gates 108 users I/O pins  Xilinx Webpack Development Software CD  Sample Code for Board Testing  Learning Material (CD) for reference  Functional Explanation of Development Boards  Detachable 54 I/Os for easy to experiment  16 DIP Switches for Logic Inputs  16 LED Outputs for Logic Outputs  6 Digit 7-Segment Multiplexed Display Pushbutton switches for Pulse Inputs  Scope of Learning  Basic gates  Flip-Flop  Mux -Demux  Encoder-Decoder  Counter</p>	<b>10</b>		

Item Code	Description	Qty	Unit Rate	Total Amount
	Resistors LED flasher Bank Token Display IP Core design for Rs232 Interface <b>Technical Specifications</b> Xilinx Family : CPLD> XC95108 > Package : PC84 Device Density : >108 macrocells > 2400 usable gates >108 users I/O pins Configuration Methods : JTAG Interface (Boundary Scan) Number of I/O's : 84 Peripheral interface: RS232 interface. On board: +5 V supply to CPLD & other hardware circuit Crystal 8MHz External i/o's: Power Supply : 110 - 240 V, $\pm 10\%$ , 50/60 Hz Power Consumption: 2.5 VA approximately.  The trainer kits must be quoted with all necessary accessories including power supplies, base units, necessary power cables, data cables, connecting leads, operating softwares, Programmers and computers (if required).			
<b>ES/SPFL-06</b>	<b>DSP Starter Kit</b> DSP Development Board with 512K Flash and 16MB SDRAM DSK Code Composer Studio™ IDE Fast Simulators and access to Analysis Toolkit on Update Advisor USB Cable ,Universal Power Supply Embedded JTAG support via USB AC Power Cord(s) audio jacks for microphone, line in, speaker and line out Expansion port connector for plug-in modules DSP/BIOS™ real-time kernel Target error recovery software On-board standard IEEE JTAG interface DSK diagnostic tool  The kit must be provided with all the necessary accessories Including power supplies, base units, necessary power cables, date cables, Connecting leads, programmers and computers (if necessary).	<b>10</b>		

Item Code	Description	Qty	Unit Rate	Total Amount
<b>ES/SPFL-07</b>	<b>ZedBoard Zynq™-7000 Development Board</b> Kit includes ISE® WebPACK™ with device-locked ChipScope license Onboard USB-JTAG Programming 512MB DDR3, 256Mb Quad-SPI Flash 10/100/1000 Ethernet, USB OTG 2.0 and USB-UART Dual-core ARM Cortex A9 Multiple displays Applications include: Video processing Motor control Software acceleration Linux/Android/RTOS development etc Accessories include: ZedBoard base board 12 V AC/DC power supply, 4 GB SD Card Getting Started guide , USB Adapter Vivado® Design Suite with device-locked Design Edition license  The kits must be quoted with all necessary accessories including power supplies, base units, necessary power cables, data cables, connecting leads, operating softwares, Programmers and computers (if required).	<b>10</b>		
<b>ES/SPFL-08</b>	<b>Nexys™3 Spartan-6 FPGA Board</b> Xilinx Spartan®-6 FPGA Intended for use with ISE, Webpack, or EDK Digilent USB2 port providing board power, programming, & data transfers 16MB Micron Cellular RAM, 16MB Micron Parallel PCM, 16MB Micron Quad-mode SPI PCM	<b>10</b>		
<b>ES/SPFL-09</b>	<b>Virtex-5 OpenSPARC Evaluation Platform</b> Xilinx Virtex-5 FPGA (17,280 Virtex-5 Slices) Intended for use with ISE or EDK Ships with XUP USB-JTAG Programming Cable Large DDR array, Gbit ethernet, USB host, audio / video CODECs	<b>10</b>		
<b>ES/SPFL-10</b>	<b>Spartan-3 Starter Board</b> Xilinx Spartan-3 FPGA (200K or 1000K Gates) Intended for use with ISE or Webpack Works with Digilent's JTAG3, JTAG USB, and JTAG USB Full Speed cables, as well as 1MB ISSI SRAM, VGA, PS/2, RS-232, three 40-pin expansion connectors, P4 & MultiPRO cables from Xilinx	<b>10</b>		

