

Michela Di Rocchi  
Cinzia Ferrari

# IMech

English for Mechanical Technology

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<b>ORIENTAMENTO ALLA PROFESSIONE</b>

**HOEPLI**



# I Mech

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Via Hoepli 5, 20121 Milano (Italy)

tel. +39 02 864871 – fax +39 02 8052886

e-mail [hoepli@hoepli.it](mailto:hoepli@hoepli.it)

**[www.hoepli.it](http://www.hoepli.it)**



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MICHELA DI ROCCHI

CINZIA FERRARI

# I Mech

English  
for Mechanical Technology



**EDITORE ULRICO HOEPLI MILANO**

# PRESENTAZIONE

## Contenuto e impostazione

*I Mech* è un nuovo corso di inglese tecnico destinato agli studenti che frequentano il secondo biennio e il quinto anno delle scuole secondarie superiori, per gli Istituti Tecnici indirizzo Meccanica, Meccatronica ed Energia e per gli Istituti Professionali indirizzo Industria e Artigianato per il Made in Italy. Il testo è stato costruito secondo le Linee Guida ministeriali e si propone di condurre lo studente al traguardo di competenza linguistica B2 (QCER).

Il volume ha l'obiettivo di far raggiungere agli studenti la padronanza della microlingua inglese nel settore di riferimento, con una particolare attenzione allo sviluppo di **conoscenze, abilità e competenze**.

La metodologia seguita parte dai contenuti propri dell'indirizzo per sviluppare con gradualità l'acquisizione del vocabolario tecnico, la padronanza delle strutture linguistiche e le abilità produttive. Il volume si compone di 3 moduli che richiamano i settori di indirizzo, ciascuno formato da un numero variabile di unità.

Ogni unità comprende:

- **letture tecniche** tratte da materiali reali e attuali, corredate di un glossario per i termini più complessi e con esercizi di varia tipologia, graduati per livello di difficoltà;
- la sezione **Expand your Vocabulary**, con attività di ampliamento e rafforzamento del **lessico**, con l'ausilio di disegni e immagini ed esercizi calibrati anche per la didattica inclusiva;
- la sezione **Language in Action**, che propone due pagine di **riepilogo grammaticale**, accompagnate anche da attività di *Word Formation* e *Use of English* basate sulle certificazioni PET e FIRST;
- la sezione **Professional Communication**, che riprende i contenuti tecnici dell'unità in chiave comunicativa ed è arricchita dal box **Key language**, con espressioni utili per l'interazione nel mondo professionale;
- la sezione **What do you Remember?**, che propone una **mappa finale** di riepilogo dei contenuti, utile per il ripasso e per la didattica inclusiva.

Oltre alle attività di ascolto, numerosi spunti per approfondire le tematiche trattate vengono fornite da **Surf the Net!**, una rubrica dedicata alla visione di filmati legati ai contenuti tecnici.

Una sezione **Work it out!** propone, per ogni modulo tecnico, dei **compiti di realtà** che offrono agli studenti l'opportunità di mettere in atto le competenze acquisite sulla base delle conoscenze.

A fine volume, **From School to Work** offre due strumenti utili per lo studio e il lavoro. Il primo, **Safety**, affronta la tematica della sicurezza sul lavoro sia dal punto di vista pratico, delle misure da adottare, sia dal punto di vista dell'atteggiamento e del comportamento da tenere. Il secondo, **Applying for a Job**, propone una sequenza di attività che permettono agli studenti di acquisire il vocabolario, le conoscenze e le competenze necessarie per chi si affaccia a un mondo del lavoro sempre più internazionale.

Infine, il modulo **Culture and Society** presenta letture con contenuti di attualità collegati ad argomenti tecnici. Sono presenti attività di comprensione sulla tipologia delle **prove INVALSI** per accompagnare gli studenti nella preparazione all'Esame di Stato.

A completamento del corso si trova un **Technical Glossary**, con i vocaboli più ricorrenti nel testo e specifici della materia.

