ROBOTICS IN STEM

FUN, ENGAGING & SKILLING

ENABLES LIFE - SKILLS LIKE COMMUNICATION, TEAMWORK

CONNECTS TECHNOLOGY TO SCIENCE

TABLE OF CONTENTS

1. Robotics in STEM: Summary of Bill of Material

Category	Type	Scope of Supply & Services	Item
Supply	Hardware	Robotics in STEM Kit:	Mini Robot
			Mini Robot (Project)
			Robot Application Kit for Technology
			Robot Application Kit for Engineering
			Robot Application Kit for Science & Maths
Supply	Software	Robotics in STEM Software	M-Robot
			AristoSIM
Supply	Courseware	Courseware: Interactive eLearning licenses	STEM Courseware
Supply	Courseware	Courseware: PDF Books	STEM Courseware
Services	Services	Commissioning & Demonstration	
Services	Services	Warranty	
Services	Services	Mentoring & Monitoring	
Services	Training	Train the Teachers	
Services	Services	Workshop and Competitions	

Robotics in STEM					
Sno	**Item**	**Sub Item**	**Description**	**Qty**	**UoM**
1	Mini Robot	Robot	5 axes miniature industrial robot in a fully assembled condition	1	No
		Controller	Robot controller	1	No
		Control Software	Robot programming and control software. PC is not included for this	1	License
		User Manual	User manual will be supplied on how to program and use the robot	1	PDF Doc
		General Manual	General operating manual along with details of the product and essential drawings	1	PDF Doc
2	Mini Robot (Project)	Robot Mechanical Sub Assembly	The 5 links of the robot will be supplied in different stages of sub- assembly	1	Set
		Robot Electrical Parts	Electrical parts such as motors and gripper for the assembly	1	Set
		Robot Connectors	Electrical connectors and insulation required for assembly of robot	1	No
		Controller	Robot controller	1	No
		Control Software	Robot programming and control software. PC is not included for this	1	License
		User Manual	User manual will be supplied on how to program and use the robot	1	PDF Doc

		General Manual	General operating manual along with details of the product and essential drawings	1	PDF Doc
		Assembly Manual	This will be supplied as part of the application projects under STEM	1	PDF Doc
3	M-Robot	Software	Robot Programming Software	10	License
4	AristoSIM	Software	Robot application software	10	License
5	Robot Application Kit for Technology	Base Plate	In an assembled & ready to use condition	1	Set
		Pick & Place			
		Palletizing			
		Drawing			
		Writing			
		Mobile Robot			
		Motors & Operation			
		Line Tracer			
		Circuit Design - PCB			
		Circuit Design - Bread Board			

Robotics in STEM					
Sno	**Item**	**Sub Item**	**Description**	**Qty**	**UoM**
6	Robot Application Kit for Engineering	Base Plate	To be assembled	1	Set
		Pick & Place	To be assembled		
		Palletizing	To be assembled		
		Drawing	To be assembled		
		Writing	To be assembled		
		Mobile Robot	To be assembled		
		Motors & Operation	To be assembled		
		Line Tracer	To be assembled		
		Circuit Design - PCB	To be assembled		
		Circuit Design - Bread Board	To be assembled		
7	Robot Application Kit for Science & Maths	Maths Concepts	As relevant for Class 8-12	1	Set
		Physics concepts	As relevant for Class 8-12		
8	STEM Courseware	Science for Class 8	ELearning / PDF Book Course material (Perpetual licenses) will be delivered with the delivery of the product.	10	License
		Technology for Class 8		10	License
		Mathematics for Class 8		10	License
		Science for Class 9		10	License
		Technology for Class 9		10	License
		Engineering for Class 9		10	License
		Mathematics for Class 9		10	License
		Science for Class 10		10	License

		Technology for Class 10		10	License
		Engineering for Class 10		10	License
		Mathematics for Class 10		10	License
		Science for Class 11		10	License
		Technology for Class 11		10	License
		Engineering for Class 11		10	License
		Mathematics for Class 11		10	License
		Science for Class 12		10	License
		Technology for Class 12		10	License
		Engineering for Class 12		10	License
		Mathematics for Class 12		10	License

2. Scope Of MTC Services

MTC shall provide the following services along with the STEM labs proposed in this document in order to enhance the student engagement with the program and the delivery of skills by faculty to the students. The services are defined in this section.

2.1. Train The Trainer

The teachers will be trained on the STEM labs. The training will cover the STEM curriculum offered by MTC and training on the usage of the kits. Each training will be for duration of 5 days at a centralized location. The number of teachers from each school is limited to: 2 teachers from Science, 2 from Mathematics and 1 from Computer Science.

2.2. Mentoring The Trainers

For every 10 schools, one mentor will be provided (to be firmed up based on mutual discussion, considering factors like distance, transportation etc.,) for continuous support to the teaching faculty at the schools. The mentor will spend maximum of 2 working days (in a month) at each school throughout the warranty period. The role of the mentor is to act as a facilitator and guide for the teachers to implement the STEM curriculum.

2.3. Workshops And Competition

MTC shall assist in conducting workshops and competitions via the mentors. This segment covers details about how these events should be planned and scheduled. One customer event coordinator must be assigned for each workshop. One workshop and competition will be conducted for every 15 schools (need to be discussed and firmed up). MTC Scope of work is limited to the following:

- The maximum Number of student participation in each project is limited to five.
- There are two levels of participation: Level1 (Class 8,9,10) & Level2 (Class 11 & 12)
- Marketing Material: Art work for posters and banner will be given by MTC.
- The layout of the workshop will be given by MTC along with the program schedule. The customer has to coordinate with the workshop school for arranging the same.
- Location and Layout
- Local arrangement must be taken care by the school management (recurring expense)
- MTC will capture the event (as photographs) and will offer you the digital USB after the date of the event along with a report.
- Prize Category: Each level of project will be awarded as Winner and Runner up prize. Along with the prize certificates for each winning student will be given.
- Certificates to all the participating schools will be given.
- Security to the event: Safety aspects must be taking care by the customer.
- No. of Participants: 75 – 100
- No. of Visitor – Approximately 1000 nos. Customer should arrange for the facilities to manage the visitors.

Selection and Evaluation of Projects displayed at the event: A PowerPoint presentation and a write up of the project (limited up to 250 words) must be submitted by the participating school. The selection process of the winner is done by MTC. The submission date will be given in the Artwork.