Item Code	Description	Qty	Unit Rate	Total Amount
ES/SPFL-11	<b>Basys™2 Spartan-3E FPGA Board</b> Xilinx Spartan 3E FPGA (100K or 250K gates) Intended for use with ISE or Webpack Digilent USB2 port providing board power, programming, and data transfers, VGA & PS/2 connectors.	10		
ES/SPFL-12	<b>C6000 DSP+ARM® Processor Platform</b> Includes cost efficient, high performance processors comprised of devices with a floating and fixed-point DSP processor and an ARM9™ processor. Devices include integrated high-bandwidth peripherals and display engines.	10		
ES/SPFL-13	<b>NEXYS4 Artix7 FPGA Trainer Board</b> A ready-to-use digital circuit development platform based on the latest Artix-7™ Field Programmable Gate Array (FPGA) from Xilinx. Trainer should include large, high-capacity FPGA (Xilinx part number XC7A100T-1CSG324C), generous external memories, and collection of USB, Ethernet, and other ports, Trainer should host designs ranging from introductory combinational circuits to powerful embedded processors. Several built-in peripherals, including an accelerometer, temperature sensor, MEMs digital microphone, a speaker amplifier, should be used for a wide range of designs without needing any other components. <ul style="list-style-type: none"> <li>• Programmable over JTAG and Quad-SPI Flash</li> <li>• On-chip analog-to-digital converter</li> </ul> <b>Key Specifications</b> Logic Slices :15,850 (4 6-input LUTs & 8 flip-flops each) Block RAM: 4,860 Kbits Clock Tiles: 6 (each with PLL) DSP Slices : 240 Internal clock : 450MHz+ Cellular RAM :16MB Quad-SPI Flash : 16 MB Ethernet: 10/100 PHY Connectivity and Onboard I/O SD : microSD card connector Pmod Connectors: 4 Pmod ports VGA :12-bit VGA port Audio :PWM audio output Application area should cover all the necessary experiments of FPGA & Digital electronics fields. <b>Design Resources</b> Vivado Board:17.2 Trainer should include all the necessary documentation, reference manuals, power supplies, base cables, data cables, connecting leads, programmers, computers (if required)	10		



Item Code	Description	Qty	Unit Rate	Total Amount
ES/SPFL-14	<p><b>COMPUTER CONTROLLED TEACHING UNIT FOR THE STUDY OF DIGITAL SIGNAL PROCESSING</b></p> <p>Unit must be mounted in a metallic box.</p> <p>2 Function Generators modules, each one includes:</p> <p>Waveform selector: sine, square and triangular.</p> <p>Frequency potentiometer, range: 20 Hz to 20 KHz.</p> <p>Amplitude potentiometer, range: <math>\pm 10</math> V.</p> <p>Duty cycle potentiometer, range: 0% to 100%.</p> <p>BNC output connector.</p> <p>Noise Generator module:</p> <p>White noise generator:</p> <p>Amplitude potentiometer, range: <math>\pm 10</math> V.</p> <p>BNC output connector.</p> <p>Pink noise generator (also called frequency inverter or noise 1/□):</p> <p>Amplitude potentiometer, range: <math>\pm 10</math> V.</p> <p>BNC output connector.</p> <p>Microphone Pre-Amplifier module:</p> <p>It adapts the microphone signal to be analyzed by the data acquisition system or by the speaker.</p> <p>1/4" jack input connector for the microphone.</p> <p>BNC output connector.</p> <p>Microphone:</p> <p>Impedance: 500ohm.</p> <p>Frequency response: 70 Hz to 14 KHz.</p> <p>1/4" jack connector.</p> <p>Power Amplifier module, including:</p> <p>BNC input connector.</p> <p>BNC output connector.</p> <p>Potentiometer to regulate the power amplifier gain.</p> <p>Speaker module:</p> <p>Impedance: 8 ohm.</p> <p>Nominal maximum power: 30 W.</p> <p>Frequency response: 100 Hz to 13 KHz.</p> <p>PC input/output module, including:</p> <p>2 BNC input connectors.</p> <p>2 BNC output connectors.</p> <p>SCSI connector to the data acquisition board (to be placed in the computer).</p> <p>Possibility of working simultaneously with two external signals, facilitating operations that require more than one signal.</p> <p>Moreover, system should be able to generate different waveforms by the software and send them to the outputs of the unit. These signals must be visualized by an external oscilloscope or be listened by the speaker.</p>	10		

