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# PRACTICAL FUNDAMENTALS OF MECHANICAL ENGINEERING



## **YOU WILL LEARN HOW TO:**

- Understand the principles of mechanical drawings and design
- Do basic static safety factor mechanical designs
- Identify failure modes of mechanical components
- Understand the behaviour of engineering materials and do basic selections
- Select manufacturing processes for simple designs
- Design and implement simple mechanical automation systems
- Understand the principles of fluid engineering
- Identify and select basic fluid engineering components
- Perform simple fluid engineering designs
- Select a maintenance strategy for mechanical machinery
- Recognise general mechanical problems and suggest corrective actions

## **WHO SHOULD ATTEND:**

This introductory seminar is designed for those with little or no prior formal background, who function as managers, supervisors, engineers, planners, inspectors, designers, researchers, investors or procurers, and who seek a basic understanding of the practical aspects of mechanical engineering.

## The Workshop

This workshop introduces the basics and fundamental concepts and applications of Mechanical Engineering. The course starts with an introduction to the basic principles of mechanical drawings such as tolerances, symbols, sections, fasteners etc. The use of computer aided design and good drawing office practises are also discussed. After this, the properties and mechanical behaviour of engineering components are presented. Phenomena such as stress and strain, fatigue, fracture, creep and corrosion are discussed. Mechanical design philosophies are discussed with the focus on the use of safety factors during the design for static strength. Delegates will have the opportunity to gain some insight in the process of mechanical design for manufacturing/production.

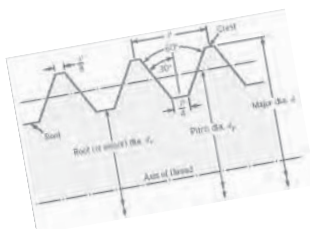
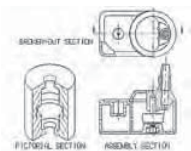
Various manufacturing operations will be discussed, starting with the production of metal and alloys. The methods to shape metal into its final desired shape, such as casting, forming, machining, welding etc. will be discussed. Delegates will be introduced to the use of computerised methods of manufacturing (CNC, CAM) and also the use of rapid prototyping. Principles of mechanical automation as it is typically found in industry will be discussed with the focus on the application of hydraulic and pneumatic systems. There is also a discussion on electric motors, mechanical actuation systems and common control systems (e.g. PLCs).

The course will also introduce the various aspects of pipe technology, including types of pumps, flanges, gaskets, jointing methods, pipe support and standards. The basic design and analysis of pipe systems will also be presented. An introduction of underlying practical principals of thermodynamics will also be included. The course closes off with a discussion on one of the most important aspects in mechanical engineering, namely maintenance. A discussion on the various types of maintenance philosophies and their underlying principles will enable delegates to identify the correct maintenance approach for their workplace.

## Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

**To gain full value from this workshop, please bring your laptop/notebook computer.**



## The Program

### BASICS OF MECHANICAL ENGINEERING

- Basic concepts
- Units for engineering quantities
- Friction and its importance

### MECHANICAL DRAWINGS

- Purpose of drawings
- Lines, letters
- Projections, views
- Sections
- Conventions
- Dimensions
- Symbols
- Assemblies
- Welds, bolts, keyways, rivets, etc.
- Shafts and bearings
- Fitting and tolerances
- Couplings
- Transmission components (belts, gears etc.)
- Flow control equipment
- CAD
- Design and drawing office practices

### ENGINEERING MATERIALS

- The processing of metals and alloys
- Stress and strain in metals
- Normal stress and shear stress
- Tensile and hardness testing
- Stress and strain diagram
- Alloy production and properties (stainless, copper, aluminium, cast iron etc.)
- Fracture of metals
- Fatigue of metals
- Creep and stress rupture of metals
- Types of corrosion
- Corrosion control

### MECHANICAL DESIGN

- Design philosophies/methods/phases
- Factor of safety
- Codes and standards
- Loads (forces, moments)
- Static analysis of systems
- Design for static strength
- Design of fasteners and connections
- Design of load-carrying members
- Fundamentals practises of design-for-fatigue
- Design for manufacturing
- Tolerance, limits and fits

### MECHANICAL ENGINEERING CODES AND STANDARDS

- Need for standardization
- Overview of standards
- Benefits of standardization
- Mechanical engineering standardisation
- ISO 9000/1
- Six sigma

### MANUFACTURING

- Metal production - foundry
- Casting
- Heat treatment
- Hot working of metal
- Cold working of metal
- Press work and tooling
- Numerical control
- Machining, metal cutting (turning, drilling, boring, milling)
- Shaping, sawing, broaching
- Welding, brazing
- CAM
- Rapid prototyping

### MECHANICAL AUTOMATION

- Sensors and transducers
- Pneumatics
- Hydraulics
- Mechanical and electrical actuation
- Principles of control systems
- PLCs

### FLUID ENGINEERING

- Pumps
- Compressors
- Other fluid engineering components
- Design/analysis of piping systems
- Principles of thermodynamics (introduction to first and second law)
- Power and refrigeration systems

### MAINTENANCE OF MACHINERY

- Maintenance philosophies
- On-line tests/inspections
- Time-based maintenance
- Condition-based maintenance

### THEORY OF HEAT TRANSFER

- Heat basics
- Heat transfer: conduction, convection and radiation
- Laws of thermodynamics
- Thermal cycles
- Heat exchangers: types, maintenance and troubleshooting
- Heat pumps
- Air conditioning

### SUMMARY, OPEN FORUM AND CLOSING