Selection criteria:

- Innovative and creative thinking
- Team work
- Application of technology/ concept relevance to the real world

3. Scope Of The Customer

3.1. Technical Scope

- The equipment shall be kept in the Computer Science lab
- Power supply with proper earthing
- Personal Computer (10 no's with LAN internet connection) with technical specifications as per Bill of Materials. The same is also listed below.
- Teacher's computer should have internet connection
- Table for keeping the robot (2 no's)
- Projector for presentation
- License key (dongle) for accessing the software
- Internet connection is allowed only for teachers

Desktop computer on network as per the below specifications:

- Operating System : Windows 7 Professional or higher, Two free USB ports
- Processor: Intel 2,8 GHz or higher, RAM : at least 4 GB, 1 DVD Drive for software installation
- Graphic Card : NVIDIA GeForce at least 1 GB or equivalent, Recommended: 19" TFT Mon

Power Supply: Stable power supply is required as mentioned in the robot specifications.

3.2. Administrative Scope

- List of schools to be given along with the Purchase Order as per **Annexure 1**
  - The school should be selected that the requirement of the technical scope is met by the school
- Sensitization and information to the selected schools to be done within 2 weeks of Purchase Order release
- During Train the Teachers Program:
  - The customer has to submit the details of the teachers who have to be trained as per the format given in **Annexure 2.**
  - The customer has to organise for the teachers to come to the centralised training location (host School).
  - Any and all expense that will be incurred by the teachers or the host schools for the training has to be borne by the customer.
  - Refreshment to be provided during the training. (Two tea breaks and one lunch)
  - Training Timing: 9AM till 4 PM
  - The host school should be equipped with the following training facilities :
    - Projector
    - White Board with ink pens
    - Computer lab with 15 -20 computers
    - Stable power supply and earthing should be available during training
- Workshop and Competition: MTC will give the number of workshops and competitions it will conduct during the period of 1 year. Example : For 150 schools MTC will conduct 10 workshops and competitions. In order to facilitate this event, the customer should
  - Select the Venue and give it along with the purchase order. Refer **Annexure 3** for format. The venue has to be from one of the schools where the supply will be made. Two schools from the district cannot be selected. The school selected to host the

competition is known as the “Workshop School.” The Workshop School should have the infrastructure of a large assembly hall which can accommodate a display of total 30 projects. One school from a group of five adjacent districts must be selected.

- Invitation of the Chief Guest should be done by the Workshop School. Mementos for the visiting dignitaries should be arranged.
- 15 Schools will participate in the event including the Workshop School. Maximum of 2 project per school will be allowed for display. For each participating school, One teacher along with two student per project will be allowed for the competition.
- Participating Schools will select the two project and the teams that they wish to display at the event.
- The workshop is a day event : From 11 AM till 3 PM (we can work on mutual time)
- Any and all expense that will be incurred by the teachers, students & the Workshop schools for the event has to be borne by the customer.
- Refreshments to be provided (for the dignitaries, participants and support personnel involved in the workshop) during the Event and the same will be in the scope of the Workshop School. (Two tea breaks and one lunch)
- Workshop School should take care of facilities such as lighting requirements, fans, installation of speakers, PA system, number of mike etc.,
- Artwork given by MTC should be printed and displayed in the event and distributed across the region and schools by the customer. Artwork will be given for posters and banners.
- The customer should market the event to all the schools under school education coming under their district. Advertisement of the event has to done by the customer.
- Promotion of the event, Media coverage, Photography and video to be taken care by the Customer.
- Any and all Statutory permission required for conducting this event is to be obtained by the customer
- Safety norms should be followed and ensured as per the Government regulation.

4. Bill of Material: Minirobot

4.1. Robot

Minirobot is a miniature scale down model of a 5 axes industrial robot. This modular table-top 5 axis articulated robot consists of light-medium duty stepper motors for all joint actuation as a special feature the gripper is driven by a RC servo motor. The controller consists of easy pluggable type cable for swift interfacing and online programming thru' dedicated application for various applications control.

Training and control of an articulated robot for broad rationale applications or special purpose application thru Jog (Teach method) as well as Auto mode control for Fatigue tasks.

This robot is offered with a series of application kits and courseware that is meant for delivering skills related to STEM Labs. In the following pages, the different aspects of the Robotics in STEM Lab solution will be detailed out.

4.2. CONTROLLER

The robot controller offered is a compact and mobile controller that is east to install and connect. The controller has been built on international safety standards and each component used has been selected to meet these standards.

		Metric Units		SAE Units
Controller		PC based Stepper Control algorithm		PC based Stepper Control algorithm
Control Software		Specially developed Robot Programming Language.		Specially developed Robot Programming Language
Path Type		Point-to-Point		Point-to-Point
Communication		PC USB Port		PC USB Port
Accessories & Input/output		8 digital Inputs/Outputs		8 digital Inputs/Outputs
Power supply		110V/ 230V AC, 50/60 Hz, 5A		110V/ 230V AC, 50/60 Hz, 5A
Repeatability	mm	1	in	0.04
Resolution	mm	1	in	0.04
Weight of Robot Controller	kg	4 without control box	lbs	8.8

4.3. Control Software

The control software is M-Robot. M-Robot is user-friendly 3D software for robot programming. This software gives the flexibility to design your applications and import them into the 3D software for simulation. Ready-made applications are available to train the user in the operations of the robot such as movement, programming and code generation. M-Robot has graphics which enable you to visualize the robot from various angles as the robot moves in the simulated application. It allows you to watch your code at work. Thus, finalizing your program for operation and protecting the robot from accidents. Once your programs are ready and verified in an offline and online Software, the students can use it in the online mode to work the robot.

4.4. User Manual

User manual is given in the PDF format. The user manual comprises of how to use the robot, programming of the robot.

4.5. General Manual

General manual is given in the PDF format. The manual comprises of general Dos and Don'ts of the product along with generic information about the product.

5. Bill of Material: Minirobot (Project)

5.1. Robot

Minirobot is a miniature scale down model of a 5 axes industrial robot. This modular table-top 5 axis articulated robot consists of light-medium duty stepper motors for all joint actuation as a special feature the gripper is driven by a RC servo motor. The controller consists of easy pluggable type cable for swift interfacing and online programming thru' dedicated application for various applications control.

The robot is supplied in a dis-assembled condition as separate joints. The primary purpose of this is to learn skills on assembly, electronics and programming.

Training and control of an articulated robot for broad rationale applications or special purpose application thru Jog (Teach method) as well as Auto mode control for Fatigue tasks.

This robot is offered with a series of application kits and courseware that is meant for delivering skills related to STEM Labs. In the following pages, the different aspects of the Robotics in STEM Lab solution will be detailed out.