Item Code	Description	Qty	Unit Rate	Total Amount
	<p><b>The unit should cover the Exercises and Practical as:</b></p> <ol style="list-style-type: none"> <li>1.- Continuous wave form generation, with the possibility of varying the frequency and amplitude of signals, besides of duty cycle.</li> <li>2.- Characterization of signals. To analyze the nature of the signals: sine, square, triangular, etc.</li> <li>3.- Working simultaneously with two external signals.</li> <li>4.- Generating signals directly by the software and send them to the unit outputs and then visualizing or listening by the speaker or an external oscilloscope.</li> <li>5.- Signal digitalization, permitting the most suitable sampling time, avoiding "aliasing".</li> <li>6.- Digitalization of signals with the possibility of adjusting the sampling frequency.</li> <li>7.- Fast Fourier Transforms (Power Spectrum).</li> <li>8.- Addition, subtraction and multiplication of signals.</li> <li>9.- Study of "aliasing".</li> <li>10.- Study of different noise types: <ul style="list-style-type: none"> <li>-White noise.</li> <li>-1/f noise.</li> </ul> </li> <li>11.- Study and use of filters: <ul style="list-style-type: none"> <li>-Possibility of filtration of any signal.</li> <li>-Reconstruction of signals through the application of filters.</li> <li>-Digital filters: <ul style="list-style-type: none"> <li>Finite Impulse Response (FIR) Filters and Infinite Impulse Response (IIR) Filters.</li> <li>-Analogue filters: <ul style="list-style-type: none"> <li>Butterworth, Chebyshev, etc.</li> </ul> </li> <li>-Possibility to use Bartlett, Hanning, Hamming, Kaiser, Parzen, etc. windows for applying on the signal</li> </ul> </li> </ul></li></ol>			
<b>ES/SPFL-15</b>	<p><b>SIGNAL PROCESSING: ANALOG PROCESSING</b></p> <p>The courseware should cover, and include practical experiences, at least, on the following subjects over analog signals:</p> <ul style="list-style-type: none"> <li>· sum and subtraction –</li> <li>· attenuation</li> <li>· exponential and logarithmic</li> <li>· integrative and derivative</li> <li>· multiplication, division, raising to a power and square root</li> <li>· automatic gain control (AGC)</li> <li>· switching capacity filters (SCF)</li> <li>· VCO- PLL etc.</li> </ul> <p>For the common characteristics, refer to item ACT5.</p> <p>Required specific technical features are:</p> <p>attenuator with attenuation ranging from 0 to 15 dB with steps of 1 dB built-in signal generator with the following characteristics: provided with three signals with fixed frequency (square-wave at 100 kHz and 1 kHz and sine-wave at 500 Hz) and a variable frequency generator (square, triangle and sine-wave).</p>	<b>10</b>		

