



P R E S E N T S

Rocketeers

Learning Centre



A Space To Build For Space

We are creating a space to build for space!

India is one of the leading space faring nations of the world. As ISRO supports more and more privatisation, we aim to help build the ecosystem that acts as the primary growth driver and talent pool. We will build for this industry the rocket scientists it needs and deserves.

Founded by IISTians, the Rocketeers team has a background in rocket science, understanding the nitty gritty, applications and impact of space technology on our daily lives. With the vision to bring this to the people, we have had following achievements :

- Flew more than 150,000 rockets till now.
- Initiated conversations about rocketry related laws, policy at the highest levels of govt. from parliament to ISRO, DIPP and PESO
- Collaborated with ISRO to create a guinness world record at IISF 2021.
- Built rockets using blackpowder, sucrose, dextrose, APCP and other solid fuels.
- Facilitated rocketry projects in over 300 institutions in India.
- Became official merchandise providers for ISRO.

We aim to make rocket sciences safe, reliable, accessible, fun and intuitive.



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Introduction

The Rocketeers Rocket Laboratory is the first of its kind in India. Rocketeers is the only Indian entity to set up a STEM curriculum based laboratory that is dedicated exclusively to rocketry. The lab has all the components necessary to design, build and safely launch a model or amateur rocket, Cansats and Cubesats including nose cones, body tubes, adapter cones, payload buses, sensors and rocket motors. The lab is also equipped with a various testing apparatus, remote ignition system and launcher apparatus.

Purpose of the Lab

The lab has been set up to start off a grass root level model rocketry ecosystem, the idea being that rocketry should be accessible to all. It is a great platform to practically learn and apply the fundamental concepts of science, math and engineering that are taught as theory in classrooms. This is surely set to inspire the rocket scientists of tomorrow.

This lab is completely equipped to take students from young inspired space enthusiasts to entrepreneurs working with space technology. A path to begin learning with simple model rockets to highly specialized experiments on amateur rockets and high altitude balloons, Cansats and Cubesats. The rocketeers vision of creating an ecosystems of such labs across the country is targeted to become a pivotal game changer in feeding the space technology, electronics and data driven industry of india with highly skilled and motivated human resource.

List of materials

S. No	Part Name	Specification	Quantity (Nos)
Experimental Apparatus			
1	Thrust Test Stand - Small	Load Cell Sensor High FPS Camera Single Point Clamp Resolution 1 Newton Max Thrust 100 N 8 readings/Sec SS Scaffolding Standard Exhaust Area Required 5ft*5ft Height 8ft	1
2	Thrust Test Stand - Medium	Load Cell Sensor - 2 Resolution 1 Newton Max Thrust 3000 N 8 readings/Sec SS Scaffolding Standard Exhaust Area Required 12ft*5ft Height 6ft	1
3	Computer	Intel i5, 2 GB RAM, 21" LCD display, USB mouse, keyboard and UPS	4

Rocket Components (External)			
1	Nose cone Assorted Sizes	HDPE Dia - 20, 25, 30, 35, 40, 45, 50 mm	950 each
2	Body Tubes Assorted Sizes	Sack-Kraft Paper Tube High Strength Dia - 20, 25, 30, 35, 40, 45, 50 mm Length - 1 m, 2 m	950 each
3	Balsa Wood Fins	Balsa wood Thickness - 2 mm 12 Shapes	12000
4	Fin sheet	Kraft Paper sheet Size - 30in*40in	10000
5	Adaptor Set	Sack-Kraft Paper Tube High Strength Adaptor Discs and Clips PVC Foam 2 cones/set 6 discs/set 10 Clips/set	300 Sets
Rocket Components (Internal)			
1	Block Rings All Motors	PVC Foam Sheet Thickness - 3mm	2500
2	Centring Rings All Motors	PVC Foam Sheet Thickness - 3mm Assorted Sizes	24000
3	Motor Housing All Motors	Sack-kraft Paper Tubes High Strength	2000
4	Payload Set	PVC Foam sheet Thickness - 3mm Width - 40 mm Length - 100mm Discs - 2/Set	300 Sets
9	Parachute Sheet	LDPE Sheet roll (40 m)	25
10	Parachute String	High Strength Cotton Thread	25 rolls
11	Shock Cord	High Strength Synthetic Elastic String	5 roll