5.2. CONTROLLER

The robot controller offered is a compact and mobile controller that is east to install and connect. The controller has been built on international safety standards and each component used has been selected to meet these standards. Here again the controller is supplied in a dis-assembled condition. Connectors, motors etc. are supplied and the exercises are focussed around building, assembling the robot controller

		Metric Units		SAE Units
Controller		PC based Stepper Control algorithm		PC based Stepper Control algorithm
Control Software		Specially developed Robot Programming Language.		Specially developed Robot Programming Language
Path Type		Point-to-Point		Point-to-Point
Communication		PC USB Port		PC USB Port
Accessories & Input/output		8 digital Inputs/Outputs		8 digital Inputs/Outputs
Power supply		110V/ 230V AC, 50/60 Hz, 5A		110V/ 230V AC, 50/60 Hz, 5A
Repeatability	mm	1	in	0.04
Resolution	mm	1	in	0.04
Weight of Robot Controller	kg	4 without control box	lbs	8.8

5.3. CONTROL SOFTWARE

The control software is M-Robot. M-Robot is user-friendly 3D software for robot programming. This software gives the flexibility to design your applications and import them into the 3D software for simulation. Ready-made applications are available to train the user in the operations of the robot such as movement, programming and code generation. M-Robot has graphics which enable you to visualize the robot from various angles as the robot moves in the simulated application. It allows you to watch your code at work. Thus, finalizing your program for operation and protecting the robot from accidents. Once your programs are ready and verified in an offline and online Software, the students can use it in the online mode to work the robot.

5.4. USER MANUAL

User manual is given in the PDF format. The user manual comprises of how to use the robot, programming of the robot.

5.5. GENERAL MANUAL

General manual is given in the PDF format. The manual comprises of general Dos and Don'ts of the product along with generic information about the product.

5.6. ASSEMBLY MANUAL

The assembly manual is supplied with details on how to assemble the different parts of the robot and the required connectivity details etc. This is to be used as a reference for the teacher. The exercises to build the robot and the different projects focused around the robot construction are detailed in the courseware.

6. BILL OF MATERIAL: M-ROBOT

INTRODUCTION

M-Robot is user-friendly 3D software for robot programming. This software gives the flexibility to design your applications and import them into the 3D software for simulation. Ready-made applications are available to train the user in the operations of the robot such as movement, programming and code generation. M-Robot has graphics which enable you to visualize the robot from various angles as the robot moves in the simulated application. It allows you to watch your code at work. Thus, finalizing your program for operation and protecting the robot from accidents.

OBJECTIVES

Learn and Control an articulated robot for broad applications or special purpose application through robot control functions, and through online and offline programming.

Once your programs are ready and verified in an offline and online Software, the students can use it in the online mode to work the robot.

M-Robot is 3D Software. This 3D Software can support three Models of Robot simulation:

- Aristo Robot - 6 Axes
- Mini Robot - 5 Axes
- SCARA Robot - 4 Axes

SOFTWARE FEATURES

- Offline simulation software
- Easy to use & simulate – user friendly design
- Readymade applications in 3D environment - 3D environment for robot and world objects
- User friendly Teach pendant to program
- Robot Commands include Import/Export robot programs, Axial & Cartesian movement of robot, Robot program flow control, Commands such as Point to point (Cartesian / Axial), Path (Line / Spline / Circle)
- Design of applications through CAD Explorer which includes Create/Import models, Insert standard robot pedestal & table, Extensive library of Tools, Tool Library (inbuilt / custom), Grasping CAD objects, Machine status display, Tool path tracer (Tool ON / OFF)
- Applications package is readily available. Applications can also be designed as per user requirements.

MANUAL

Software Manual for programming is built and offered with the software as a PDF file.

TRAINING SKILLS

The following training skills are delivered using this product:

- Introduction to Robot programming
- Interpret of robot inter-joints, kinematics
- Learn about Off-line programming techniques
- Robot movement, Individual axis movement, Cartesian movement
- Jogging speed, Simulation speed
- Robot Programming techniques - Programming using Joint control or Cartesian control.
- Easy Teach through approach using diverse commands

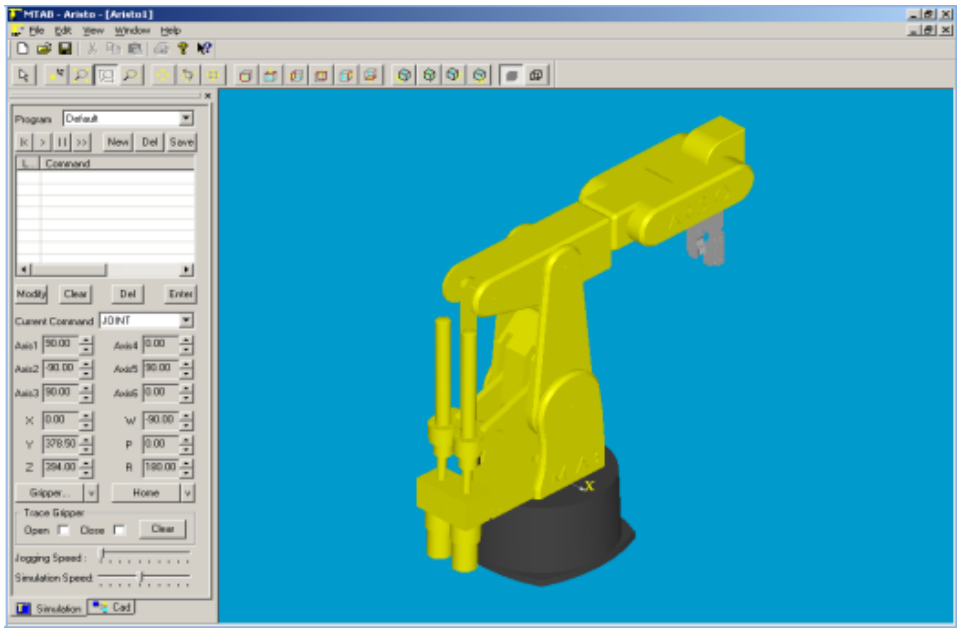
- Programming using Lead through & Teach method.
- Merits & demerits of each programming type based on application.
- Ability to Trace Robot path movement
- Programming perspective based on the application being designed
- Learn about the Possibility of Faulty programming and corrective methods.
- Learn about the risk of flawed/ unsafe programming
- Understand correct programming methods by simulating virtually all programming methods.

7. BILL OF MATERIAL: ARISTOSIM

INTRODUCTION

This ARISTO SIM is designed to control a 6-Axis articulated robot in a virtual environment once the simulated program is satisfactory and meets the required process the program can be loaded to the real-time robot (ARISTO) to carry out these experiments. Thus ARISTO SIM can work as a standalone system and can also be combined with Real-time Robot (ARISTO) for Training of Engineering students and Industry Professionals.

