

ROBOTICS CLUB

SCIENCE AND TECHNOLOGY
COUNCIL
IIT KANPUR



Robotics Club Winter Camp 2019

Unlock The Roboticist Within!



Designing and Manufacturing

What kind of a company is this?



Apple is also precision manufacturing company

- Apple's market value: ~1 trillion USD
- Apple makes excellent products that people want, but also because it's a precision manufacturing company, and manufacturing is a value multiplier

Why manufacturing?

- Look around you – Everything is manufactured
- Manufacturing has become an increasingly complex activity – Needs engineers, managers, technicians, policy makers and politicians
- Manufacturing adds value

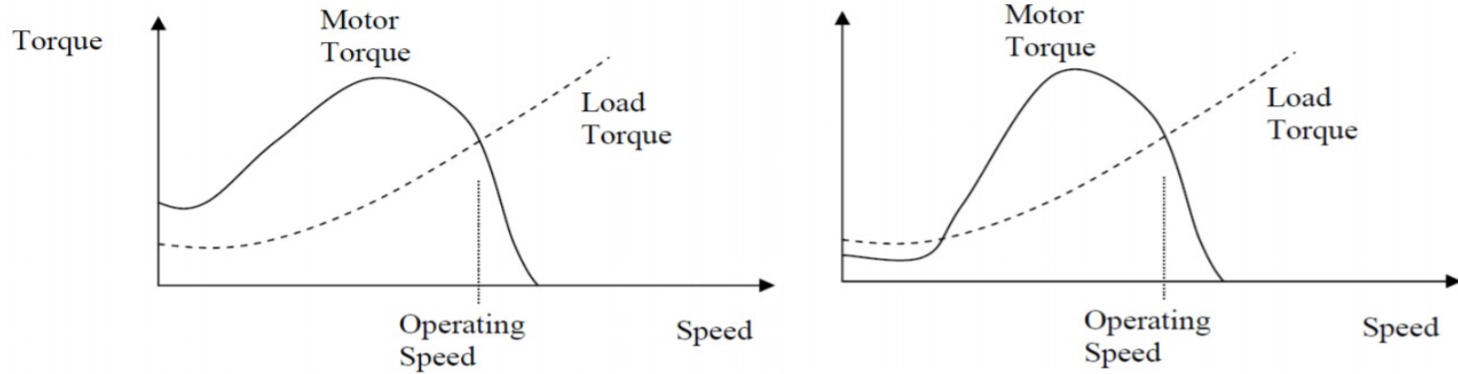
Sizing projects and motors

Normally, you design a mechanism or a machine to perform a given task, or useful mechanical work, and select motors that can provide the necessary speed, power, and torque to help you achieve your goals.

Steps involved in sizing motors

- **Step 1** - Decide on a mechanism (direct rotation, screw-nut, gears, belt-pulley, etc.)
- **Step 2** - Determine dimensions, mass and friction necessary for load calculations
- **Step 3** - Determine the operating speed, positioning, load specifications etc.
- **Step 4** - Calculate the inertia, torque and speed to be supplied by the motor
- **Step 5** - Select the motor(s)

Which of these motors will not start?

