Tender Conditions and procedure to be abided by the tenderers

1. INTRODUCTION

1.1. This tender is for procurement of the following equipments for Annamalai University, Annamalainagar, Chidambaram, India.

No.	File No.	Description
1.	GUCC/DST PURSEII/ Tender/01 /2019-20	Field Emission Scanning Electron Microscope with EDS
2.	GUCC/DST PURSEII/ Tender/ /2019-20	Matlab software

The specification for the above mentioned equipments is given in Schedule A

1.2. Applicability of Tamil Nadu Transparency in Tenders Act and Rules: This tender will be governed by the Tamil Nadu Transparency in Tenders Act 1998 and Rules 2000 as amended from time to time.

2. ELIGIBILITY CRITERIA

2.1. A tenderer will be eligible for tendering only if he satisfies the eligibility criteria as given below:

a) A tenderer should be a manufacturer possessing a valid manufacturing license from the competent authority for manufacturing the items quoted and should have at least three years' experience. (Documentary evidence to be furnished)

b) The manufacturer should be an ISO:9001 / Equivalent certified company. Documentary evidence should be enclosed.

c) Authorized Dealer / Distributor / Supplier can also bid with authorization from the Manufacturer. (Documentary evidence to be furnished). A manufacturer shall not authorize more than one dealer / distributor for participating in this tender.

d) In case a tenderer is participating as an authorized Dealer/Distributor/Supplier the manufacturer of the item should satisfy the conditions mentioned at (a) and (b) above.

e) The tenderer should have a Tamil Nadu Value Added Tax Registration / Central Sales Tax Registration. Copy of the Registration Certificate should be enclosed.

f) The Tenderer should be an Income Tax assesse. (Return filed should be enclosed)

2.2. The tenderer should not have been blacklisted or debarred from participating in tenders by any Central / State Government agencies or autonomous bodies or universities/ institutions. (An undertaking to this effect should be furnished)

2.3. The tenderer submitting their offer must have supplied similar items to other Universities or institutions or Government agencies. Copies of such order must be enclosed this tender document.

3. COST OF TENDERING

The Tenderer shall bear all costs associated with the preparation and submission of this Tender and the tender inviting authority will in no way be responsible or liable for these costs.

The Tenderer may also download the application format from University Web Site

3.1 Cost of Tender Document:

The cost of the tender document is `. 2100/-. The demand draft should be in favour of "The Registrar, Annamalai University" payable at Annamalainagar or Chidambaram.

4. GENERAL INSTRUCTIONS

4.1. The tenderers are requested to go through the instructions, terms and conditions and specifications given in the tender. Failure to furnish all required information in every aspect will be at the tenderer's risk and may result in the rejection of the tender.

For any queries tenderer may contact **Registrar, Annamalai University, Annamalainagar, Chidambaram – 608 002. Tamil Nadu, INDIA.**

4.2. Clarification on the tender

A prospective tenderer requiring any clarification on the tender may request the Office of the Registrar, Annamalai University by a letter or by fax. Registrar, Annamalai University will respond in writing to any request for clarification in the tender.

4.3. Amendments to the Tender

    i.   Tender Inviting Authority may amend the tender wherever it is felt that such an amendment is absolutely necessary.

    ii.   Amendment to tender may also be given in response to clarifications by prospective tenderers and it is solely the discretion of the Tender Inviting Authority. Any amendment to the tender will be uploaded on the website **www.annamalaiuniversity.ac.in. It is the responsibility of the tenderer to verify the amendments if any and get the amendment documents before the submission of the tender provided no such change could be effected 48 hours prior to the time fixed for opening of the tender.**

4.4. The **Tender document is not transferable** under any circumstances

5. EARNEST MONEY DEPOSIT (EMD)

5.1. The tenderer should furnish **Earnest Money Deposit (EMD) 1% of the total cost** along with the tender by way of Demand Draft/Bankers cheque obtained from any Nationalized/ Scheduled Bank and drawn in favour of "**The Registrar, Annamalai University**" payable at **Annamalainagar or Chidambaram**.

5.2. Any tender without required EMD will be considered as NON-RESPONSIVE and will be SUMMARILY REJECTED.

5.3. The Tender Inviting Authority will arrange to refund the Earnest Money Deposit to the unsuccessful tenderers after publishing the list of successful tenderers, within a reasonable time.

5.4. No interest will be paid on the EMD.

5.5. The EMD is liable to be forfeited if:

    i. The Tenderer withdraws his tender at any stage after the last date and time fixed for submitting the tender.

    ii. The Tenderer on becoming successful, fails to furnish the required security deposit or sign the agreement, within the stipulated time limit.

6. PERFORMANCE SECURITY :

i. Successful tenderer has to furnish Security Deposit equivalent to 5% of the tendered value either in form of Demand Draft drawn in favour of "Registrar, Annamalai University" or in form of irrevocable bank guarantee obtained from any Nationalized/Scheduled bank.

ii. The EMD of the Successful Bidder will be adjusted towards Security Deposit (SD). Security Deposit will be released only after the expiry of the warranty period as mentioned in clause 8.5.

7. SUBMISSION OF TENDER:

7.1. Due Date for Tender Submission

i. The tender document duly filled in, signed on all pages shall be submitted in sealed cover to **the Registrar, Annamalai University at his office upto 3.00 PM on _____** as per the procedure laid down herein. The tender can be submitted on all working days upto the above closing date. In the event of this day being declared as a holiday, the tenders can be submitted up to 3.00 P.M. on the following working day.

ii. The tender inviting authority will not be held responsible for any delay in the receipt of the Bank Draft or any delay in the receipt of the document by the tenderer including loss of the document in transit or delay in obtaining any document / certificate or on any other account. No extension of the date and time for the submission of the documents will be given for any such delay.

iii. The tender inviting authority may extend the due date for submission of tender by issuing an amendment in which case all the rights and obligations of the Tender Inviting Authority and the Tenderers previously subject to the original due date for submission will then be subject to the new date for submission.

iv. **Any tender received** by the Tender Inviting Authority **after the due date and time will not be considered and will be returned to the tenderer.**

7.2. Procedure for Submission of Tender

i. Tenderers are advised to go through the tender documents and understand all the provisions and stipulations contained therein before submitting the

tender.

ii. The tender shall be submitted as per the procedures and requirements stipulated herein.

iii. Tender submitted by telex, cable or fax will not be accepted and will be summarily rejected.

iv. The Commercial bid should be neatly typed. Hand written offers will be rejected. Any deviation in the offer shall lead to rejection.

v. **The tenderer who are supplying imported material, must be registered with the Competent Authority/Department of the Government of India.**

vi. *The purchaser shall not be responsible for any postal delay in receipt of the offer. Any bid received by the Purchaser which does not fulfil the desired terms and conditions shall be rejected out rightly and no communication in this regard shall be sent. Delayed/Late bids will not be accepted, at any circumstances.*

vii. *All the bids will be opened in the presence of bidders representatives, who, chose to attend the same as per the date and time specified in the Tender Document.*

viii. *This tender is based on two-cover systems i.e. Technical bid and price bid. Therefore the tender shall be submitted in two parts viz. Cover A and Cover B. Each part shall be placed in an independent sealed envelope and shall be super scribed as follows*

Cover-A   :   "TECHNICAL BID COVER"

"**TENDER FOR SUPPLY OF** <u>**FESEM with EDS**</u> **EQUIPMENT TO ANNAMALAI UNIVERSITY**"

TENDER NUMBER:

Cover-B   :   "PRICE BID COVER"

"**TENDER FOR SUPPLY OF** <u>**FESEM with EDS**</u> **EQUIPMENT TO ANNAMALAI UNIVERSITY**"

TENDER NUMBER:

ix. The contents of each of the two covers shall be as described in the subsequent clauses. For all other references, these covers will be referred to briefly as "**Technical Bid Cover**" and "**Price Bid Cover**".

