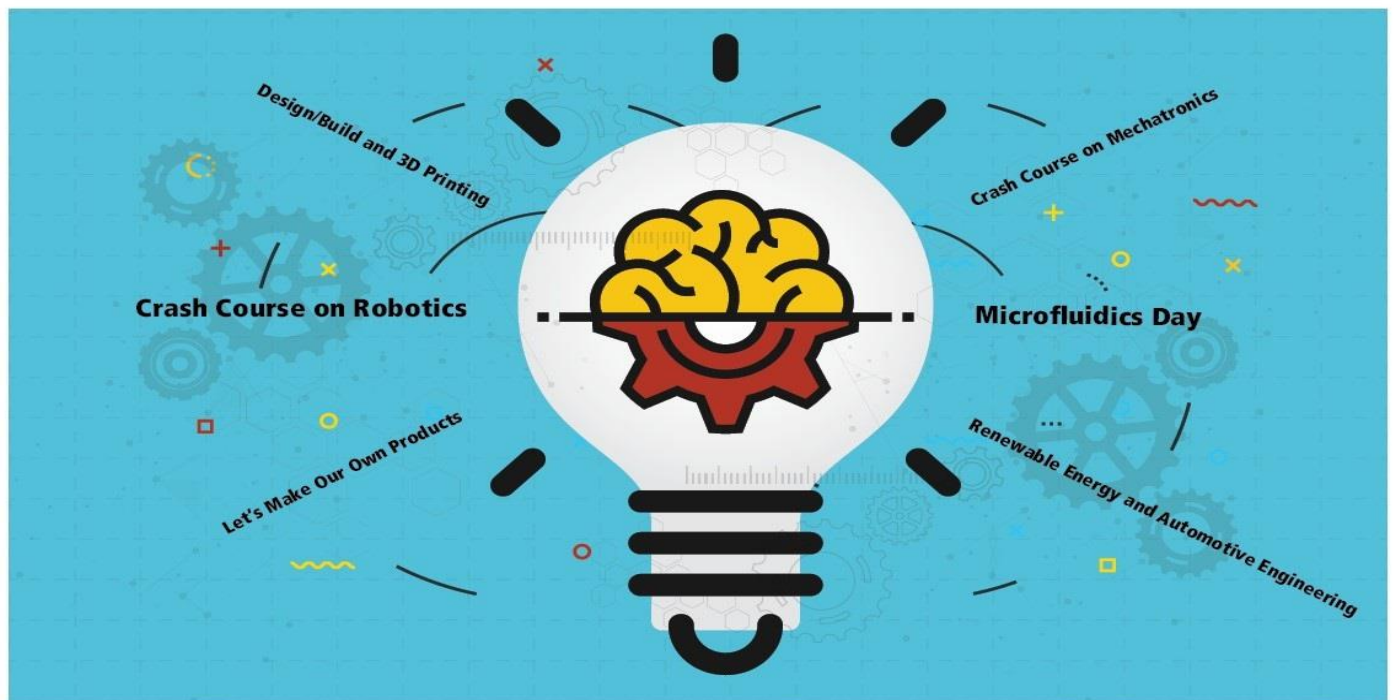


# Explore, Design and Build: A Mechanical Engineering Boot Camp

A Boot Camp Open to High School Students in Years 10–12

AUS College of Engineering



**Mechanical engineers are problem solvers and innovators. As the world changes, we are facing problems that only engineers can solve.**

At the AUS Mechanical Engineering Boot Camp, our hands-on activities will show you how studying mechanical engineering can lead to a career where you can design solutions to problems people face each day.

- Enjoy hands-on activities and build your critical thinking skills.
- Improve your communication and collaboration skills.
- Make new friends with similar interests.
- Enjoy an unforgettable campus experience at AUS.



Join our camp for five days of exploring mechanical engineering in our world-class university labs, led by our highly qualified faculty members.

# Welcome to AUS!

This boot camp help you explore the exciting field of mechanical engineering and build valuable skills.



