

Sessions Details - 2016

Sessions@Roboknights 2016 will be a certified online course on “Introduction to Machine Design” that will cover all of the essential knowledge and hands-on experience required to start building your own machine from scratch, and even going a little further and helping you make your dream project come true !

The course has many topics which are individually covered in various modules arranged systematically, and starts from the ground level basics of electronics, programming and mechanics, and going upto advanced applications like: IOT, image processing, general robotics and lots more.

General course timeline: Sessions have currently been postponed until further notice due to logistical reasons. The general time duration of the full course will be around 8 weeks, with the final presentation and exam being held around the last week of July or the first week of August.

Courses offered:

S.No.	Course	Classes**	Duration
1.	Introduction to course, course expectations (Introduction week)	6 to 12	1 week
2.	Mathematics and Physics prerequisites	8 to 10	
3.	Electrical Design and Circuitry (Requires 2 day hands-on experience workshop)	6 to 12 *	2.5 weeks
4.	Mechanical Design and Power tools (Requires 2 day hands-on experience workshop)	8 to 12	
5.	Programming and Computer interface	6 to 12 *	2 weeks
6.	Product Design	6 to 12 *	1 week
7.	Coordination of components / Interfacing	6 to 12*	1 week
8.	Advanced Miscellaneous Topics	8 to 12	
9.	Final project + Presentation + Test	6 to 12	1 week

* Separate modules for discrete levels of understanding

** Recommended

Course Combinations offered:

1. **Full Course:** Includes all 8 individual courses, over a span of 8-9 weeks.
2. **Mechatronics:** Includes only “*Electrical design and circuitry*” and “*Mechanical design and power tools*” courses.
3. **Product Design:** Includes “*Product Design*” course on aesthetics of designing a machine, it’s uses and impacts on social life, systems engineering, and the essential elements that go into creating a final product.
4. **Programming and Arduino:** Includes “*Electrical design and circuitry*”, “*Programming and Computer interface*” and “*Coordination of components/ Interfacing*” courses. Covers only arduino, ranging from programming to the hardware.

NOTE: A student can only choose one of the above combinations (1 to 4). The individual course “Mathematics and Physics prerequisites” is optional for all combinations.

Details of individual courses:

1. **Introduction to course, course expectations (Introduction week):**
 - General course guidelines, ice-breaking session, course ethics and motivation.
2. **Mathematics and Physics prerequisites:**
 - **Mathematics:** The cartesian and polar coordinate system, trigonometry, graphing of functions, matrices and determinants, the quadratic formula, basic differential calculus.
 - **Physics:** Motion and its characteristics, center of mass, concepts of work, energy and power, moment of inertia, degrees of freedom, transmission of motion, gear transmission, gear ratio, concepts of torque and moments, simple machines, mechanical advantage, electricity - AC and DC, ohm’s law, magnets and electromagnetism.
3. **Electrical design and circuitry:**
 - **Module 1:** Basics of electronics, breadboards, resistors, capacitors, diodes, transistors, voltage dividers, relays, sinusoids and phasors etc.
 - **Module 2:** Analog and digital electronics, understanding schematics
 - **Module 3:**
 - Arduino:* Transistors and ICs to drive motors, reading sensors, Pulse Width Modulation, connecting speakers, USB and serial communication.
 - Building your own PCB:* Advanced circuit simulation and transforming the prototype circuit into custom Printed Circuit Boards (PCBs).
 - Hands-on workshop on usage of electronic tools and circuit soldering.

4. Mechanical design and power tools:

- **Module 1:** Introduction to robotics, motion subsystems, actuators (including connection with Arduino or similar microcontroller).
- **Module 2:** Sensors, vision system (to be continued in programming), transformations (links and joints) of robotic machines.
- **Module 3:** Statics and stability of structure, inertial considerations, motion control (path generation, point to point planning, cartesian space planning).
- Hands-on workshop on power tools and structure design.

5. Programming and Computer interface:

- **Module 1:** Basics of logic, boolean logic, programming, flowcharts, and basic Arduino programming.
- **Module 2:** Advanced Arduino programming - Algorithms, Hardware and timer interrupts, data logging and analysis.
- Simulation on AutoDesk 123D Circuits.

6. Product Design:

- **Module 1:** Designing a suitable enclosure for the product, design aesthetics and essential design elements.
- **Module 2:** Systems engineering and lifecycle of product

7. Coordination of components/ Interfacing:

- **Module 1:** Handshake protocol (Connecting and synchronising 2 arduino boards), I²C and SPI bus.
- **Module 2:** Processing, feedback loop

8. Advanced Miscellaneous Topics

- **Module 1:** Image processing, connecting arduino to internet (& IoT), filters (high pass, low pass), shift registers.

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Important details:

- The registration for the entire session on “Introduction to Machine Design” is free of cost.
- The session is based completely on Open Source Software/Technology.
- Each course will start with a brief overview of what had been taught in the last session followed by the content of that session. It will end with the summary points, so that clarity and understandability is maintained throughout, and all the students are at par with the flow of the course.
- The sessions will be conducted twice a week online on Google Drive where the particular document will be shared with the enrolled students in suggestion mode. They can read through the course document anytime during that day and write down their doubts or suggestions and ideas, which will be attended by the course instructor.
- Weekly assignments will be provided to all the students, which are to be completed within the stipulated time. Certification will be provided only on timely and successful submission of all assignments and passing of final test.
- After the course, all students will get to work on a project of their choice to be presented within a week’s time, for which they will receive guidance and technical help from the instructors. Makers of deserving projects will get recognition and a special Certificate of Merit on behalf of RoboKnights Club.