Fuel Cartridge			
1	Rocketeers Model Rocketry Motors	Fuel - Black Powder Class B,C & D with and without ejection charge	1000
2	Solid Propellant Setup	Sugar Motors Chemical Grade KNO ₃ Sugar Other Chemicals like sorbitol, additives etc Oven Curing and mixing Gear Safety Gear	upto 200 cartridges
3	Sugar motor description	• Sucrose - 19 kg • KnO₃- 15.5 Kg • D glucose- 500 gm * 2 = 1 kg • M-seal- 17 kg • Magnesium sulfate- 500 gm • Al sulfate- 500 gm • Paraffin wax- 2 kg • Mannitol-500 gm*2=1 kg • Ferric oxide red- 500 gm*2=1 kg • Diphenylamine-250 gm*2=500 gm • Polyethylene glycol- 500 ml*2= 1 liter • Blow torch gun can-3 • Silica gel- 1 packet • Araldite- 1 (13 gm) • UPVC Seal –Solvent Cement- 1 (20 ml) • Sand-Paper-241 • Butter paper- 403 gm • CPVC tube- 14 full +1 half (28.7 mm OD) • CPVC tube- 14 full, 7 half (35 mm OD) • CPVC tube- 14 full+ 7 half (41 mm OD) • Nozzle clay- 25 kg • Nozzle glue – 25 kg	

Rocket Launch Components			
1	Launch Pad	Iron Tripod Mount with Angle Adjusting Aluminium Clamp, SS Deflector plate, Aluminium Launch Rod	4
2	Ignition system	3 Cell Lithium Ion Battery pack (6 - months warranty) with Aluminium Housing Electric cord with Master switch, Launch button, connecting wire and in built charging circuit 60 Launches/Charge	4
3	Launch Lug	LDPE Pipe	1000
4	Igniter	Copper wire Electrical triggers	2000
5	Lasso String	Soft Cotton String	100 Metre Roll

Safety Gears			
1	Safety gears	• First aid Box-1 • Fire extinguisher 2 • Fire blankets- 3 (1 used, 2 new) • Heating Gloves- 5 pairs • Protective goggles- 18 • Latex Gloves-4 pairs • Nitrile gloves- 6 pairs • Nylon gloves -18 pairs • Face mask – 118	

Payloads and Satellite Equipment			
1	Bench power supply	0-30V DC, 2 OUTPUT DC power supply	4
2	Multimeter	Fluke	2
3		4.5 digit true RMS multimeter	4
4	Oscilloscope	100-500 MHz Techtronix/Lecroy	2
5	Oscilloscope probes	Passive probes	6
6	Universal IC Programmer	Microchip	4
7	Soldering Iron	Mini soldering iron with changeable tips deluxe kit	4
8	Soldering equipment		4
9	Tweezers		8
10	Wires		20 sets
11	Miscellaneous		
12	First aid kit		1
14	Components kits	Resistors, Capacitors, LEDs, IC, connectors etc	10 kits
15	Breadboard		10
16	Debugging components		
17	Raspberry Pi kits + com module OR Arduino kit + Comms module		4
18	IOT Development Kit		2
19	ARM Development Kit		1
Specialised Space Technology Components			
1	Trancend 1U CubeSat Model Kit	Includes 1U CubeSat Structure, Solar Panels, Lithium Polymer Batteries, EPS, On Board Computer using Raspberry Pi, Wireless Comms modules, Sensors for telemetry Data	4
2	XINA Box CANSAT Development Project	Includes CANSAT structure, power systems, on-board computer, telemetry	4
3	Sensor Modules	Ex: Temperature, humidity and pressure	4
		GPS Modules	4
		Camera Modules	8
		MPU6050+HMC5883L+BMP180 3-axis Gyro + 3-axis Acceleration + 3-axis Magnetic Field + Air Pressure Sensors	4
4	Communication Modules	0.1-2000mhz RF Wideband Amplifier Gain 30db Low-Noise Amplifier LNA Board Module	1
		RFM 97xx Wireless Communication Module	2
5	Satellite Communication Modules	VHF/UHF Transceiver Module for Amateur Radio Frequencies	2