Item Code	Description	Qty	Unit Rate	Total Amount
ES/SPFL-16	<p><b>Opto-Electronics Trainer</b>  A kit of Opto-electronic components, mounted on small printed circuit carriers, which are housed in a convenient storage tray with identification information. The kit should introduce the student to the characteristics Of various Optical devices like LED , LDR and Photodiodes.</p> <p><b>Accessories include</b>  Light Emitters: Tungsten Lamp  LEDs: Red, Green, Yellow, Bi-colour (red/green), Red, 3mm pair (2mA/ standard).  Photo Detectors: Photodiode, Phototransistor, Light-activated Switch, Light-dependent Resistor (LDR).  Optocouplers: Transistor output, Type 4N25. Darlington output, Type 4N32.  Driver Modules: Type 741 Op. Amp., Flasher Module using Type 555 timer, Type LM3909 Flasher 1C.  Fibre Optic Link: A short length of suitably terminated fibre optic cable.  Active &amp; Passive components: A range of Bi-polar transistors, diodes capacitors &amp; resistors.  The trainer kits must be quoted with all necessary accessories including power supplies, base units, necessary power cables, data cables, connecting leads, operating softwares, Programmers and computers (if required).</p>	10		
ES/SPFL-17	<p><b>Programmer</b>  Xilinx FPGA JTAG programmer  Fully compatible with XILINX PLATFORM USB CABLE  Key Features</p> <ul style="list-style-type: none"> <li>• True plug-and-play</li> <li>• Bus-powered USB device (no power supply required)</li> <li>• Selectable target clock frequency up to 24 MHz</li> <li>• Compatible with Full-Speed and Hi-Speed USB ports</li> <li>• USB-IF certified</li> <li>• Firmware downloadable over cable</li> <li>• Target power status LED</li> <li>• CE and FCC compliant</li> <li>• Compatible with target voltages in the range of 1.5 VDC to 5 VDC</li> <li>• iMPACT and ChipScope tool support in ISE software v6.3.03i (Windows only)</li> <li>• Linux support in ISE software v7.1i</li> <li>• Supports Boundary Scan and Slave-Serial configuration modes</li> <li>• Pb-Free (RoHS compliant)</li> </ul> <p>Device Family Support</p> <ul style="list-style-type: none"> <li>• Virtex</li> <li>• Virtex-4</li> <li>• Virtex-5 FX</li> <li>• Virtex-5 LXT</li> <li>• Virtex-5 SXT</li> <li>• Virtex-E</li> <li>• Virtex-II</li> </ul>	10		

Item Code	Description	Qty	Unit Rate	Total Amount
	<ul style="list-style-type: none"> <li>• Virtex-II Pro</li> <li>• XC18Vxx Series</li> <li>• XC9500</li> <li>• XC9500XL</li> <li>• CoolRunner XPLA3</li> <li>• CoolRunner-II</li> <li>• Platform FLASH</li> <li>• Spartan</li> <li>• Spartan-3</li> <li>• Spartan-3A</li> <li>• Spartan-3A DSP</li> <li>• Spartan-3AN</li> <li>• Spartan-3E</li> <li>• Spartan-II</li> <li>• Spartan-IIE</li> </ul> <p>Requirements Windows XP or Windows 2000</p> <p>1. Altera USB BLASTER CPLD/FPGA Programmer Details:</p> <ul style="list-style-type: none"> <li>• Supports ALTERA total series FPGA/CPLD</li> <li>• Supports AS, PS, JTAG three download modes High-speed, stable, and internal FT245R+CPLD designed</li> <li>• Supports SignalTap II embedded logic analyzer</li> <li>• Supports Nios II of embedded processor communication and debugging</li> <li>• High download speed: FT245+CPLD+244</li> <li>• Compatible with ALTERA USB Blaster</li> </ul> <p>The programmers must be quoted with all necessary accessories including power supplies, base units, necessary power cables, data cables, connecting leads, operating softwares, Programmers and computers (if required).</p>			
<b>ES/SPFL-18</b>	<p><b>SIGNAL PROCESSING: A/D and D/A CONVERTERS</b></p> <p>The courseware should cover, and include practical experiences, at least, on the following subjects:</p> <ul style="list-style-type: none"> <li>• characteristics of A/D conversion: quantization, sample &amp; hold, conversion time etc – Converters: simple and double ramp, successive approximation method</li> <li>• D/A converters: characteristics, parallel method etc.</li> </ul> <p>For the common characteristics, refer to item ACT5.</p> <p>Required specific technical features are:</p> <ul style="list-style-type: none"> <li>• 8-bit conversions A/D and D/A</li> <li>• analog input range: between 0 to 8V and -8 to +8V</li> <li>• analog output range: between 0 to 8V and -8 to +8V</li> <li>• the D/A should have 2 selectable inputs: one from the A/D converter, the other from 8 manual switches, for digital input simulation.</li> <li>• LED display for digital signals in both converters</li> </ul>	<b>10</b>		