The industrial robot arm functions like linear, circular, spline path generation, joint & Cartesian movement of robot can be simulated. ARISTO SIM also includes features like Import/Export of CAD files in STEP format, selection of various types of End-effectors from the Tools library, creation of rectangular box, cylinder are also possible for work cell development and it also includes many practice programs for engineering students to learn about the use of Robots and its applications.



OBJECTIVES

Programming and virtual simulation of 6-axis articulated robot for broad rationale applications or (in-built) special purpose application through Jog (Teach method) or Auto mode with feasibility to import/export components and grippers according to the type of application to be handled. Discern & understand types of gripper's & effective robot programming methodology.

SOFTWARE FEATURES

- Offline simulation software
- Easy to use & simulate – user friendly design
- Readymade applications in 3D environment - 3D environment for robot and world objects
- User friendly Teach pendant to program

- Robot Commands include Import/Export robot programs, Axial & Cartesian movement of robot, Robot program flow control, Commands such as Point to point (Cartesian / Axial), Path (Line / Spline / Circle)
- Design of applications through CAD Explorer which includes Create/Import models, Insert standard robot pedestal & table, Extensive library of Tools, Tool Library (inbuilt / custom), Grasping CAD objects, Machine status display, Tool path tracer (Tool ON / OFF)
- Applications package is readily available. Applications can also be designed as per user requirements.

MANUAL

Software Manual for programming is built and offered with the software as a PDF file.

TRAINING SKILLS

The following training skills are delivered using this product:

- Introduction to Robot programming
- Interpret of robot inter-joints, kinematics
- Learn about Off-line programming techniques
- Robot movement, Individual axis movement, Cartesian movement
- Jogging speed, Simulation speed
- Robot Programming techniques - Programming using Joint control or Cartesian control.
- Easy Teach through approach using diverse commands.
- Programming using Lead through & Teach method.
- Merits & demerits of each programming type based on application.
- Ability to Trace Robot path movement
- Programming perspective based on the application being designed
- Learn about the Possibility of Faulty programming and corrective methods.
- Learn about the risk of flawed/ unsafe programming
- Understand correct programming methods by simulating virtually all programming methods.

IN-BUILT APPLICATIONS:

The following applications are built in the software and ready to use for the trainees. This is to make the understanding easier and better and thus encourage the trainee to build more applications – both fun and relevant to today's generic usage of robots

- MACHING & FABRICATION USING ROBOTS: Arc Welding, Laser cutting, Grinding, Deburring and Polishing
- MATERIAL HANDLING & ASSEMBLY USING ROBOTS: Machine tending, Loading / Unloading, Assembly, Pick and Place
- ARTIFICAL INTELLIGENCE USING ROBOT: Inspection and detection, Actions based on recognition, Actions that require cognition and decision making
- FUN WITH ROBOTS: Different applications such as painting, Colouring an object, Assembling a Toy, Dancing to music etc.

8. Bill of Material: Robot Application Kit for Technology

The following application kit is offered as Robot Application Kit. This is offered as a fully assembled kit for the Trainees to program the application. The STEM Courseware related to this is shown in the various Courses under STEM: Technology Courses:

- Base Plate – Aluminium Profile Plate of rectangular size
- Pick & Place – Kit for demonstrating Pick and Place application
- Palletizing – Ball Pallet Kit with ball feeder, balls and pallet
- Drawing – Paint wit brush Kit
- Writing – Writing Kit with papers
- Mobile Robot – Mobile robot kit
- Motors & Operation – Miniature motors and connectors
- Line Tracer – Wheels, gears and connectors
- Circuit Design - PCB
- Circuit Design - Bread Board

9. Bill of Material: Robot Application Kit for Engineering

The following application kit is offered as Robot Application Kit. This is offered as a fully disassembled kit for the Trainees to design, build and program different applications. The STEM Courseware related to this is shown in the various Courses under STEM: Engineering Courses:

- Base Plate – Aluminium Profile Plate of rectangular size
- Pick & Place – Kit for demonstrating Pick and Place application
- Palletizing – Ball Pallet Kit with ball feeder, balls and pallet
- Drawing – Paint wit brush Kit
- Writing – Writing Kit with papers
- Mobile Robot – Mobile robot kit
- Motors & Operation – Miniature motors and connectors
- Line Tracer – Wheels, gears and connectors
- Circuit Design - PCB
- Circuit Design - Bread Board

10. Bill of Material: Robot Application Kit for Science & Maths

1 Set of Application Kit relevant to the Experiments mentioned in the Robotics in STEM Courseware (Science & Maths) will be supplied.

11. Utilities Required At Site

The Robotics In STEM Kit will be supplied and commissioned at the Computer Lab. The following utilities are required at site for commissioning, demonstration & training:

11.1. Utilities for Mini Robot

One Desktop computer on network as per the below specifications:

- Operating System : Windows 7 Professional or higher, Two free USB ports
- Processor: Intel 2,8 GHz or higher, RAM : at least 4 GB, 1 DVD Drive for software installation
- Graphic Card : NVIDIA GeForce at least 1 GB or equivalent, Recommended: 19" TFT Mon

Power Supply: Stable power supply is required as mentioned in the robot specifications.

Utilities for Mini Robot (Project): One Desktop computer as per the above specifications is required and hence the same computer as supplied above can be used.

11.2. Utilities for M-Robot & AristoSim

Software can be installed with following requirements in the installation PC's:

Desktop System Requirements: The number of desktops is 10.

- Operating System : WIN 7 Professional or Higher (32 bit only)
- Intel Core 2 Duo E 4300 with 2 x 1,8 GHz or equivalent RAM : at least 4 GB
- Graphic Card : NVIDIA Quadro FX 550 or equivalent, 1 GB
- USB Interface & With 1 DVD Drive, 19" TFT Monitor, 2 free USB ports
- Local Hard Disk of minimum 2/4 GB
- The 10 computers should be on a common LAN Network.