- Learn how mechanical engineers solve problems and make a difference using modern engineering software.
- Find out about the mechanical engineering degree program and future career options.
- Enjoy hands-on activities and build your critical thinking skills.
- Improve your communication and collaboration skills.
- Make new friends with similar interests.
- Enjoy an unforgettable campus experience at AUS.

## **Day 1: Design/Build and 3D Printing Day**

You will learn how designers uses Autodesk Inventor to sketch and build their products. Designers start with making a 2D sketch, which is then used to make a 3D model for the needed part. All parts are assembled together to make the product. A 3D printed prototype can be tested in order to improve part shape and functionality. You will try new things and learn new skills!



### **Outline**

On this day of the camp, you will:

- learn how to use Autodesk Inventor to model a quadcopter
- learn how to use Autodesk Inventor to assemble all quadcopter parts
- learn how a 3D printer works
- use a 3D printer to make some parts of the prototype

## Day 2: Let's Make Our Own Products

The goal of workshop day is to introduce you to the manufacturing field. In addition to the technical skills mentioned in the outline, you will learn to work as a team, share knowledge and help each other. You will learn how things are made and how much effort and time it costs to make a product. By the end of the day, you will go home with useful things you have made.

### Outline

Throughout the workshop day, you will learn:

- how to read and convert drawings to real parts
- manufacturing methods like sheet metal work and metal forming
- how to use hand tools like the power drill, hacksaw, files, sheet metal sheet metal cutters, and a spot-welding gun
- how to take measurements using precise measuring tools like the Vernier caliper, micrometer and height gauge
- how to assemble parts by spot welding and the shrink fit method



## Day 3: Crash Course on Robotics

The crash course is designed to introduce you to computer algorithms through graphical programming tools and a robotics kit. You will get the chance to build your own LEGO robot and learn how to program it. The course activities are also set to emulate the autonomous capacity of a modern car, such as its special awareness, intelligent cruising, lane keeping and obstacle avoidance. You will leave with a deeper understanding of what makes a system autonomous and intelligent.

### Outline

On this day of the boot camp, you learn to:

- explain the significance of learning programming
- define and recognize a robot
- develop computational thinking skills
- create graphical algorithms
- build functional robots with the LEGO EV3 robotics kit
- program LEGO robots to solve simulated problems

## **Day 4: Crash Course on Mechatronics**

The crash course is designed to introduce you to mechatronics systems using the Arduino Inventor kit. You will learn how to build and program a mechatronics system. The course projects are designed to mimic real mechatronic systems and you will get familiar with the basic elements of a mechatronic system. At the end of the day, you will have a good understanding of mechatronic systems.

### **Outline**

On this day of the boot camp, participants will:

- learn to explain the significance of mechatronics systems
- get an overview of Arduino and become familiar with Arduino software
- learn how to send an output signal
- learn how to read an input signal
- build a functional mechatronics system with the Arduino inventor kit

## **Day 5: Renewable Energy, Automotive Engineering, and Micro fluids module**

Renewable energies sources are becoming increasingly important in today's world. They are clean and aid in the fight against climate change and pollution. They are inexhaustible as they are obtained from natural processes and convert existing flows of energy into useable forms. In this module, you will learn more about two types of renewable energies: solar and wind. Automotive engineering deals with the design, development, manufacturing, testing, maintenance and servicing of automobiles including cars, trucks, motorcycles and other vehicles, and the related sub systems. In this module, you will learn about the various mechanical design concepts related to design, manufacture and assembly of the engine, the gearbox and the differential, and the thermodynamic processes required to convert petrol or diesel fuel to mechanical engine power.

Have you seen scientists in Hollywood movies using sophisticated equipment to analyze the DNA in a blood sample in the lab to identify a murder suspect? Would not this be faster if they could perform such analysis using pocket devices at the crime scene? Microfluidics, a branch of science devoted to studying liquid flow in micron-size channels (i.e., 1/100 the diameter of a human hair), has facilitated miniaturization of many of the biological assays used for forensic applications and medical diagnostics.