Both the covers i.e. Cover-A and Cover-B, shall be placed inside an

outer cover and shall be super scribed as follows:

"**TENDER FOR SUPPLY OF <u>FESEM with EDS</u> EQUIPMENT**"

TENDER NUMBER:

x.   The sealed tender envelope shall be addressed to

The Registrar,
Annamalai University,
Annamalainagar,
Chidambaram-608 002, Tamil Nadu, India

xi. The tender envelope shall carry the name and address of the Tenderer prominently with Phone No. / email ID / and FAX No.

xii. The **Technical Bid Cover** (**Cover-A**) shall contain the following as per the sequence indicated below.

1.	Earnest Money Deposit (EMD) of as per clause-5 of the Tender document.
2.	Application form for supply of equipment as per Appendix-1
3.	Documentary evidence for payment of income tax (latest income tax return should be furnished)
4.	Letter of Tender as per Appendix-2
5.	Documentary evidence for registration under Tamil Nadu Value Added Tax / Central Sales Tax.
6.	Documentary evidence for ISO:9001 / equivalent certified company
7.	A copy of Manufacturing license/Registration Certificate
8.	Authorization from Manufacturer in case of Authorized Dealers/Distributors/Supplier
9.	Documentary evidence of supplying similar items to other Universities/Institutions/Govt. agencies.
10.	In addition to the above any document or certificates etc., mentioned anywhere in the tender document shall also be a part of the technical tender requirements.

xiii.   The **PRICE BID COVER (Cover-B)** shall contain the Price Bid as per the format given in Appendix-3.

The tenderer shall not carry out any alteration in the format prescribed for Price Bid. The tenderer shall not enclose any other document or statement that will influence the price. In such an event, the tender inviting authority shall summarily reject the tender.

7.3. Signing of the Tender

The tender shall be signed by a person or persons duly authorized to sign on behalf of the Tenderer. All pages of the tender shall be signed by the person or persons signing the tender. <u>The tenderer shall enclose a certified copy of the power of attorney authorizing the signatory or signatories to sign the tender document.</u> This certification shall be from the Managing Director or the Legal Manager of the firm.

The tender shall contain no alterations or additions, except those to comply with instructions issued by the Tender Inviting Authority, or as necessary to correct errors made by the tenderer, in which case such corrections shall be signed by the person or persons signing the tender.

All the pages in the tender document should be signed by the tenderer, after filling the prices in figures & words.

8. GENERAL TERMS AND CONDITIONS

8.1. DELIVERY SCHEDULE:

The Price Quoted should be FOR CHIDAMBARAM

i.   Materials should be door delivered at Annamalai University, Annamalainagar, Chidambaram, Tamilnadu.

ii. Delivery must be made within a period of 45 days from the issue the order either directly or through their dealer network unless otherwise specified.

iii. If the supplier fails to deliver the equipment ordered within the allotted delivery period as specified above, the Purchaser may procure goods or services similar to those un-delivered upon such terms and in such manner as it deems appropriate from any other firm at the risk and cost of the supplier.

8.2 PAYMENT TERMS:

i. Payment will be made within 30 days from the date of delivery, installations, commissioning and demonstration of the equipment and acceptance by concerned Department/ Section.

ii. ***Payment shall be made by Cheque or such other mode***/ electronic fund transfer offered by the Bank.

8.3 Taxes& Duties :

i. As per Govt. Notification No.10/97-CE dated 1st March 1997, Annamalai University, Chidambaram is exempted from Excise Duty for SCIENTIFIC / TECHNICAL INSTRUMENTS WHICH ARE USED FOR RESEARCH PURPOSE ONLY. The University shall provide all the documents under this notification to enable supplier to clear the goods without payment of excise duty, whenever required. Supplier should state clearly that this certificate is required.

ii. As per Govt. of India Notification 51/96 Customs dated 23rd July 1996, Annamalai University, Chidambaram is exempted from Custom duty for all research equipment. The University shall provide all the documents under this notification to enable supplier to clear the goods without payment of Custom duty, whenever required. Supplier should state clearly that this certificate is required.

iii. GST will be charged as applicable. Any statutory variation will be paid to supplier on documentary evidence. Supplier should clearly indicate the percentage of GST applicable.

iv. Clearing forwarding charges should also be mentioned

8.4 Loss, Damage & shortage :

Annamalai University shall not be responsible for any loss, damages and shortage during transit. Payment shall be made for the material received in good condition only.

8.5 Warranty

The equipment supplied under the contract shall carry a warranty for at least Five years.

8.6 Commissioning and Demonstration

The Supplier shall be responsible for commissioning of the equipment. Supplier should also arrange for demonstration of the equipment to the Staff of the University.

8.7 Annual Maintenance

The University reserves the right to entrust Annual Maintenance of the equipment supplied under this tender to the concerned supplier. Therefore the tenderer shall mention the annual maintenance charges AMC/SMC in the price schedule. Tenderer should also give a brief write up about the services to be covered under Annual Maintenance charges quoted by him.

8.8 General:

The acceptance of the offer will rest with the Annamalai University who reserves the right to reject/accept partially or wholly the tenders received, without assigning any reason.

i. Mere submission of tender/ proposal does not imply acceptance of the same at this end and the firms will be finalised only after meeting the laid down qualifying parameters for which decision of the Tender Inviting Authority / Tender Accepting Authority shall be final and binding on the parties.

ii. Printed terms and conditions of the applicant on their quotation Form/ Literature/ Letter etc. if any, will not be binding on the University.

8.9 Liquidated Damages :

Timely delivery is essence of the contract and hence should any consignment be delayed, liquidated damages at the rate 0.5% of the value of the delayed consignment, for each week or part there of shall be levied and recovered subject to maximum of 5% of total order value.

8.10 Acceptance / Rejection:

The Tender Accepting Authority reserves the right to accept a quotation in part or in full or to reject all quotations or any of the quotations received, for non-compliance of any of the above items, conditions or instructions or for any other reason without assigning any reason thereof.

9.1. TENDER OPENING

i. Tender will be opened in the presence of the tenderers or their

authorized representative who choose to be present and the tender scrutiny committee at **4.00 P.M. on _____.** The representative of tenderer who attend the tender opening must produce their **identification proof** and **authorization letter** from the companies / tenderer.

ii. In the event of the specified date of Tender opening being declared a holiday, the tenders will be opened at the same time on the next working day.

iii. **Cover-A containing "Technical Bid" shall be opened first.**

iv. On opening the tender, the details such as name of the tenderer, address, EMD details, etc., will be read out.

v. Tenders found without the EMD or with an invalid EMD or insufficient EMD, will be summarily rejected. Unopened tenders will be returned to such tenderers.

vi. On verifying the EMD, the Technical bids will be examined to decide their service suitability for the said work. Tenderers whose Technical bids are not found acceptable will be advised of the same and their sealed covers containing the respective Financial Bids will not be opened. Their EMD will also be returned to them.

vii. **Price bids of only those tenderers whose Technical bids are substantively responsive, will be opened.**

9.2. Process to be Confidential

i. Information relating to the examination, clarification, evaluation and comparison of tenders and recommendations for the award of contract shall not be disclosed to tenderers or any other persons not officially concerned with such process until the award to the successful tenderer has been announced.

ii. **Any effort by a tenderer to influence the tender accepting authority, scrutiny / evaluation committee or its members in the processing of tenders or award decisions may result in the rejection of his tender.**

9.3. Criteria for Technical Evaluation
(Evaluation of Technical Bid)

i. The tender accepting authority will determine whether the tenderer has fulfilled all the tender conditions as stipulated in the tender document and whether the tender is substantially responsive or not.

ii. A responsive tender is one which conforms to all the terms, conditions and specifications of the tender documents without material deviation or reservation. A material deviation or reservation is one:

   a) Which affects in any substantial way the scope, quality or performance of the contract.

   b) Which is a substantial way is inconsistent with the Tender conditions, the tender accepting authority's rights or the Tenderers obligations under the Contract, or

   c) Whose rectification would affect unfairly the competitive position of other Tenderers presenting substantively responsive Tenders.

iii. Tenderers who have not fulfilled the tender conditions shall be a non-responsive tender and will not be taken up for further evaluation and Price Bid opening.

iv. To assist the examination, evaluation and comparison of Tenders, the tender accepting authority may at its discretion, ask any tenderer for clarification on his Tender. The request for clarification and the response shall be in writing or by fax but no change in the substance of the Tender shall be so sought, offered, or permitted

v. When a tender fails to be responsive, it will be rejected by the tender accepting authority and may not subsequently be made responsive by correction or addition / withdrawal of the non-conforming deviation or reservation.