Power Supply: Stable power supply is required for the computers

12. BILL OF MATERIAL: STEM COURSEWARE

12.1. ROBOTICS IN STEM COURSEWARE

ROBOTICS IN STEM COURSEWARE : 19 COURSES		
ROBOTICS IN STEM COURSEWARE : Over 250 Hours of Training		
CLASS	**COURSES**	**DURATION (in Hours)**
Class 8	Science	56
	Technology	
	Maths	
Class 9	Science	56
	Technology	
	Engineering	
	Maths	
Class 10	Science	42
	Technology	
	Engineering	
	Maths	
Class 11	Science	56
	Technology	
	Engineering	
	Maths	
Class 12	Science	42
	Technology	
	Engineering	
	Maths	

12.2. ROBOTICS IN STEM COURSEWARE FOR CLASS 8

CLASS	COURSES	COURSE DESCRIPTION	DURATION (in Hours)
Class 8	Science	Metals and non-metals	40
		Force and pressure	
		Mass, weight and density	
		Light	
	Technology	Introduction to robotics and robot structure	
		Classifications	
		Basic concept of motion	
		End effector	
	Maths	Linear equations in one variable	
		Quadrilaterals	
		Comparing quantities	
		Introduction to graph	

SNO	COURSES	COURSE DESCRIPTION
1	**STEM : Science**	This module will be covered as 1 hour classes. The classes will be scheduled in the lab where the metals/non-metals, force and pressure, mass, weight and density, light will be covered here using robots, its software and application kit. Different exercises will be conducted across this module to demonstrate the topics of force, pressure, mass, weight and density, light, etc. and its application in the real world. Experiments using this solution will be done in each time slot and the students will demonstrate the experiments to the rest of the class. The primary objectives achieved here are: understanding of the theoretical concepts of science, its application in technology, its relevance in the everyday real world. The secondary objective achieved here are: relating knowledge to application, communication skills thru demonstration, confidence building thru problem solving techniques and overall wellbeing and enhancement of life skills thru access to better infrastructure and learning techniques. This module is scheduled to be aligned with the teaching schedule of the school thus becoming an enabler for the teacher and a learning enhancement tool for the student. It starts with a reckoner showcasing what was learnt in the previous year's thus enabling the teacher and allowing the student to connect the learning process between classes.
2	**STEM: Technology**	This module follows the STEM: Science Modules and thus enforces the learning of the abstract concepts thru technology. The classes will be scheduled in the lab where the concepts of robotics and automation, history, classification, end effector - gripper, types, working and real time application will be covered here using robots and its software. Students will perform different exercises using the equipment and thus experience different aspects of technology used today. Experiments using this solution will be done in each time slot and the students will demonstrate the experiments to the rest of the class. The primary objectives achieved here are: exposure to technology, its relevance in the everyday real world. The secondary objective achieved

		here are: relating knowledge to application, communication skills thru demonstration, confidence building thru problem solving techniques and overall wellbeing and enhancement of life skills thru access to better infrastructure and learning techniques. This module follows the STEM: Science Modules and thus enforces the learning of the abstract concepts thru technology.
SNO	**COURSES**	**COURSE DESCRIPTION**
3	**STEM: Maths**	This module will be covered as 1 hour classes. The classes will be scheduled in the lab where the concepts of linear equation in one variable, quadrilaterals, comparing quantities, Introduction to graph will be covered using robots, its software and application kit. Experiments using this solution will be done in each time slot and the students will demonstrate the experiments to the rest of the class. The primary objectives achieved here are: understanding of the linear equation, quadrilaterals, comparing quantities concepts of maths, its application in technology, its relevance in the everyday real world. The secondary objective achieved here are: relating knowledge to application, communication skills thru demonstration, confidence building thru problem solving techniques and overall wellbeing and enhancement of life skills thru access to better infrastructure and learning techniques. This module is scheduled to be aligned with the teaching schedule of the school thus becoming an enabler for the teacher and a learning enhancement tool for the student.

12.3. ROBOTICS IN STEM COURSEWARE FOR CLASS 9

CLASS	COURSES	COURSE DESCRIPTION	DURATION (in Hours)
Class 9	Science	Fundamental units	64
		motion	
		Force & law of motion	
		Gravitation	
		Work and energy	
	Technology	Robot anatomy	
		Robot axis and coordinate system (frame)	
		Robot motions	
		Type of motion and human anatomy vs robot anatomy & Technologies	
	Engineering	Sensors & Instrumentation – Introduction	
		Measuring system – Calibration Techniques	
		Basic Programmable logic controllers	
	Maths	Number system	
		Algebra	
		Coordinate geometry	
		Geometry - Angles, circles and triangles	
		Measurement - surface area and volume	

SNO	COURSES	COURSE DESCRIPTION
4	STEM : Science	This module will be covered as 1 hour classes. The classes will be scheduled in the lab where the concepts of motion, gravity will be discussed and taught using Robots and its software. Different exercises will be conducted across this module to demonstrate the topics of motion and gravity and its application in the real world. Experiments using this solution will be done in each time slot and the students will demonstrate the experiments to the rest of the class. The primary objectives achieved here are: understanding of the theoretical concepts of science, its application in technology, its relevance in the everyday real world. The secondary objective achieved here are: relating knowledge to application, communication skills thru demonstration, confidence building thru problem solving techniques and overall wellbeing and enhancement of life skills thru access to better infrastructure and learning techniques. This module is scheduled to be aligned with the teaching schedule of the school thus becoming an enabler for the teacher and a learning enhancement tool for the student.
SNO	COURSES	COURSE DESCRIPTION

5	**STEM: Technology**	This module will be covered as 1 hour classes. The classes will be scheduled in the lab where the concepts of robot structure - links and joints, robot motions, laws, coordinates system will be covered here using robots and its software. Students will perform different exercises using the equipment and thus experience different aspects of technology used today. Experiments using this solution will be done in each time slot and the students will demonstrate the experiments to the rest of the class. The primary objectives achieved here are: exposure to technology, its relevance in the everyday real world. The secondary objective achieved here are: relating knowledge to application, communication skills thru demonstration, confidence building thru problem solving techniques and overall wellbeing and enhancement of life skills thru access to better infrastructure and learning techniques. This module follows the STEM: Science Modules and thus enforces the learning of the abstract concepts thru technology. It starts with a reckoner showcasing what was learning in the previous year's thus enabling the teacher and allowing the student to connect the learning process between classes.
6	**STEM: Engineering**	This module will be covered as 1 hour classes. The classes will be scheduled in the lab where the following areas will be covered: Programming of specific robot application using various shapes, path planning, programming of robot application like pick and place, palletizing, assembly using robots and software. Students will perform different exercises using the equipment and thus experience different aspects of engineering used today. Experiments using this solution will be done in each time slot and the students will demonstrate the experiments to the rest of the class. Engineering is an aspirational area for today's students and this prepares the students thru a better understanding of the field of engineering and technology. This module focusses on developing the analytical skills and problem solving techniques of these students - thus allowing them to envision various career opportunities. The primary objectives achieved here are: exposure to engineering, relevance of the theoretical aspects of learning to engineering, its relevance in the everyday real world. The secondary objective achieved here are: relating knowledge to application, communication skills thru demonstration, confidence building thru problem solving techniques and overall wellbeing and enhancement of life skills thru access to better infrastructure and learning techniques. This module follows the STEM: Maths Modules and connects concepts of science and maths to technology. It starts with a reckoner showcasing what was learning in the previous year's thus enabling the teacher and allowing the student to connect the learning process between classes.
7	**STEM: Maths**	This module will be covered as 1 hour classes. The classes will be scheduled in the lab where the concepts of number system, algebra, coordinate geometry, geometry-angles, circles and triangle will be covered using robots, its software and application kit. Experiments using this solution will be done in each time slot and the students will demonstrate the experiments to the rest of the class. The primary objectives achieved here are: understanding of the theoretical concepts of maths, its application in technology, its relevance in the everyday real world. The secondary objective achieved here are: relating knowledge to application, communication skills thru demonstration, confidence building thru problem solving techniques and overall wellbeing and enhancement of life skills thru access to better infrastructure and learning techniques. This module is scheduled to be aligned with the teaching schedule of the school thus becoming an enabler for the teacher and a learning enhancement tool for the student.