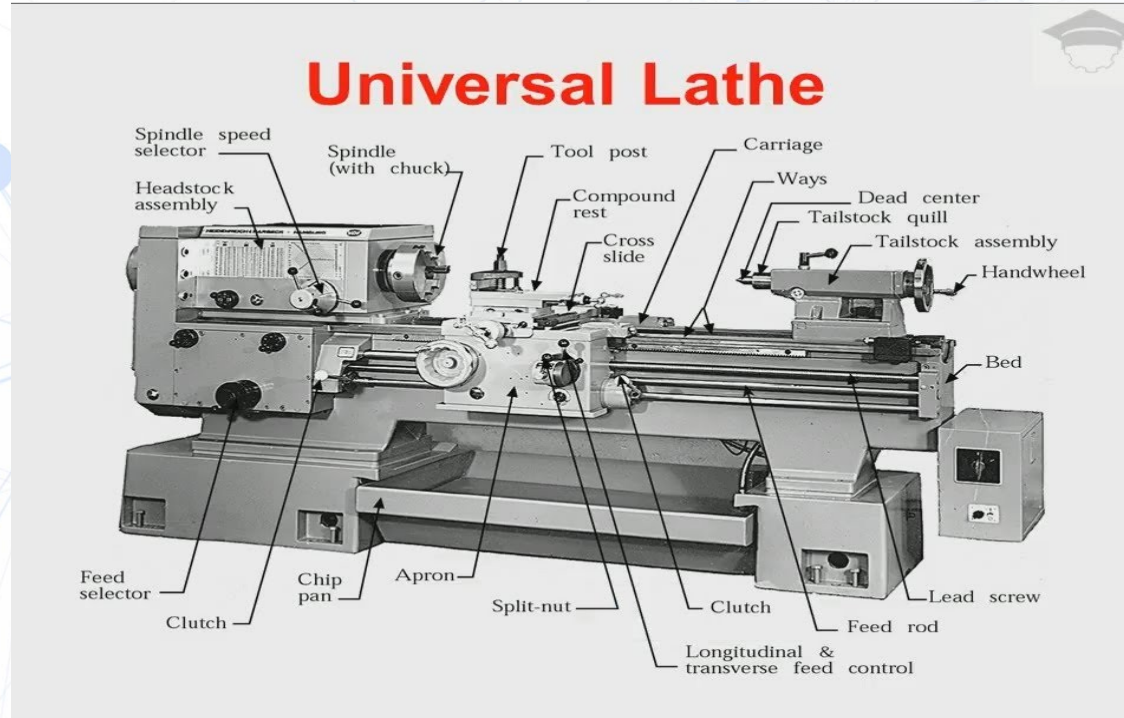


Machines and machining processes

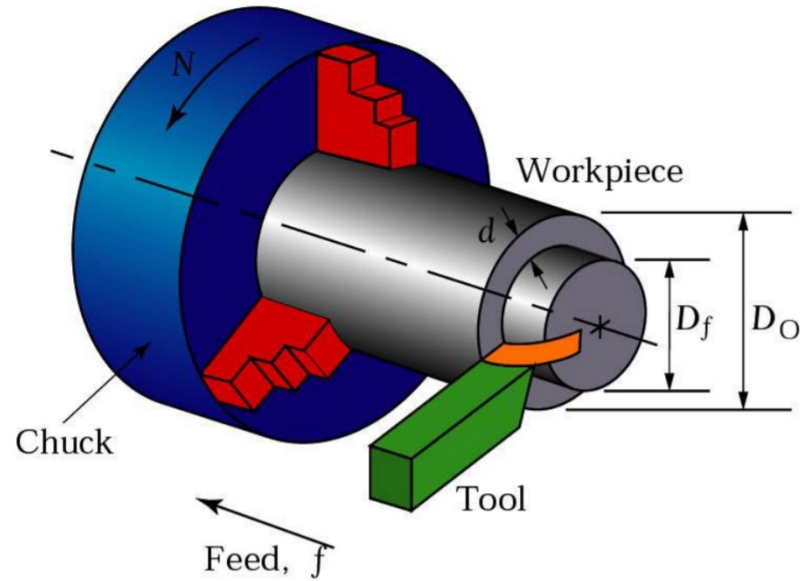
- Machine is a mechanism or a collection of mechanisms which performs useful mechanical work. For us, that useful mechanical work will be used to make parts used in your projects.
- Broadly, the two types on machines that concern us in this course: manual machines and CNC machines.

Manual Machines

Lathe machine



Turning on a lathe



Kalpajian and Schmid's book

<https://www.youtube.com/watch?v=XXpOwsD0fWM>

Drilling machine



<https://www.youtube.com/watch?v=6nGsVgD2W4k>

Milling machine



<https://www.youtube.com/watch?v=IAm6x9WSdhY>

Let's make a spur gear



Step 1: Identify the raw material – a cylinder in this case



Step 2: Turning of cylinder in the lathe



Step 3: Cut the gear teeth one at a time in Milling Machine



Index



Your spur gear should look like:



CNC Machines



<https://www.youtube.com/watch?v=IbV4vIYUg1U>

<https://www.youtube.com/watch?v=s5si6YMxJTo>

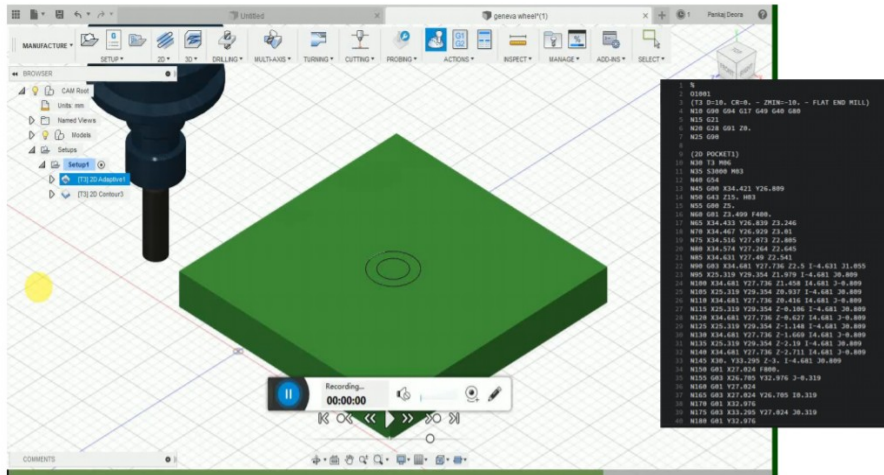
What is a CNC machine?

- Computer numerically controlled (CNC) machine tools were developed with minicomputers used as control units in the 1970s.
- Current CNC systems allow simultaneous servo-position and velocity control of all the axis, monitoring of controller and machine tool performance, online part programming with graphical assistance, in-process cutting process monitoring, and in-process part gauging for completely unmanned machining operations.
- Fundamental units of CNC machine tools:
 - The mechanical machine tool unit
 - Power units (motors and amplifiers),
 - The CNC unit

Difference between Manual And CNC Machine

Primary difference between manual machines and CNC machines is that CNC machines have servo-controlled feed and spindle drive systems, i.e., there is feedback.

Software for CNC Machines



- Autodesk Fusion 360
- Import CAD Model from Autodesk Inventor
- Generate G Code in Fusion 360
- Simulate the CNC operations in it.
- Feed the Programme to CNC Machine for part making.

Non-traditional Machining

Why non-traditional machining processes?

Sometimes traditional methods of manufacturing face difficulties with:

- New materials with a low machinability (Nickel alloys)
- Meeting dimensional and accuracy requirements (sub-micron)
- Making products with complicated geometries (non-circular holes)
- Meeting productivity rates with economy

Some Non-traditional machining processes:

- Abrasive jet machining (AJM)
- Ultrasonic machining (USM)
- Electrochemical Machining (ECM)
- Electric discharge machining (EDM)

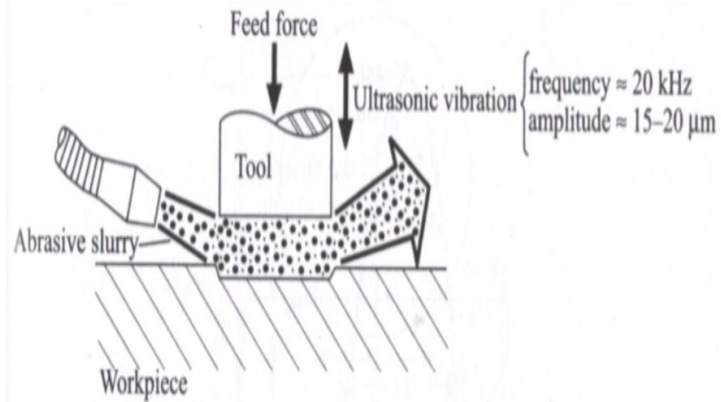
Abrasive jet machining (AJM)



- Abrasive jet machining is best suited for machining brittle and heat sensitive materials like glass, quartz, sapphire, ceramics etc.
- It is used for drilling holes, cutting slots, cleaning hard surfaces, deburring, polishing etc.