9.4. Price Bid Opening and Evaluation of Price Bid

i) The Tender inviting Authority will then proceed with opening of **Cover-B,** i.e., "PRICE BID COVER" of those tenderers whose technical bid has been found substantively responsive.   The opening of the "**Price Bid cover**" will be done in the presence of those tenderers or their representatives who choose to be present. The Tender Inviting Authority will inform such tenderers in advance about the acceptance of their technical tender and the date and time of opening of the "Price Bid Cover".

ii. The tender will be evaluated based on the prices offered by the tenders for the concerned equipments.

iii. The tender who has bid the lowest evaluated price will be determined considering the following factors:-

   a) the quoted price shall be corrected for arithmetical errors;

   b) in cases of discrepancy between the prices quoted in words and in figures, lower of the two shall be considered;

iv. The evaluation shall include all central duties such as customs duty and central excise duty and sales tax as a part of the price, as details below

   a) In evaluation of the price of an imported item, the price has to be determined inclusive of the customs duty;

   b) In evaluation of the price of articles which are subject to excise duty, the price has to be determined inclusive of such excise duty.

   c) In a tender where all the tenderers are from within the State of Tamil Nadu, or where all the tenderers are from outside the State of Tamil Nadu, the (Value Added Tax) shall be included for the evaluation of the price; and

   d) In a tender where the tenderers are both from the State of Tamil Nadu as well as from outside the State of Tamil Nadu, [the Value Added Tax levied under Tamil Nadu Value Added Tax Act, 2006 (Tamil Nadu Act 32 of 2006)] shall be excluded for the evaluation of the price.)

v. Annual Maintenance charges will not be included while evaluating the tender.

10. **AWARD OF TENDER**

10.1. The award of the tender shall be made strictly in accordance with the "Tamil Nadu Transparency in Tenders Act 1998 and Rules 2000 and no deviation will be made.

10.2. Notwithstanding anything that is said herein, the Tender Accepting Authority reserves the right to accept or reject any tender or all tenders, and to cancel the tendering process and reject all tenders, at any time prior to the award of tender, without thereby incurring any liability to the affected tenderer or tenderers or any obligation to inform

the affected tenderer or tenderers on the grounds for the tender accepting authority's action.

11. <u>**NOTIFICATION OF AWARD**</u>

11.1 The tenderer whose tender has been accepted will be notified by the Tender Accepting Authority, in writing.

11.2. Upon furnishing the security deposit by the successful tenderer or tenderers and upon signing the Agreement (Appendix-4), the EMD will be returned to the unsuccessful tenderer within a reasonable time period.

12. <u>**DISPUTES AND JURISDICTION**</u>:

Any legal disputes arising out of any breach of contract pertaining to this tender process shall be settled in the court of competent jurisdiction located within the **town of Chidambaram** in Tamil Nadu.

13. <u>**ACKNOWLEDGEMENT:**</u>

It is hereby acknowledged that we have gone through all the conditions mentioned above and we agree to abide by them.

Date: Signature of Tenderer

Place:

                                                                              Official seal and address

Appendix-1

APPLICATION FORM FOR SUPPLY OF FESEM with EDS EQUIPMENT

S.NO.	VENDOR DETAILS	
1	Name and Address of the Manufacturer/Firm/Vendor (with Telephone /fax/Mobile /email address)	
	Phone Number	
	Fax	
	E-Mail	
	Contact Person Name	
	Mobile Number	
2	Name and Address of the Local Authorized Dealer/Distributors/ Supplier	
	Phone Number	
	FAX	
	E-Mail	
	Contact Person Name	
	Mobile Number	
3	GST No / TIN No. of the Firm/Dealer (copy to be enclosed)	
4	PAN No. of the Dealer (Copy to be attached)	
5	EMD (DD No., Date & Amount and issuing Bank)	
6	Name of the University/ Government Institutes who have purchased similar equipments from your concern (attach copies)	

7. **Declaration by the tenderer.**

    i.)   We hereby declare that all the particulars given in this application are true and complete to the best of our knowledge and belief and we will produce all the relevant documents promptly, if necessary or as and when asked for by Annamalai University, Chidambaram. We understand that information provided by us will serve as Prequalification Criteria for supply of equipments under this tender and in the event of any information being found false or incorrect or ineligibility being detected even after the award of Contract, Our contract may be cancelled and all our claims may be forfeited by the Annamalai University, Annamalainagar. We have read and understood all the terms and conditions of the tender and we fully agree to it.

    ii.)   We also declare that we will not sell our products at a lesser price to other parties than those supplied to Annamalai University and in the event of happening of such situation, we will be bound to refund the difference and our contract may also be cancelled at the discretion of Annamalai University.

    iii.)   We also undertake that all the terms such as Product Range, Price, Discount, Delivery/other charges, Terms of Payment and also the name/s of the Dealer/ Distributor will remain unchanged during the contract period and no alteration will be done without the approval of Annamalai University.

Date :

Place :

Signature   :

Name   :

Designation   :

Seal of the firm :

Appendix – 2

TENDER FOR SUPPLY OF FESEM with EDS EQUIPMENT TO ANNAMALAI UNIVERSITY

LETTER OF TENDER

To

The Registrar,
Annamalai University,
Annamalai Nagar,
Chidambaram – 608 002.

Sir,

Sub: Tender for Supply of **FESEM with EDS** Equipment.
*****

1)   I / We, the undersigned do hereby tender and undertake to Supply of **FESEM with EDS** equipment to Annamalai University in strict accordance with and subject to the terms and conditions set forth or mentioned in the Tender documents and appendices.

2)   I / We have gone through the instructions in the tender and carefully read all the conditions of tender and agree to abide by all the conditions mentioned there in.

3)   I / We hereby state that I/we have remitted _____ (Rupees … … … … only) in the form of Demand Draft/Bankers Cheque No. _____ Dated : _____ drawn on _____ Bank _____ Branch, in favour of the Registrar, Annamalai University as Earnest Money Deposit and agree to have it forfeited to the Annamalai University in case of my / our failure to supply the equipment.

4)   I / We hereby certify that the price offered is final and I / We will not come forward for any revision or alteration in rates quoted subsequently due to hike in prices or any other reasons. However I/we are aware of the university's right to negotiate the discount rate while evaluating the tender.

5)   I / We confirm that our Tender is in conformity with the technical specifications and commercial terms & conditions as stipulated in the Tender Document and without any deviations whatsoever. I am / We are aware that our Tender is liable for disqualification in the event of technical and commercial deviations observed by the Tender Accepting Authority at a later date during the process of evaluation of our Tender.