12.4. ROBOTICS IN STEM COURSEWARE FOR CLASS 10

CLASS	COURSES	COURSE DESCRIPTION	DURATION (in Hours)
Class 10	Science	Electricity	64
		Magnetic effects of electric current	
	Technology	Basics of input and output devices	
		Transmission system & Technologies	
		Degree Of Freedom (D.O.F)	
		Jog methods & type	
		Robot programming - motion commands & math command	
	Engineering	Electronic devices & Circuits	
		Electrical & Power systems	
		Practicals - Real time application (Pick and place, palletizing)	
	Maths	Real numbers	
		Geometry	
		Measurement - surface area and volume	

SNO	COURSES	COURSE DESCRIPTION
8	**STEM : Science**	This module will be covered as 1 hour classes. The classes will be scheduled in the lab where the concepts of electricity, electric current, components and circuits will be covered here using robot and robot controller. Different exercises will be conducted across this module to demonstrate the topics of electricity, electric current etc. and its application in the real world. Experiments using this solution will be done in each time slot and the students will demonstrate the experiments to the rest of the class. The primary objectives achieved here are: understanding of the theoretical concepts of science, its application in technology, its relevance in the everyday real world. The secondary objective achieved here are: relating knowledge to application, communication skills thru demonstration, confidence building thru problem solving techniques and overall wellbeing and enhancement of life skills thru access to better infrastructure and learning techniques. This module is scheduled to be aligned with the teaching schedule of the school thus becoming an enabler for the teacher and a learning enhancement tool for the student. It starts with a reckoner showcasing what was learnt in the previous year's thus enabling the teacher and allowing the student to connect the learning process between classes.
SNO	**COURSES**	**COURSE DESCRIPTION**

9	**STEM: Technology**	This module will be covered as 1 hour classes. The classes will be scheduled in the lab where the concepts of robot programming - point-to-point, joint, delay and programming methods, commands - if, label, math command using robots and software. Students will perform different exercises using the equipment and thus experience different aspects of technology used today. Programming is an important aspect in today's learning and it offers the students to explore and innovate thru development of application on various platforms. This module focusses on developing the analytical and programming skills of these students - thus allowing them to envision various career opportunities. Experiments using this solution will be done in each time slot and the students will demonstrate the experiments to the rest of the class. The primary objectives achieved here are: exposure to technology, its relevance in the everyday real world. The secondary objective achieved here are: relating knowledge to application, communication skills thru demonstration, confidence building thru problem solving techniques and overall wellbeing and enhancement of life skills thru access to better infrastructure and learning techniques. This module follows the STEM: Science Modules and thus enforces the learning of the abstract concepts thru technology. It starts with a reckoner showcasing what was learnt in the previous year's thus enabling the teacher and allowing the student to connect the learning process between classes.
10	**STEM: Engineering**	Employability skills is the key focus in this module. Thru this module, the students are equipped with employability skills to become part of the structured work force, choose to take up further vocational courses or opt for higher education. This module will be covered as 1 hour classes. The classes will be scheduled in the lab where the following areas will be covered: Building of robot application using various shapes, path planning, programming of robot application like pick and place, palletizing, assembly using robots and software. Students will perform different exercises using the equipment and thus experience different aspects of engineering used today. There is shift in experiential learning in this module wherein the students start working together in groups to physically construct the application and then program and execute. This is a project based module and the project (Experiments using this solution) will be done across 2-4 classes and the students will demonstrate the projects to the rest of the class. Each project will be unique and thus also allow the students to demonstrate: innovative thinking, critical path approach, presentation skills, team working, leadership skills, ability to address conflicts, conflict resolution, convincing of ideas and so on. Engineering is an aspirational area for today's students and this prepares the students thru a better understanding of the field of engineering and technology. This module focusses on developing the analytical skills and problem solving techniques of these students - thus allowing them to envision various career opportunities. The primary objectives achieved here are: exposure to engineering, relevance of the theoretical aspects of learning to engineering, its relevance in the everyday real world. The secondary objective achieved here are: relating knowledge to application, communication skills thru demonstration, confidence building thru problem solving techniques and overall wellbeing and enhancement of life skills thru access to better infrastructure and learning techniques. This module follows the STEM: Maths Modules and connects concepts of science and maths to technology. It starts with a reckoner showcasing what was learnt in the previous year's thus enabling the teacher and allowing the student to connect the learning process between classes.

SNO	COURSES	COURSE DESCRIPTION
11	**STEM:** **Maths**	This module will be covered as 1 hour classes. The classes will be scheduled in the lab where the concepts of real numbers, geometry, measurement - surface, area and volume will be covered using robots, its software and application kit. Different exercises will be conducted across this module to demonstrate the topics of real numbers, geometry, measurement etc. and its application in the real world. Experiments using this solution will be done in each time slot and the students will demonstrate the experiments to the rest of the class. The primary objectives achieved here are: understanding of the theoretical concepts of maths, its application in technology, its relevance in the everyday real world. The secondary objective achieved here are: relating knowledge to application, communication skills thru demonstration, confidence building thru problem solving techniques and overall wellbeing and enhancement of life skills thru access to better infrastructure and learning techniques. This module is scheduled to be aligned with the teaching schedule of the school thus becoming an enabler for the teacher and a learning enhancement tool for the student. It starts with a reckoner showcasing what was learnt in the previous year's thus enabling the teacher and allowing the student to connect the learning process between classes.