Storage and Work Equipment			
Sl no	Part name	Description	Quantity (Nos)
1	Steel Shelves	MS slotted angle shelves, painted Blue and Black 2ft X 3ft X 5ft	10
3	Storage containers (Large & Medium)	HDPE plastic storage containers	100
4	Storage containers (small)	HDPE plastic storage containers	50
5	Body Tube Bin	SS Seive Bin	20
Work Tables			
1	Test Benches	Table Size: 30x60x30"	5
2	Work Benches	ESD Protected Table top/ESD Mat	2
3		Tested with Ohmic Test for ESD protection	

Misc. Components		
Sl no	Part Name	Quantity (Nos)
1	Spray Paint	25
2	Markers	10
3	PVA Glue	5, 1Kg boxes
4	Instant Glue	20 gms Tube, 100 Packs
5	Scissors	20 Small, 10 Big
6	Paper cutter	25
7	Sandpaper	150
8	Duct tape	20
9	Dustbin	2
10	Standard Tool Kit	2 Pack
11	First Aid Kit	2 Pack
12	Fire Extinguisher	2
13	ESD Wrist band	1
14	Safety Gloves and Goggles	4
15	Lab coats/Aprons	10
16	ESD Shoes cover/Head protection caps	10

List of Services

1. Installation service:

This takes into account the assembly and setting up of the lab itself.

- Installation Service shall also include all necessary hardware required including but not limited to wall paper, paint, electrical supplies, and hardware supplies.
- All the components and equipment required will be brought to site and assembled by a team of at least 4 people from Rocketeers.
- The functioning and inventory of all equipment will be checked before handing over the lab to the operator
- All the assembly required and styling of the lab will be undertaken by Rocketeers.
- A team of 4-5 shall make this happening over 10-12 days. The accommodation and food for the team is to be provided by the operators.

2. Teaching and consultancy

This takes into account the training of the lab facilitators and curriculum that will be followed in the lab.

- Teachers of the operator will be trained on basic rocketry principles and also on running and maintenance of the lab.
- The curriculum to be followed will be available on the computer in the lab, which the teachers can then transfer and share if they choose.
- Rocketeers will be available off site for any consultation, if necessary.
- Biannual visits from Rocketeers will be scheduled to ensure that the lab is active.
- Rocketeers will also be facilitating skills and knowledge transfer across various labs in the country, so that each individual lab may benefit from the advances of another lab.

3. **Annual Maintenance Contract:**

This takes into account the various maintenance requirements of the equipment and support from Rocketeers. For the first year of lab, all electronic and electrical equipment come with a 1 year offsite repair warranty. For consecutive years, the AMC will be applicable.

- The propulsion test stand comes with a 1 year offsite repair warranty.
- The AMC will include annual replenishing to material stock for upto a 100 rockets.
- The AMC will cover off-site repairs and refurbishments of all electrical and electronic components of the lab
- The AMC will also include biannual visits from Rocketeers to ensure maintenance and upkeep of the apparatus and equipment.
- The AMC will also provide for periodic upgrades to the experimental apparatus in the lab.

4. **Training Software Subscription:**

This takes into account the various software subscriptions provided for students. We will provide Annual Educational Subscription for upto 4 PCs.

Apart from these services, Rocketeers will be in touch with the teachers on a regular basis and will keep updating the curriculum with the latest material on a biannual basis. All online resources like, presentations, videos, documents, workbooks etc shall also be provided and updated on a regular basis.