6)   I / We further declare that the information and documents furnished in the Tender submitted by us are correct and genuine. I am / we are aware of the Tender

Inviting Authority's right to forfeit the Earnest Money Deposit and / or Security Deposit and blacklisting me / us if, any information furnished by us proved to be false at the time of inspection and not complying with the tender conditions.

7)   I / We state that I / We have not been blacklisted or debarred from participating in tenders by any Central / State Government agencies or autonomous bodies or universities / institutions.

8)   In the event of my / our tender becoming successful, I / We undertake and agree to forward to the Registrar, Annamalai University in ten (10) days, after the notification of the acceptance of this tender has been received by us.

9)   We undertake and agree that we will not withdraw this Tender during the period that will be required for intimation of acceptance or non-acceptance as stipulated in clause 10 of the Tender document. If I / we do so withdraw, I / we shall forfeit the Earnest Money Deposit to Annamalai University. I / We agree to execute at our cost the Agreement in ten (10) days after the notification of the acceptance of our Tender has been received by us. In the event of our failing to make the Security Deposit or to execute the Agreement in the said manner, the Earnest Money Deposit accompanying this Tender shall be forfeited to the Annamalai University and this concluded Contract shall in such case be considered as having been cancelled or terminated and I / we agree to be liable, irrespective of the forfeiture aforesaid for all damages, losses, costs, charges and expenses arising from or by reason of such failure and arrangements.

As witness our hand this..............day of...............of 2019.

Signature of the Tenderer   :

Name & Address   :

Company Seal   :

Appendix-3

PRICE BID

1	Price (Both in figure and words) in Rs.	
2	GST	%

		Amount in Rs.
	Total Amount in Rs.	

Important Note:

1. The price quoted above shall be inclusive of all taxes and charge except GST.
2. GST shall be mentioned separately.
3. FOR; Destination as given in the purchase order.

Other Information to be provided:

1.	Period of warranty in years (warranty starts after successful installation)
	Annual maintenance charges (applicable after warranty period)
2.	First year after warranty
3.	Second year after warranty
4.	Third year after warranty
5.	Fourth year after warranty
6.	Fifth year after warranty

Signature:

Name:

Designation:

Seal of the firm:

FORMAT OF CONTRACT AGREEMENT

THIS AGREEMENT made on the ………… day of ………….. 2019 between The Registrar, Annamalai University, Annamalainagar, Chidambaram – 608 002. (Herein after "the Purchaser") of the one part and ……………………………… (Name of Supplier) of …………..   (Address of the Supplier) (herein after called "the Supplier) of the other part:

WHEREAS the Purchaser is desirous of procuring _____ equipment as per the tender reference No………………….. and has accepted a bid by the Supplier for the above said equipment price offered by the Supplier is Rs._____(Rupees in words …)

NOW THIS AGREEMENT WITNESSETH AS FOLLOWS:

1. In this Agreement words and expressions shall have the same meanings as are respectively assigned to them in the Conditions of Tender referred to, and they shall be deemed to form and be read and construed as part of this agreement.

2. The following documents shall be deemed to form, be read and construed as part of this Agreement, viz;

   a) The letter of Acceptance issued by the purchaser.

   b) The Notice Inviting Tender.

   c) The supplier's bid including enclosures, appendixes, documents, Price Catalogue etc.

   d) The Tender Document including various Terms and Conditions.

   e) Any other document listed in the Tender document.

3. In consideration of the payments to be made by the Purchaser to the Supplier within thirty (30) days from the date of delivery and acceptance by concerned department/ section.

4. The warranty period is _____ years.

5. The AMC/SMC for the subsequent year after the warranty period will be as follows.

First year after warranty	
Second year after warranty	
Third year after warranty	
Fourth year after warranty	
Fifth year after warranty	

IN WITNESS whereof the parties here to have caused this Agreement to be executed in accordance with their respective laws the day and year first above written.

Signed, Sealed and Delivered by the Said .... (For the Purchaser) in the presence of ....

Signature

Name Address

Signed, Sealed and Delivered by the Said .... (For the Supplier) in the presence of ....

Signature

Name Address

Signed, Sealed and Delivered by the Said .... (For the Purchaser) in the presence of ....

Signature

Name Address

Field Emission Scanning Electron Microscope(FESEM) with EDS

The offered FESEM should be a computer controlled system with all the required hardware, software, accessories, standards and other consumables required for installation, commissioning, calibration of the unit at Annamalai University, Annamalainagar.

The quoted FESEM should able to image (high resolution- morphological, compositional) all kinds of materials suitable for Agriculture, biology, marine, dental, non-conducting (without conductive coating), metallurgy, conducting, semiconducting, metals, metal oxides, powders, nano composites, polymers and magnetic samples applications.

S.No	Description	Specification
1	Electron Gun	High stability Schottky Field emission electron source with a minimum guaranteed life for 3 years. Filament or its replacement must be provided for at least 3 years from the date of installation.
2	Resolution	i. 1 nm or better with SE detector (specify KV for resolution) 3 nm or better with BSE detector (specify KV for resolution) ii. NIST (National Institute of Standards and Technology) certified calibration sample to be provided for resolution. iii. The definition of resolution and the method used to determine the resolution should be clearly specified and resolution should be determined at the site of installation on standard sample at supplied accelerating voltage iv. The definition of resolution is based on average method
3	Magnification	10,00,000x or more, continuously varying
4	Accelerating Voltage	Variable from 0.2KV or less to 30 KV or more
5	Chamber	Chamber must accommodate a sample size of 100mm x 100mm or more with 8 or more accessory port
6	Probe current	10 PA(or less) to 100nA (or more), Better than 0.2% per hour Probe current setting must be fully automatic.
7	Detectors	i. In lens and chamber mounted SE detector (Everhart – Thornley) ii. In lens and chamber mounted BSE detector iii. EDS detector iv. CCD camera for in-chamber viewing v. Specimen current detector (SCD)
8	EDS	✓ Detector size: 30 mm^2 or more ✓ Resolution: 129 eV or better@ Mn Kα ✓ LN2 Free, Peltier cooled detector (SDD) ✓ Detection from B(5) to U(92) ✓ Supplied EDS server & analysis software should be capable of performing data acquisition storing and transfer in

		common windows based application formats, qualitative & quantitative analysis, line scanning, elemental or dot mapping including spectrum imaging and phase mapping with specimen drift correction. ✓ Standard sample for calibration should be provided.
9	Sample stage	i. 5 axis motorised stage: X= 100mm or more – fully motorized Y= 80 mm or more – fully motorized Z = 30 mm or more – fully motorized Tilt = -3̊ or less to +60̊ or more Rotation = 360̊ ii. Stage should be fully Eucentric or Compucentric iii. A standard specimen holder with labelled positions and positions are predefined in the UI for easy navigation. iv. The movement to be controlled through computer and manually by joystick or other similar mechanism. v. Multi sample holder for holding 5 or more sample stubs. Details should be indicated. vi. Wafer sample holders for gently holding semiconductor wafer sample perpendicularly to observe the wafer's cross section is essential. Details of the arrangement should be indicated.
10	Vacuum system	i. Suitable vacuum system should be completely automated having ion pump, TMP, oil free pre vacuum pump, pneumatic values etc.. ii. System should be compatible for FEG source against contamination during loading and unloading of the sample. Sufficient protection mechanism should be provided. iii. Suitable protection mechanism for FEG source on sudden failure of vacuum pump operation is required. iv. Evacuation time is not more than 5 minutes during specimen exchange. v. Operating Modes: High Vacuum, Low Vacuum etc..
11	Electron optics	i. Beam booster/ beam deceleration/ gentle beam unit may be included for high resolution imaging at low KV. ii. System should have appropriate electrostatic or electromagnetic or hybrid lens or equivalent lens assembly for high resolution (specify magnification with working distance) imaging of magnetic materials. iii. Technique to support simultaneous collection of SE & BSE from sample. iv. The system capable of high resolution imaging of biological (non-conductive) samples without coating may be preferred.