12.5. ROBOTICS IN STEM COURSEWARE FOR CLASS 11

CLASS	COURSES	COURSE DESCRIPTION	DURATION (in Hours)
Class 11	Science	Units and measurements	64
		Motion in straight line	
		Law of motion	
		Work, energy and power	
		Gravitation	
	Technology	Input device (sensor and switching devices) & Technologies	
		Output device (motor and types) & Technologies	
	Engineering	Electric circuits - working & schematic symbols	
		Building circuits - on bread boards	
		Building circuits - on PCB	
		PIC controller - working and basic programming	
	Maths	Coordinates	
		Straight line	
		Quadratic equation	
		Introduction to 3D geometry	
		Trigonometry functions	

SNO	COURSES	COURSE DESCRIPTION
12	**STEM : Science (Physics)**	This module will be covered as 1 hour classes. The classes will be scheduled in the lab where the concepts and laws of gravitation, work, energy, power, motion in straight line will be covered here using robots, its software and application kit. Different exercises will be conducted across this module to demonstrate the topics of gravity, energy, power etc. and its application in the real world. Experiments using this solution will be done in each time slot and the students will demonstrate the experiments to the rest of the class. The primary objectives achieved here are: understanding of the theoretical concepts of science, its application in technology, its relevance in the everyday real world. The secondary objective achieved here are: relating knowledge to application, communication skills thru demonstration, confidence building thru problem solving techniques and overall wellbeing and enhancement of life skills thru access to better infrastructure and learning techniques. This module is scheduled to be aligned with the teaching schedule of the school thus becoming an enabler for the teacher and a learning enhancement tool for the student. It starts with a reckoner showcasing what was learnt in the previous year's thus enabling the teacher and allowing the student to connect the learning process between classes.

13	**STEM: Technology**	This module will be covered as 1 hour classes. The classes will be scheduled in the lab where the concepts and working principles of input & output devices (switches, sensor & motors) will be covered here using STEM kit. Students will perform different exercises using the equipment and thus experience different aspects of technology used today. Electronics is an important aspect in today's life and this module offers the students to explore basic electronics. This module focusses on developing a base understanding of these concepts thus ensuring that when they proceed towards higher education and career they are amply equipped with understanding and skills required to excel in these fields. Experiments using this solution will be done in each time slot and the students will demonstrate the experiments to the rest of the class. The primary objectives achieved here are: exposure to technology, its relevance in the everyday real world. The secondary objective achieved here are: relating knowledge to application, communication skills thru demonstration, confidence building thru problem solving techniques and overall wellbeing and enhancement of life skills thru access to better infrastructure and learning techniques. This module follows the STEM: Science Modules and thus enforces the learning of the abstract concepts thru technology. It starts with a reckoner showcasing what was learnt in the previous year's thus enabling the teacher and allowing the student to connect the learning process between classes.
14	**STEM: Engineering**	This module will be covered as 1 hour classes. The classes will be scheduled in the lab where the concepts of developing electric circuits using schematic symbols, building of circuit on breadboards and PCB and PIC controller - working and programming concepts. Students will perform different exercises using the equipment and thus experience different aspects of engineering used today. There is higher shift in experiential learning in this module wherein the students start working together in groups to physically design, construct the application and then program and execute. In this module, students start thinking about designing applications connected to their life and experiences. This allows student creativity at its best. This is a project based module and the project (Experiments using this solution) will be done across 2-4 classes and the students will demonstrate the projects to the rest of the class. Each project will be unique and thus also allow the students to demonstrate: innovative thinking, critical path approach, presentation skills, team working, leadership skills, ability to address conflicts, conflict resolution, convincing of ideas and so on. Engineering is an aspirational area for today's students and this prepares the students thru a better understanding of the field of engineering and technology. This module focusses on developing the analytical skills and problem solving techniques of these students - thus allowing them to envision various career opportunities. The primary objectives achieved here are: exposure to engineering, relevance of the theoretical aspects of learning to engineering, its relevance in the everyday real world. The secondary objective achieved here are: relating knowledge to application, communication skills thru demonstration, confidence building thru problem solving techniques and overall wellbeing and enhancement of life skills thru access to better infrastructure and learning techniques. This module follows the STEM: Maths Modules and connects concepts of science and maths to technology. It starts with a reckoner showcasing what was learnt in the previous year's thus enabling the teacher and allowing the student to connect the learning process between classes.

SNO	COURSES	COURSE DESCRIPTION
15	**STEM MATHS**	This module will be covered as 1 hour classes. The classes will be scheduled in the lab where the concepts of coordinates, straight line, quadratic equation, 3D geometry will be covered using robots, software. Experiments using this solution will be done in each time slot and the students will demonstrate the experiments to the rest of the class. The primary objectives achieved here are: understanding of the theoretical concepts of maths, its application in technology, its relevance in the everyday real world. The secondary objective achieved here are: relating knowledge to application, communication skills thru demonstration, confidence building thru problem solving techniques and overall wellbeing and enhancement of life skills thru access to better infrastructure and learning techniques. This module is scheduled to be aligned with the teaching schedule of the school thus becoming an enabler for the teacher and a learning enhancement tool for the student.

12.6. ROBOTICS IN STEM COURSEWARE FOR CLASS 12

CLASS	COURSES	COURSE DESCRIPTION	DURATION (in Hours)
Class 12	Science	Communication system	40
		Semiconductor electronics	
	Technology	Path planning	
		Motor speed control – methods	
		PIC controller - Programming syntax	
	Engineering	Engineering components and blueprint reading	
		Principles to assemble, test and operate a robot	
		Design & Fabrication Project	
	Maths	Transformations	
		Vector algebra	
		Matrix	

SNO	COURSES	COURSE DESCRIPTION
16	**STEM : Science (Physics)**	This module will be covered as 1 hour classes. The classes will be scheduled in the lab where the concepts of digital electronics, communication system will be covered here using robots. Different exercises will be conducted across this module to demonstrate the topics of electronics, communication etc. and its application in the real world. Experiments using this solution will be done in each time slot and the students will demonstrate the experiments to the rest of the class. The primary objectives achieved here are: understanding of the theoretical concepts of science, its application in technology, its relevance in the everyday real world. The secondary objective achieved here are: relating knowledge to application, communication skills thru demonstration, confidence building thru problem solving techniques and overall wellbeing and enhancement of life skills thru access to better infrastructure and learning techniques. This module is scheduled to be aligned with the teaching schedule of the school thus becoming an enabler for the teacher and a learning enhancement tool for the student.
17	**STEM: Technology**	This module will be covered as 1 hour classes. The classes will be scheduled in the lab where the concepts of mobile robot working and method of path detections, PIC controller programming concepts developments. Students will perform different exercises using the equipment and thus experience different aspects of technology used today. Electronics is an important aspect in today's life and this module offers the students to explore basic electronics. This module focusses on developing a base understanding of these concepts thus ensuring that when they proceed towards higher education and career they are amply equipped with understanding and skills required to excel in these fields. Experiments using this solution will be done in each time slot and the students will demonstrate the experiments to the rest of the class. The primary