<https://www.youtube.com/watch?v=EqpdPc7urGQ>

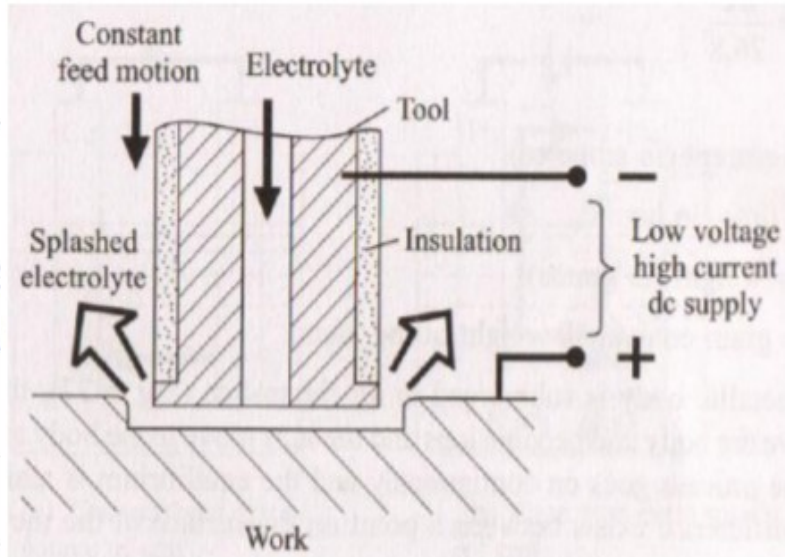
Ultrasonic machining (USM)



- Basic USM process involves a tool (made of a ductile and tough material) vibrating at a high frequency with a continuous flow of an abrasive slurry between the gap between the tool and the workpiece.
- Impact of hard abrasive grains fractures the hard and brittle workpiece, resulting in removal of work material in the form of small particles carried away by the slurry.

<https://www.youtube.com/watch?v=jh8852sfhpw>

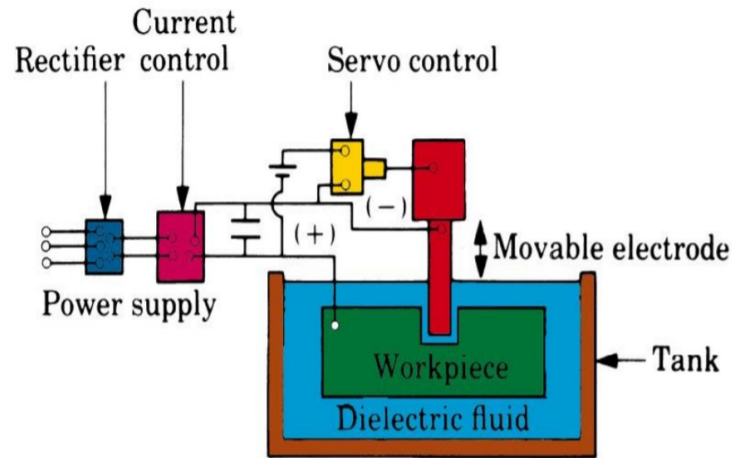
Electrochemical Machining (ECM)



- Based on the principle of electrolysis, and can be thought of as the reverse of electroplating
- Workpiece is the anode (+ve terminal), and tool is the cathode (-ve terminal)
- Gap between tool and workpiece is filled with an electrolyte, and is maintained constant, and typically is of the order of a few hundred micron
- When current is passed, dissolution of the anode occurs, and is prevented from being deposited on the tool, by a flushing action of the electrolyte

<https://www.youtube.com/watch?v=Ej-GWNPYFVM>

Electric discharge machining (EDM)



- Any materials that are electrically conductive can be machined by EDM.
- Materials, regardless of their hardness, strength, toughness and microstructure can be easily machined/cut by EDM process.
- Edge machining and sharp corners are possible in EDM process.
- The tool making is easier as it can be made from softer and easily formable materials like copper, brass and graphite.

<https://www.youtube.com/watch?v=L1D5DLWWMp8>

<https://www.youtube.com/watch?v=rbPfYrDTLMI>

Contact us if you have any problem/ suggestion:

Aditya Goyal

8728070756

Anmol Gupta

8445142083

 **akash Choudhary**
roboticsclubiitkanpur@gmail.com



377993633
<http://students.iitk.ac.in/roboclub/>



<https://www.facebook.com/roboclubiitkanpur>



<https://www.youtube.com/c/RoboticsClubIITKanpur>