		v. All parts including apertures should be operated through computer controlled software.
12	Computer	✓ Compatible windows based latest configuration computer/workstation (2TB hard disk, 8GB or more RAM, front panel USB ports, CD/DVD recorder) with all its peripheral devices and add-on cards required for FESEM operation. ✓ Additional input slots for future usage. ✓ Most recent OS is preferred.
13	Display & Image processing	✓ High definition display system to view live images of different detectors simultaneously (24-inch HD LCD or LED Screen: 02 no.) ✓ Image size: 5120 X3840 pixel or better ✓ Image depth: up to 16 bits or better ✓ Image format: BMP, TIFF, JPEG, JPEG2000, GIF, PNG, etc. ✓ Software should be capable of automatic generation of report in MS-Office. MS-office to be provided. ✓ Image acquisition system should be compatible with Windows 7 or recent operating system version of windows. ✓ Operating conditions need to be stored.
14	Software	✓ Pre-loaded licensed software having all regular and advanced measurement functions based on latest windows OS with Customizable GUI. ✓ Software should reloaded or upgraded whenever required at free of cost during warranty and AMC period.
15	Sputter Coater System	✓ TMP based metal Sputtering unit ✓ Metal Target: Au or Pt or carbon to be provided, ✓ 1 set of additional/spare target to be provided.
16	Standard/calibration samples	Standard samples such as Co, Mn, Gold magnification standard Faraday cup, a brass duplex standard for BSD calibration, etc. should be provided for calibration. All other optional standard samples may also be quoted as optional items.
17	Sample holders and consumable	✓ Sample holders for wafers – 2 Nos. ✓ Cross section and tilted sample holders – 5 Nos. each of 45˚ and 90˚ ✓ Pin/regular stubs 1 inch – 50 numbers ✓ Conductive carbon adhesive tapes – 10 Nos.; ✓ Quote for additional FE - tips - 5 nos.
18	Essential Accessories	✓ IR Touch alarm safety detector for specimen stage and detectors ✓ Remote control hardware & network software for on line fault diagnosis using internet TCP / IP open protocols.

		✓ All essential commissioning and operating accessories like Air compressor, Chillers (noise and vibration free) etc, to be provided. Specify water requirements for chiller. ✓ Essential tool kit to be provided ✓ A suitable ISO-9001 certified make online UPS (15 KVA or more) for the whole system(including chiller and accessories) with 10 Hours or more backup on full load to be provided ✓ Colour Laser printer. ✓ Dehumidifier, ✓ Nitrogen cylinder, ✓ Additional PC for offline processing with 1TB (or more) storage and 8 GB RAM etc. along with its peripheral devices. ✓ Suitable generator for the effective running of FESEM and AC units. ✓ Three number of AC units having the capacity 2 ton or more
19	Optional accessory and future upgradability	✓ Plasma cleaner ✓ STEM detector ✓ In situ heating stage ✓ Any additional attachment can be quoted as an optional item.
20	Warranty and AMC	The system should be quoted with 5 years on-site comprehensive warranty including all parts (accessories and computer), consumables and labour. Further quote for next 5 years AMC (from 6th year onwards).
21	Spares	▪ Include all the spares + consumables required for operation during warranty period. List them separately ▪ The supplier should undertake the responsibility of spares for the next ten years after installation/discontinuation of the system/model
22	Installation and training	Onsite installation, demonstration of all specification quoted. Free of cost at site for minimum 10 working days for a group of scientists/technical staff/students for operating the instrument starting from basic to advanced applications with sample preparation techniques for different types of samples. Training programs may be periodically arranged.
23	Service facility in India	Supplier should clearly mention about their service set up in India for prompt service support along with number of service engineers specially trained on the offered system. Down-time call attendance should be within 48 hours under the period of warranty and annual maintenance. Breakdown period should not be counted as Warranty period and must be extended after the expiry of initial warranty period. Supplier should ensure a demo. lab or other sample analysing facility with similar/better model and analyse

		ANNAMALAI UNIVERSITY samples free of cost during instrumental breakdown.
24	Documents	A hard copy of operating manual, routine maintenance manual, attending procedures for routine problems, software back up, etc. need to be given.
25	Others	✓ If additional facilities (power, gas, earthing, etc.) required for running SEM, chiller, battery back up, etc. need to be mentioned clearly. ✓ Machine and associated humans should be protected from current, water leakage, vacuum, gas leakage, if any. Emergency switch is to be provided.
26	Pre-Installation requirement	▪ Pre-installation advice such as room, floor plan, size, electrical requirements should be sent immediately after the placement of the order. ▪ Necessary environmental requirements, i.e. temperature, humidity etc. during the operation (and unused hours) of FESEM & EDS should be specified clearly.

Mandatory

It is mandatory to get (test) the quality of the images of the samples (will be given by us). The testing process is to be done in the presence of end user or through skype or similar web based application.

Note:

✓ The supplier is responsible for complete installation, smooth operation, maintenance and comply of all warranty clauses for all the items ordered in this package. Eventhough order may be separate for different parts in the package, the supplier is responsible for all the items in the package. Supplier has to ensure that all the items quoted under the package must be new (Models must be released after 2015). Manufacturer has to give a certificate on the Model and the Year of the manufacture. Compatible spares must be available for 10 years after they stop manufacturing the equipment.

✓ Equipment may be shifted to another building within the campus after one to two year of installation. The equipment shifting should be free of cost.

✓ A quote may be given for an operator to be stationed at site for three years for smooth functioning of the system to serve a multi-user laboratory with breakdown below 5% of the instrument time (considering weekends too) and no down time is more than three continuous working days. The operator should not only be trained in operating but also know the installation requirements for smooth uninterrupted functioning of the FESEM. The expenses for such service are to be included in the quote. Operator may be diploma/BSc (or higher) qualified. He may be given 15 days holiday/year, other than Sundays. supplier should quote this on yearly basis. Salary (including annual hike) to the operator need to be mentioned.

- ✓ After complete installation, supplier should provide application demo. to the students, researchers, faculty members of various faculties of Annamalai University.
- ✓ The supplier should sponsor a two day workshop on Applications of FESEM.

MATLAB

The Language of Technical Computing

Millions of engineers and scientists worldwide use MATLAB® to analyze and design the systems and products transforming our world. MATLAB is in automobile active safety systems, interplanetary spacecraft, health monitoring devices, smart power grids, and LTE cellular networks. It is used for machine learning, signal processing, image processing, computer vision, communications, computational finance, control design, robotics, and much more.

Math. Graphics. Programming.

The MATLAB platform is optimized for solving engineering and scientific problems. The matrix-based MATLAB language is the world's most natural way to express computational mathematics. Built-in graphics make it easy to visualize and gain insights from data. A vast library of pre-built toolboxes lets you get started right away with algorithms essential to your domain. The desktop environment invites experimentation, exploration, and discovery. These MATLAB tools and capabilities are all rigorously tested and designed to work together.

Scale. Integrate. Deploy.

MATLAB helps you take your ideas beyond the desktop. You can run your analyses on larger data sets, and scale up to clusters and clouds. MATLAB code can be integrated with other languages, enabling you to deploy algorithms and applications within web, enterprise, and production systems.