Item Code	Description	Qty	Unit Rate	Total Amount
<b>ES/SPFL-19</b>	<b>SIGNAL PROCESSING: V/F and F/V CONVERTERS</b> The courseware should cover, and include practical experiences, at least, on the following subjects: characteristic parameters of V/F and F/V converters (conversion factor, linearity, errors etc)- · V/F converters square wave output - F/V conversions: integrator and diode pump- · photocouplers for linking circuits etc. For the common characteristics, refer to item ACT5. Required specific technical features are: · not less than 6 IC for the above mentioned experiences. · required blocks in the board: V/F and F/V converters-optocoupler	<b>10</b>		
<b>ES/SPFL-20</b>	<b>SIGNAL PROCESSING: V/I and I/V CONVERTERS</b> The courseware should cover, and include practical experiences, at least, on the following subjects: characteristics of V/I and I/V converters (voltage and current range, conversion linearity, errors etc). For the common characteristics, refer to item ACT5. Required specific technical features are: · V/I output: 4-20 mA · I/V input : 4-20 mA·	<b>10</b>		
<b>ES/SPFL-21</b>	<b>AC &amp; DC Power supply</b> Bench top power supply module must be able to supply continuous variable voltages of 0-400 Vac (three-phase) / 0-220 Vac (single-phase), with rated current of 5 -15A. Three-phase Bridge rectified DC variable output of 0-600 V 0-25 A for high load application and intermittent to continuous operation. Programmable power supplies which provide real time voltage, current and power values with high setting and read back resolution and independently adjustable overvoltage protection (OVP) along with advanced parallel and serial operation. Must have output provided with Floating, overload and short circuit-proof outputs with range of at least 0 V to $\geq 32$ V/0 A to $\geq 10$ A ( $\geq 500$ W). The provided item must have Low residual ripple, high output power, and excellent regulation to provide protection of sensitive loads by current limit or electronic fuse.	<b>10</b>		
<b>ES/SPFL-22</b>	<b>Oscilloscope</b> 60 MHZ Digital Storage Features 60MHz Bandwidths 1GSa/s Real-Time Sample Rates Maximum, 25GSa/s Equivalent-Time 2Mega Point Record Length 2mV~10V Vertical Scale up to 600V peak input 1ns~50s Horizontal Range Up to 27 Automatic Measurements Versatile Math Functions + , - , x, FFT, FFTrms 5.6" TFT LCD Display USB Interface & SD Card Supported Multi-Language Support on Operation Menu & On-Screen Help	<b>10</b>		

Item Code	Description	Qty	Unit Rate	Total Amount
<b>ES/SPFL-23</b>	<b>Function Generator</b> Advanced Direct Digital Synthesis (DDS) technology, 2 output channels, built-in counter, 20MHz maximum output frequency (5 MHz max square) wave.	<b>10</b>		
<b>ES/SPFL-24</b>	<b>Digital Multimeter</b> Digital multimeter required in the lab to perform the following parameters with defined specification range as: DC voltage: 1000V AC voltage: 1000V DC current: 10A (20 A for 30 seconds maximum) AC current: 10A (20 A for 30 seconds maximum) Max: resistance: 50M-Ohm Capacitance: 9,999µF Frequency: 200kHz Max duty cycle: 99.9% Temperature measurement feature (temperature probes) Maximum conductance: 60.00ns Diode range: 3V	<b>10</b>		
<b>ES/SPFL-25</b>	<b>Multimedia Solutions</b> Specifications Short Through Multimedia Projector Resolution: 1280 x 800 / Higher Projection Method Front/rear/ceiling mount Engine Type LCD with Optical Zoom Brightness 3200 ANSI lumens / Higher Inputs: HDMI, VGA, USB (Plug n Play) Audio in: RCA x 1 (White/Red) Screen: Gaylord Tripod Projection Screen 6' x 6'along Vendor – Channel Warranty Wall Mount Screen: Gaylord 6' x 6' Wall Mount Screen Suspended ceiling mount projector kit	<b>1</b>		