Curriculum

The following topics will be covered

- **Rocketry Basics:** ○ Motion ○ Speed and velocity ○ Acceleration ○ Equations of motion for uniform acceleration ○ Projectile motion ○ Fluid resistance and terminal speed ○ Forces ○ Free-body diagrams ○ Newton's laws of motion ○ Work, energy and power ○ Kinetic energy ○ Gravitational potential energy ○ Fluid dynamics and Bernoulli's Equation
- **Mathematics:** ○ Application of quadratic equations ○ Trigonometry ○ Heights and distances ○ Calculus ○ Statistics
- **Aerodynamics:** ○ Understanding air flow ○ Concept of forces ○ Concepts of Lift and Drag and associated application, Airplane vs. Rockets ○ Application of aerodynamics to model rocketry
- **Propulsion:** ○ Different kind of engines ○ Basic theory of propulsion ○ Concepts of weight, thrust, momentum, pressure, Specific impulse, lift-off etc ○ Comparison with real life examples in balloons, air rockets and launch vehicles ○ Application of propulsion to model rocket engines
- **Flight Mechanics:** ○ Understanding forces, aerodynamics and propulsion and applying them to launch vehicles and model rocketry. ○ Understanding the basics of flight, different phases of flight like powered ascent, coasting, reentry, terminal velocity, controlled vectored ascent (satellite launching) etc.
- **Stability:** ○ Understanding the Stability concept and why it is the most important concept in model rocketry ○ Science of CG and CP, how stability plays an important role in making a rocket fly straight ○ Application to flight mechanics, measuring CP
- **Navigation, Guidance and Control:** ○ Active Control ○ Navigation and Positioning ○ Trajectory Design ○ Telemetry and communication
- **Testing** ○ Functional Testing ○ Integration Testing ○ Environmental testing ○ Flight Model : Testing on Launch Vehicles

- **Design Concepts:** In order to design their own rocket, students learn various facets of design under Aerodynamics and Stability with Propulsion as constraint. Various design concepts regarding nose cone and fins, staging, multiple motors, aerodynamic drag, moving CP and CG for stability, length and diameter of rockets etc are discussed and a Systems Engineering feel of the system is provided
- **Launch Vehicles** ○ Launch Vehicle Design ○ Subsystems ○ Manufacturing and integration ○ Launch Operations ○ Launch Vehicle Selection ○ Transporting Spacecraft to Launch site ○ Launch site processing and integration ○ Launch Day ○ Launch Pad Design ○ Post Launch and early orbit operations
- **Introduction to Electronics and payloads:** ○ Digital and Analog ○ Introduction to system design ○ Embedded Hardware Design ○ Introduction to Arduino and Raspberry Pi ○ Sensors and Data Acquisition ○ Software Design ○ Mechanical Design ○ Product Integration and Testing
- **Payloads:** ○ Overview of Payload design ○ Communication Payloads ○ Earth Observation payloads ○ Technology Demonstration Payloads ○ Science Experiments in Rocketry and Space
- **Satellite Mission Engineering** ○ Mission Concept and analysis ○ Defining Requirements and specifications ○ Orbit Selection ○ Keplerian orbits ○ Spacecraft Orbit Terminology ○ Orbit Design ○ Specialised orbits ○ Mission Cost estimation ○ Selection of Frequency bands
- **Spacecraft Subsystems** ○ On-board Processing / Command and Data handling ○ Communication Subsystem ○ Satellite Power ○ Control Subsystems / ADCS ○ Propulsion ○ Space Avionics ○ Component Selection and Sensors
- **Space Environment** ○ Space Environment and Space Weather ○ Earth Magnetic Fields ○ Microgravity ○ Effect of Space Weather on Satellites ○ Mitigation techniques ○ Orbit Debris - Space Hazards
- **Post Launch Activities** ○ Ground Station ○ Telemetry and Tracking ○ Decoding and analysis of Satellite Data ○ Mission operations ○ End of Mission



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