Key Features
- High-level language for scientific and engineering computing
- Desktop environment tuned for iterative exploration, design, and problem-solving
- Graphics for visualizing data and tools for creating custom plots
- Apps for curve fitting, data classification, signal analysis, control system tuning, and many other tasks
- Add-on toolboxes for a wide range of engineering and scientific applications
- Tools for building applications with custom user interfaces
- Interfaces to C/C++, Java®, .NET, Python, SQL, Hadoop, and Microsoft® Excel®
- Royalty-free deployment options for sharing MATLAB programs with end users

Simulink
Simulation and Model-Based Design

Simulink® is a block diagram environment for multidomain simulation and Model-Based Design. It supports system-level design, simulation, automatic code generation, and continuous test and verification of embedded systems. Simulink provides a graphical editor, customizable block libraries, and solvers for modeling and simulating dynamic systems. It is integrated with MATLAB®, enabling you to incorporate MATLAB algorithms into models and export simulation results to MATLAB for further analysis.

Key Features
- Graphical editor for building and managing hierarchical block diagrams
- Libraries of predefined blocks for modeling continuous-time and discrete-time systems
- Simulation engine with fixed-step and variable-step ODE solvers
- Scopes and data displays for viewing simulation results
- Project and data management tools for managing model files and data
- Model analysis tools for refining model architecture and increasing simulation speed
- MATLAB Function block for importing MATLAB algorithms into models
- Legacy Code Tool for importing C and C++ code into models

Control System Toolbox

Design and analyze control systems

Control System Toolbox™ provides algorithms and apps for systematically analyzing, designing, and tuning linear control systems. You can specify your system as a transfer function, state-space, zero-pole-gain, or frequency-response model. Apps and functions, such as step response plot and Bode plot, let you analyze and visualize system behavior in the time and frequency domains.

You can tune compensator parameters using interactive techniques such as Bode loop shaping and the root locus method. The toolbox automatically tunes both SISO and MIMO compensators, including PID controllers. Compensators can include multiple tunable blocks spanning several feedback loops. You can tune gain-scheduled controllers and specify multiple tuning objectives, such as reference tracking, disturbance rejection, and stability margins. You can validate your design by verifying rise time, overshoot, settling time, gain and phase margins, and other requirements.

Key Features

- Transfer-function, state-space, zero-pole-gain, and frequency-response models of linear systems
- Step response, Nyquist plot, and other time-domain and frequency-domain tools for analyzing stability and performance
- Automatic tuning of PID, gain-scheduled, and arbitrary SISO and MIMO control systems
- Root locus, Bode diagrams, LQR, LQG, and other classical and state-space design techniques
- Model representation conversion, continuous-time model discretization, and low-order approximation of high- order systems

DSP System Toolbox Product Description

Design and simulate streaming signal processing systems

DSP System Toolbox™ provides algorithms, apps, and scopes for designing, simulating, and analyzing signal processing systems in MATLAB® and Simulink®. You can model real-time DSP systems for communications, radar, audio, medical devices, IoT, and other applications.

With DSP System Toolbox you can design and analyze FIR, IIR, multirate, multistage, and adaptive filters. You can stream signals from variables, data files, and network devices for system development and verification. The Time Scope, Spectrum Analyzer, and Logic Analyzer let you dynamically visualize and measure streaming signals. For desktop prototyping and deployment to embedded processors, including ARM® Cortex® architectures, the toolbox supports C/C++ code generation. It also supports bit-accurate fixed-point modeling and HDL code generation from filters, FFT, IFFT, and other algorithms.

Algorithms are available as MATLAB functions, System objects, and Simulink blocks.

Key Features

- Signal processing and linear algebra blocks for Simulink
- Streaming signal processing in MATLAB
- Single-rate, multirate, FIR, IIR, and adaptive filter design
- Time Scope, Spectrum Analyzer, and Logic Analyzer for visualizing and measuring streaming signals
- Fixed-point modeling and simulation of signal processing algorithms
- Support for C and C++ code generation
- Support for HDL code generation

Image Processing Toolbox

Perform image processing, analysis, and algorithm development

Image Processing Toolbox™ provides a comprehensive set of reference-standard algorithms and workflow apps for image processing, analysis, visualization, and algorithm development. You can perform image segmentation, image enhancement, noise reduction, geometric transformations, image registration, and 3D image processing.

Image Processing Toolbox apps let you automate common image processing workflows. You can interactively segment image data, compare image registration techniques, and batch-process large datasets. Visualization functions and apps let you explore images, 3D volumes, and videos; adjust contrast; create histograms; and manipulate regions of interest (ROIs).

You can accelerate your algorithms by running them on multicore processors and GPUs. Many toolbox functions support C/C++ code generation for desktop prototyping and embedded vision system deployment.

Key Features

- Image analysis, including segmentation, morphology, statistics, and measurement
- Apps for image region analysis, image batch processing, and image registration
- 3D image processing workflows, including visualization and segmentation
- Image enhancement, filtering, geometric transformations, and deblurring algorithms
- Intensity-based and non-rigid image registration methods
- Support for CUDA enabled NVIDIA GPUs (with Parallel Computing Toolbox™)
- C-code generation support for desktop prototyping and embedded vision system deployment

Optimization Toolbox

Solve linear, quadratic, integer, and nonlinear optimization problems

Optimization Toolbox™ provides functions for finding parameters that minimize or maximize objectives while satisfying constraints. The toolbox includes solvers for linear programming (LP), mixed-integer linear programming (MILP), quadratic programming (QP), nonlinear programming (NLP), constrained linear least squares, nonlinear least squares, and nonlinear equations. You can define your optimization problem with functions and matrices or by specifying variable expressions that reflect the underlying mathematics.

You can use the toolbox solvers to find optimal solutions to continuous and discrete problems, perform tradeoff analyses, and incorporate optimization methods into algorithms and applications. The toolbox lets you perform design optimization tasks, including parameter estimation, component selection, and parameter tuning. It can be used to find optimal solutions in applications such as portfolio optimization, resource allocation, and production planning and scheduling.

Key Features

- Nonlinear and multiobjective optimization of smooth constrained and unconstrained problems
- Solvers for nonlinear least squares, constrained linear least squares, data fitting, and nonlinear equations
- Quadratic programming (QP) and linear programming (LP)
- Mixed-integer linear programming (MILP)
- Optimization modeling tools
- Graphical monitoring of optimization progress
- Gradient estimation acceleration (with Parallel Computing Toolbox™)

Parallel Computing Toolbox

Perform parallel computations on multicore computers, GPUs, and computer clusters

Parallel Computing Toolbox™ lets you solve computationally and data-intensive problems using multicore processors, GPUs, and computer clusters. High-level constructs—parallel for-loops, special array types, and parallelized numerical algorithms—let you parallelize MATLAB® applications without CUDA or MPI programming. You can use the toolbox with Simulink® to run multiple simulations of a model in parallel.

The toolbox lets you use the full processing power of multicore desktops by executing applications on workers (MATLAB computational engines) that run locally. Without changing the code, you can run the same applications on a computer cluster or a grid computing service (using MATLAB Distributed Computing Server™). You can run parallel applications interactively or in batch.

Key Features

- Parallel for-loops (parfor) for running task-parallel algorithms on multiple processors
- Support for CUDA enabled NVIDIA GPUs
- Full use of multicore processors on the desktop via workers that run locally
- Computer cluster and grid support (with MATLAB Distributed Computing Server)
- Interactive and batch execution of parallel applications
- Distributed arrays and spmd (single-program-multiple-data) for large dataset handling and data-parallel algorithms

Signal Processing Toolbox

Perform signal processing and analysis

Signal Processing Toolbox™ provides functions and apps to analyze, preprocess, and extract features from uniformly and nonuniformly sampled signals. The toolbox includes tools for filter design and analysis, resampling, smoothing, detrending, and power spectrum estimation. The toolbox also provides functionality for extracting features like changepoints and envelopes, finding peaks and signal patterns, quantifying signal similarities, and performing measurements such as SNR and distortion. You can also perform modal and order analysis of vibration signals.