		objectives achieved here are: exposure to technology, its relevance in the everyday real world. The secondary objective achieved here are: relating knowledge to application, communication skills thru demonstration, confidence building thru problem solving techniques and overall wellbeing and enhancement of life skills thru access to better infrastructure and learning techniques. This module follows the STEM: Science Modules and thus enforces the learning of the abstract concepts thru technology. It starts with a reckoner showcasing what was learnt in the previous year's thus enabling the teacher and allowing the student to connect the learning process between classes.
SNO	**COURSES**	**COURSE DESCRIPTION**
18	**STEM: Engineering**	Employability skills are the key focus in these modules. Thru this module, the students are equipped with employability skills to become part of the structured work force, choose to take up further vocational courses or opt for higher education. This module will be covered as 1 hour classes. The classes will be scheduled in the lab where the following areas will be covered: Engineering components, blueprint reading and principles to assemble, test and operate a robot. Students will perform different exercises using the equipment and thus experience different aspects of engineering used today. There is higher shift in experiential learning in this module wherein the students start working together in groups to physically design, construct the application and then program and execute. In these module students start thinking about designing applications connected to their life and experiences. This allows student creativity at its best. This is a project based module and the project (Experiments using this solution) will be done across 2-4 classes and the students will demonstrate the projects to the rest of the class. Each project will be unique and thus also allow the students to demonstrate: innovative thinking, critical path approach, presentation skills, team working, leadership skills, ability to address conflicts, conflict resolution, convincing of ideas and so on. Engineering is an aspirational area for today's students and this prepares the students thru a better understanding of the field of engineering and technology. This module focusses on developing the analytical skills and problem solving techniques of these students - thus allowing them to envision various career opportunities. The primary objectives achieved here are: exposure to engineering, relevance of the theoretical aspects of learning to engineering, its relevance in the everyday real world. The secondary objective achieved here are: relating knowledge to application, communication skills thru demonstration, confidence building thru problem solving techniques and overall wellbeing and enhancement of life skills thru access to better infrastructure and learning techniques. This module follows the STEM: Maths Modules and connects concepts of science and maths to technology. It starts with a reckoner showcasing what was learnt in the previous year's thus enabling the teacher and allowing the student to connect the learning process between classes.

SNO	COURSES	COURSE DESCRIPTION
19	**STEM: Maths**	This module will be covered as 1 hour classes. The classes will be scheduled in the lab where the concepts of transformations, vector algebra, and matrix will be covered using robots, software. Experiments using this solution will be done in each time slot and the students will demonstrate the experiments to the rest of the class. The primary objectives achieved here are: understanding of the theoretical concepts of maths, its application in technology, its relevance in the everyday real world. The secondary objective achieved here are: relating knowledge to application, communication skills thru demonstration, confidence building thru problem solving techniques and overall wellbeing and enhancement of life skills thru access to better infrastructure and learning techniques. This module is scheduled to be aligned with the teaching schedule of the school thus becoming an enabler for the teacher and a learning enhancement tool for the student.

13. DELIVERY SCHEDULE

Site readiness is the scope of the customer and must meet the technical scope as mentioned in this document.

13.1. DELIVERY SCHEDULE

Delivery schedule comprises of supply of kits and Train the Teachers. Train the Teachers will happen independent of kits and will be scheduled and completed before the completion of supply of kits.

Delivery schedule for the supply of kits will be as follows:

SCHEDULE OF SUPPLY		
Week of Supply	**No. of Schools**	**Cumulative Schools supplied till date**
Week 8	5	5
Week 10	5	10
Week 12	8	18
Week 14	8	26
Week 16	10	36
Week 18	10	46
Week 20	12	58
Week 22	12	70
Week 24	15	85
Week 26	15	100
Week 28	18	118
Week 30	20	138
Week 32	22	160
Week 34	25	185
Week 36	25	210
Week 38	25	235
Week 40	25	260
Week 42	25	285
Week 44	25	310
Week 46	25	335
Week 48	25	360
Week 50	25	385
Week 52	25	410
Week 54	25	435
Week 56	25	460
Week 58	20	480
Week 60	20	500

13.2. Commissioning and Demonstration

The kits will be commissioned and demonstrated on the same day of supply.

13.3. Warranty

Warranty offered is 12 months from the date of commissioning or 15 months from the date of supply whichever is earlier. Warranty is covered for manufacturing defects.

13.4. Site Clearance by MTC:

MTC will visit all the site and prepare a site clearance report. The site clearance responsibilities are summarized below.

- MTC will submit a report regarding site clearance for the acceptance of goods at each site. The site clearance will include availability of space (Computer lab) in each site, Technical readiness as mentioned under the SCOPE OF THE CUSTOMER
- In case the site is not ready and hence not cleared, MTC will submit an appropriate report to the customer. Within 2 weeks of the MTC report date, the customer must get the site ready in the same school or find an alternative school (which has a ready site) within the same district.

14. SUMMARY OF COMMERCIAL OFFER

Our Commercial offer is being given for entire scope of supply and services. The offer will be applicable as per the number of schools given in the purchase order ie., the value of the "Robotics in STEM" solution remains the same irrespective of the number of schools placing the order, the Scope Of Supply & Services change based on the summary below.

Category	Type	Scope of Supply & Services	100-500 schools	More than 50 but less than 100 schools
Supply	Hardware	Robotics in STEM Kit:	√	√
Supply	Software	Robotics in STEM Software	√	√
Supply	Courseware	Courseware: Interactive eLearning licenses	√	
Supply	Courseware	Courseware: PDF Books	√	√
Services	Services	Commissioning & Demonstration	√	√
Services	Services	Warranty	√	√
Services	Services	Mentoring: Mentors during warranty period	√	√
Services	Services	Monitoring: Monitoring through LMS during warranty period	√	
Services	Training	Train the Teachers: Level 1: Centralised training for 1 week in Term1	√	√
Services	Training	Train the Teachers: Level 2: Centralised training for 1 week in Term2	√	
Services	Services	Workshop and Competitions	√	

****√ Indicates that the supply and service is offered for that quantity of Schools**

CONTACT DETAILS

SAFETECH PRODUCTS & SERVICES PVT LTD
39 SURVEYOR STREET
LALBAGH WEST GATE
BASAVANAGUDI
BANGALORE-560004

Email id: anupkumar@safetechin.com
Mobile: +91 9731421177