In this module, you will be introduced to the basic concepts of microfluidics: how liquids are manipulated in micro channels and the fabrication techniques required to produce such micro devices. You will also design and make some microfluidic chips yourself.

### **Outline**

On this day, you will learn:

- The basics of converting solar energy into electrical energy by assembling a system of a solar panel, charge controller, battery, inverter and load center.
- The basics of converting wind energy into electrical energy using a lab scale aero generator and wind turbine, and observing the effect of air velocity, air direction, turbine blade configuration and load on the power generation performance.
- The design, operation and performance of internal combustion engines including petrol and diesel engines, 2-stroke and 4-stroke engines, and 4-cylinder and 6-cylinder engines.
- The design and operation of a gearbox and a differential.
- Explain the advantages of using microfluidics in biomedical applications.
- Design a network of micro channels using simple CAD programs
- Fabricate micro channels using laser engraving on acrylic sheets



### Detailed Schedule

Day	Time	Topic	Room
<b>Tuesday 13/12/2022</b>	09:30–10:00	Welcoming and Introduction	Computer Lab
	10:00–10:45	2D sketching	
	10:45–11:00	Break	
	11:00–11:45	3D Part Modeling I	
	11:45–12:15	3D Part Modeling II	
	12:15–12:45	Break	
	12:45–01:45	Machines Assembly	
	01:45–02:00	Break	
	02:00–03:00	3D printing Demo	
<b>Wednesday 14/12/2022</b>	10:00–10:45	Welcome + marking the grill parts	Computer Lab
	10:45–11:00	Break	Manufacturing Lab
	11:00–11:45	Cutting and bending the parts	
	11:45–12:15	Assembling the grill using spot welding gun	
	12:15–12:45	Break	
	12:45–01:45	Introduction to CNC + marking and milling hammer head	
	01:45–02:00	Break	
02:00–03:00	Assembling hammer head and handle		
<b>Thursday 15/12/2022</b>	10:00–10:45	Welcoming, Introduction, and Lego EV3 hardware and software	Computer Lab
	10:45–11:00	Break	
	11:00–11:45	Simple driving and turning of your Robot	
	11:45–12:15	Emulate car reversing sensors on your Robot	
	12:15–12:45	Break	
	12:45–01:45	Line following Automated Robot	
	01:45–02:00	Break	
	02:00–03:00	Simple driving and turning of your Robot	

Day	Time	Topic	Room
<b>Monday 19/12/2022</b>  <b>Crash Course on Mechatronics</b>	10:00–10:45	Introduction, Arduino Hardware and Software, and Basic Electronics Components	Computer Lab
	10:45–11:00	Break	
	11:00–11:45	Project 1: Traffic Light Signal	
	11:45–12:15	Sensors	
	12:15–12:45	Break	
	12:45–01:45	Project 2: Motion Detection Alarm	
	01:45–02:00	Break	
	02:00–03:00	Actuators, and Conclusion	
<b>Tuesday 20/12/2022</b>  <b>Microfluids, Renewable Energy and Automotive Modules</b>	10:00–10:45	Introduction to microfluidics and its applications: advantages, mechanobiology for diagnostics, automation of biological assays and optics	Computer lab
	10:45–11:00	Break	
	11:00–11:45	Prepare the Design of the Microchannel Network using CAD Software	Computer lab
	11:45–12:15	Fabrication of Microchannels Using Laser Engraving and Thermal Bonding	Manufacturing lab
	12:15–12:45	Break	
	12:45–01:45	Renewable Energy: Solar and Wind Energy	Computer lab
	01:45–02:00	Break	
	02:00–03:00	Automotive Engineering, Part 1: Engines and Gearbox	EB2-037 ICE Lab

**Thank you for joining our mechanical engineering boot camp!**

To find out more about the Bachelor Science in Mechanical Engineering offered at AUS and the amazing career opportunities it can lead to, please visit [www.aus.edu/cen/bsmce](http://www.aus.edu/cen/bsmce).

American University of Sharjah  
Department of Mechanical Engineering  
www.aus.edu