With the Signal Analyzerapp you can preprocess and analyze multiple signals simultaneously in time, frequency, and time-frequency domains without writing code; explore long signals; and extract regions of interest. With the Filter Designer app you can design and analyze digital filters by choosing from a variety of algorithms and responses. Both apps generate MATLAB® code.

Key Features

- Signal Analyzer App for visualizing and comparing signals simultaneously in time, frequency, and time- frequency domains
- FIR and IIR filter design and analysis
- Algorithms for finding signal similarities, envelopes, patterns, changepoints, peaks, and outliers
- Measurements such as transition and pulse metrics, band power, bandwidth, and distortion
- Power spectrum estimation of uniformly and nonuniformly sampled data
- Order analysis of vibration signals and modal analysis of mechanical systems

Deep Learning Toolbox

Create, analyze, and train deep learning networks

Deep Learning Toolbox™ provides a framework for designing and implementing deep neural networks with algorithms, pretrained models, and apps. You can use convolutional neural networks (ConvNets, CNNs) and long short-term memory (LSTM) networks to perform classification and regression on image, time-series, and text data. Apps and plots help you visualize activations, edit network architectures, and monitor training progress.

For small training sets, you can perform transfer learning with pretrained deep network models (including SqueezeNet, Inception-v3, ResNet-101, GoogLeNet, and VGG-19) and models imported from TensorFlow®-Keras and Caffe.

To speed up training on large datasets, you can distribute computations and data across multicore processors and GPUs on the desktop (with Parallel Computing Toolbox™), or scale up to clusters and clouds, including Amazon EC2® P2, P3, and G3 GPU instances (with MATLAB® Distributed Computing Server™).

Key Features

- Convolutional neural network (CNN), long short-term memory (LSTM), and directed acyclic graph (DAG) network topologies
- Transfer learning with pretrained models and models imported from TensorFlow-Keras and Caffe
- Import and export of ONNX™ models for interoperability with other deep learning frameworks
- App for graphically designing and analyzing network architectures
- Training and inference with CPUs and GPUs on desktops, clusters, and clouds (including Amazon EC2 P2, P3, and G3 GPU instances)
- Unsupervised learning algorithms for shallow networks, including self-organizing maps and competitive layers
- Supervised learning algorithms for shallow networks, including multilayer, radial basis, learning vector quantization (LVQ), time-delay, and nonlinear autoregressive (NARX)

Fuzzy Logic Toolbox

Design and simulate fuzzy logic systems

Fuzzy Logic Toolbox™ provides MATLAB® functions, apps, and a Simulink® block for analyzing, designing, and simulating systems based on fuzzy logic. The product guides you through the steps of designing fuzzy inference systems. Functions are provided for many common methods, including fuzzy clustering and adaptive neurofuzzy learning.

The toolbox lets you model complex system behaviors using simple logic rules, and then implement these rules in a fuzzy inference system. You can use it as a stand-alone fuzzy inference engine. Alternatively, you can use fuzzy inference blocks in Simulink and simulate the fuzzy systems within a comprehensive model of the entire dynamic system.

Key Features

- Fuzzy Logic Design app for building fuzzy inference systems and viewing and analyzing results
- Membership functions for creating fuzzy inference systems
- Support for AND, OR, and NOT logic in user-defined rules
- Standard Mamdani and Sugeno-type fuzzy inference systems
- Automated membership function shaping through neuroadaptive and fuzzy clustering learning techniques
- Ability to embed a fuzzy inference system in a Simulink model
- Ability to generate embeddable C code or stand-alone executable fuzzy inference engines

Audio System Toolbox™

Design and test audio processing systems

Audio System Toolbox™ provides algorithms and tools for the design, simulation, and desktop prototyping of audio processing systems. It enables low-latency signal streaming from and to audio interfaces, interactive parameter tuning, and automatic generation of audio plugins for digital audio workstations.

Audio System Toolbox includes libraries of audio processing algorithms (such as filtering, equalization, dynamic range control, and reverberation), sources (such as audio oscillators and wavetable synthesizers), and measurements (such as A- and C-weighting). Interfaces to external MIDI controls and low-latency audio drivers such as ASIO™, ALSA, and CoreAudio enable you

to validate multichannel audio designs in MATLAB® or Simulink®. You can generate VST plugins from MATLAB code. For simulation acceleration or desktop prototyping, the toolbox supports C/C++ code generation.

Algorithms are available as MATLAB functions, System objects, and Simulink blocks.

Key Features

- VST plugin generation for digital audio workstations
- Interfaces to ASIO, ALSA, CoreAudio, and other low-latency audio drivers
- Interfaces to MIDI controls for real-time tuning of MATLAB and Simulink simulations
- Audio processing algorithms, sources, and measurements for crossover and equalization filtering, dynamic range control, reverberation, wavetable synthesis, and other tasks
- Support for C code generation

Communications Toolbox™

Design and simulate the physical layer of communications systems

Communications Toolbox™ provides algorithms and apps for the analysis, design, end-to-end simulation, and verification of communications systems. Toolbox algorithms including channel coding, modulation, MIMO, and OFDM enable you to compose and simulate a physical layer model of your standard-based or custom-designed wireless communications system.

The toolbox provides a waveform generator app, constellation and eye diagrams, bit-error-rate, and other analysis tools and scopes for validating your designs. These tools enable you to generate and analyze signals, visualize channel characteristics, and obtain performance metrics such as error vector magnitude (EVM). The toolbox includes statistical and spatial channel models, including Rayleigh, Rician MIMO, and WINNER II. It also includes RF impairments, including RF nonlinearity and carrier offset and compensation algorithms, including carrier and symbol timing synchronizers. These algorithms enable you to realistically model link-level specifications and compensate for the effects of channel degradations.

Using Communications Toolbox with RF instruments or hardware support packages, you can connect your transmitter and receiver models to radio devices and verify your designs with over-the-air testing.

Key Features

- Algorithms for designing the physical layer of standard-based or custom-designed communications systems
- Waveform Generator app and analysis tools and measurement scopes, including a bit-error-rate app, constellation diagrams, and eye diagrams
- Channel models, including AWGN, multipath Rayleigh fading, Rician fading, MIMO multipath fading, and WINNER II spatial
- RF impairment models, including nonlinearity, phase noise, I/Q imbalance, thermal noise, and phase and frequency offsets
- Receiver components, including AGC, I/Q imbalance correction, DC blocking, and timing and carrier synchronization
- Hardware support packages for connecting waveforms to radio devices and verifying designs with over-the-air testing
- GPU-enabled algorithms for computationally intensive algorithms such as Turbo, LDPC, and Viterbi decoders

Wavelet Toolbox

Analyze and synthesize signals and images using wavelets

Wavelet Toolbox™ provides functions and apps for analyzing and synthesizing signals and images. The toolbox includes algorithms for continuous wavelet analysis, wavelet coherence, synchrosqueezing, and data-adaptive time-frequency analysis. The toolbox also includes apps and functions for decimated and nondecimated discrete wavelet analysis of signals and images, including wavelet packets and dual-tree transforms.

Using continuous wavelet analysis, you can study the way spectral features evolve over time, identify common time- varying patterns in two signals, and perform time-localized filtering. Using discrete wavelet analysis, you can analyze signals and images at different resolutions to detect changepoints, discontinuities, and other events not readily visible in raw data. You can compare signal statistics on multiple scales, and perform fractal analysis of data to reveal hidden patterns.

With Wavelet Toolbox you can obtain a sparse representation of data, useful for denoising or compressing the data while preserving important features. Many toolbox functions support C/C++ code generation for desktop prototyping and embedded system deployment.

Key Features

- Time-frequency analysis using continuous wavelet transform, wavelet coherence, constant-Q transform, empirical mode decomposition, and Hilbert-Huang transform
- Wavelet Signal Denoiser app for denoising time-series data
- Decimated wavelet packet and wavelet transforms, including wavelet leaders for fractal analysis
- Nondecimated techniques, including dual-tree, stationary wavelet, maximal overlap discrete wavelet, and wavelet packet transforms
- Signal, image denoising, and compression, including matching pursuit
- Lifting method for constructing custom wavelets

RF Toolbox

Design, model, and analyze networks of RF components

RF Toolbox™ provides functions, objects, and apps for designing, modeling, analyzing, and visualizing networks of radio frequency (RF) components. You can use RF Toolbox for wireless communications, radar, and signal integrity projects.

With RF Toolbox you can build networks of RF components such as filters, transmission lines, amplifiers, and mixers. Components can be specified using measurement data, network parameters, or physical properties. You can calculate S-parameters, convert among S, Y, Z, ABCD, h, g, and T network parameters, and visualize RF data using rectangular and polar plots and Smith® Charts.

The RF Budget Analyzer app lets you analyze transmitters and receivers in terms of noise figure, gain, and IP3. You can generate RF Blockset™ testbenches and validate analytical results against circuit envelope simulations.

Using the rational function fitting method, you can build models of backplanes and interconnects, and export them as Simulink® blocks or as Verilog-A modules for SerDes design.

RF Toolbox provides functions to manipulate and automate RF measurement data analysis, including de-embedding, enforcing passivity, and computing group delay.

Key Features

- RF filters, transmission lines, amplifiers, and mixers specified by measurement data, network parameters, or physical properties
- S-parameter calculation for RF component networks

- RF Budget Analyzer app for calculating noise figure, gain, and IP3 of RF transceivers and for generating RF Blocksettestbenches
- Rational function fitting method for building models and exporting them as Simulink blocks or Verilog-A modules
- De-embedding of N-port S-parameters measurement data
- Conversion among S, Y, Z, ABCD, h, g, and T network parameters
- RF data visualization using rectangular and polar plots and Smith Charts

Antenna Toolbox™

Design, analyze, and visualize antenna elements and antenna arrays

Antenna Toolbox™ provides functions and apps for the design, analysis, and visualization of antenna elements and arrays. You can design standalone antennas and build arrays of antennas using either predefined elements with parameterized geometry or arbitrary planar elements.

Antenna Toolbox uses the method of moments (MoM) to compute port properties such as impedance, surface properties such as current and charge distribution, and field properties such as the near-field and far-field radiation pattern. You can visualize antenna geometry and analysis results in 2D and 3D.

You can integrate antennas and arrays into wireless systems, and use impedance analysis to design matching networks. Antenna Toolbox provides radiation patterns for simulating beam forming and beam steering algorithms. You can generate Gerber files from your design for manufacturing printed circuit board (PCB) antennas.

Key Features

- Rapid design and visualization of antennas using predefined or custom elements
- Design of arbitrary printed structures (PCB), and Gerber file generation for antenna manufacturing
- Design of linear, rectangular, conformal, and custom antenna arrays
- Large array analysis using the infinite array or embedded element pattern approach
- Port analysis of impedance, return loss, and S-parameters of antennas and antenna arrays
- Radiation field analysis of the pattern, E-H fields, and beam width of antennas, antenna arrays, and custom data
- Surface analysis of antenna and antenna array current, charge, and meshing

MATLAB Coder

Generate C and C++ code from MATLAB code

MATLAB® Coder™ generates readable and portable C and C++ code from MATLAB code. It supports most of the MATLAB language and a wide range of toolboxes. You can integrate the generated code into your projects as source code, static libraries, or dynamic libraries. You can also use the generated code within the MATLAB environment to accelerate computationally intensive portions of your MATLAB code. MATLAB Coder lets you incorporate legacy C code into your MATLAB algorithm and into the generated code.

By using MATLAB Coder with Embedded Coder®, you can further optimize code efficiency and customize the generated code. You can then verify the numerical behavior of the generated code using software-in-the-loop (SIL) and processor- in-the-loop (PIL) execution.

Key Features

- ANSI®/ISO® compliant C and C++ code generation
- Code generation support for toolboxes including Communications Toolbox™, Computer Vision System Toolbox™, DSP System Toolbox™, Image Processing Toolbox™, and

Signal Processing Toolbox™
- MEX function generation for code verification and acceleration
- Legacy C code integration into MATLAB algorithms and generated code
- Multicore-capable code generation using OpenMP
- Static or dynamic memory-allocation control
- App and equivalent command-line functions for managing code generation projects

HDL Coder

Generate VHDL and Verilog code for FPGA and ASIC designs

HDL Coder™ generates portable, synthesizable VHDL® and Verilog® code from MATLAB® functions, Simulink® models, and Stateflow® charts. The generated HDL code can be used for FPGA programming or ASIC prototyping and design.

HDL Coder provides a workflow advisor that automates the programming of Xilinx®, Microsemi®, and Intel® FPGAs. You can control HDL architecture and implementation, highlight critical paths, and generate hardware resource utilization estimates. HDL Coder provides traceability between your Simulink model and the generated Verilog and VHDL code, enabling code verification for high-integrity applications adhering to DO-254 and other standards.

Key Features

- Target-independent, synthesizable VHDL and Verilog code
- Code generation support for MATLAB functions, System objects and Simulink blocks
- Mealy and Moore finLte-state machines and control logic implementations using Stateflow
- Workflow advisor for programming Xilinx, Microsemi, and Intel application boards
- Resource sharing and retiming for area-speed tradeoffs
- Code-to-model and model-to-code traceability for DO-254
- Legacy code integration

Filter Design HDL Coder

Generate HDL code for fixed-point filters

Filter Design HDL Coder™ generates synthesizable, portable VHDL® and Verilog® code for implementing fixed-point filters designed with MATLAB® on FPGAs or ASICs. It automatically creates VHDL and Verilog test benches for simulating, testing, and verifying the generated code.

Key Features

- Generation of synthesizable IEEE® 1076 compliant VHDL code and IEEE 1364-2001 compliant Verilog code
- Control over generated code content, optimization, and style
- Distributed arithmetic and other options for speed vs. area tradeoff and architecture exploration
- VHDL and Verilog test-bench generation for quick verification and validation of generated HDL filter code
- Simulation and synthesis script generation

Fixed-Point Designer

Design, simulate, and analyze fixed-point systems

Fixed-Point Designer™ provides data types and tools for developing fixed-point and single-precision algorithms to optimize performance on embedded hardware. Fixed-Point Designer analyzes your design and proposes data types and attributes such as word length and scaling. You

can specify detailed data attributes such as rounding mode and overflow action, and mix single-precision and fixed-point data. You can perform bit-true simulations to observe the impact of limited range and precision without implementing the design on hardware.

Fixed-Point Designer lets you convert double-precision algorithms to single precision or fixed point. You can create and optimize data types that meet numerical accuracy requirements and target hardware constraints. You can determine the range requirements of your design via mathematical analysis or instrumented simulation. Fixed-Point Designer provides apps and tools that guide you through the data conversion process and enable you to compare fixed-point results with floating-point baselines.

Fixed-Point Designer supports C, HDL, and PLC code generation.

Key Features

- Fixed-point data type specification in MATLAB®, Simulink®, and Stateflow®
- Bit-true simulation of fixed-point and single-precision algorithms
- Histograms and related tools for exploring and optimizing data types
- Apps for converting from doubles to fixed point or single precision
- Instrumentation for collecting simulation min and max values
- Range analysis for assessing full design min and max values
- Overflow detection and precision loss tools for debugging and visualization