## Caratteristiche del corso




- **Chiarezza e praticità:** tutte le letture tecniche sono suddivise in brevi paragrafi e articolate su due pagine a fronte. La struttura del volume è snella e lineare, **facile da usare** per gli studenti e gli insegnanti.
- **Efficacia:** gli esercizi presentano un **grado crescente di difficoltà** e attivano le abilità ricettive per arrivare a quelle produttive.
- **Motivazione:** il testo offre spunti di riflessione per stimolare la capacità di **pensiero critico** e la **personalizzazione dei contenuti**, attraverso attività che richiedono una riflessione autonoma da parte degli studenti.
- **Sviluppo delle competenze comunicative simulando contesti professionali reali:** grazie ad attività specifiche che esercitano tutte le abilità in situazioni tipiche del contesto lavorativo.
- **Inclusione:** il testo offre attività specifiche per **studenti con bisogni educativi speciali** nelle sezioni *What do you Remember?*, che sintetizzano i saperi ed esplicitano la relazione tra essi in modo visivo, e nelle verifiche dedicate presenti nel *Teacher's Book*. Sono frequenti inoltre le proposte di attività a coppie o di gruppo, per favorire l'**apprendimento cooperativo** e la capacità di **lavorare in team**.
- **Ricchezza iconografica:** l'ampio apparato di immagini e disegni rende lo studio più attraente; è rivolto agli studenti di tutti i livelli e stili di studio e facilita la comprensione e l'apprendimento.
- **Contenuto aggiornato e collegamenti con il mondo del lavoro:** l'opera è stata progettata seguendo le indicazioni ministeriali e le richieste provenienti dal mondo del lavoro.

## CD-Audio

Contiene le registrazioni degli esercizi di ascolto proposti nel volume.

## eBook+

LeBook+ presenta l'intero testo in versione digitale, utilizzabile su tablet, LIM e computer, e offre numerosi contenuti aggiuntivi:

-  **esercizi interattivi**, che consentono allo studente un'utile attività di autoverifica;
-  link a **video** per attività di approfondimento;
-  i **file audio** di tutti gli esercizi di ascolto proposti nel volume.

## Risorse online [hoepliscuola.it](http://hoepliscuola.it)

Per ogni modulo sono disponibili le registrazioni degli esercizi di ascolto proposti nel volume, ulteriori materiali integrativi e strumenti didattici per il docente.

## Teacher's Book

Il *Teacher's Book* contiene:

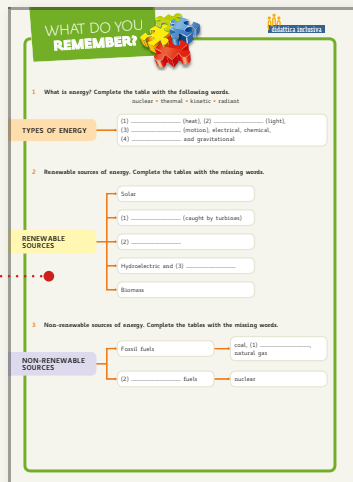
- **script e soluzioni** degli esercizi del volume;
- **prove di verifica standard**, con soluzioni;
- **prove di verifica per la didattica inclusiva**, con soluzioni.







Professional Communication sviluppa le competenze comunicative attraverso attività che simulano situazioni professionali reali, accompagnate da espressioni utili (Key language) per l'interazione nel mondo del lavoro.



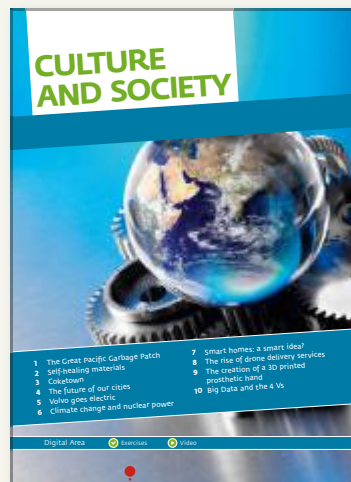
What do you Remember? propone una mappa finale da completare, fornendo un riepilogo dei contenuti dell'unità. Si presenta come un utile strumento anche per la didattica inclusiva.



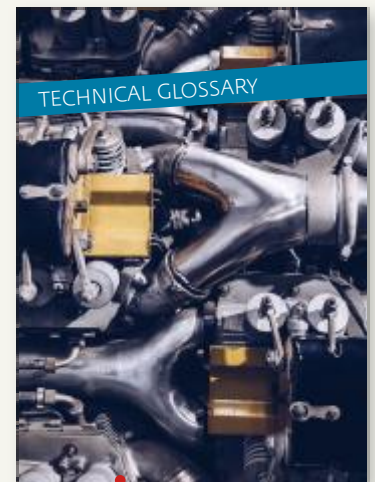
Alla fine di ogni modulo, la sezione Work it out! propone compiti di realtà che offrono la possibilità di mettere in atto la didattica per competenze e che permettono di svolgere lavori interdisciplinari con le materie professionalizzanti.



Il modulo From School to Work offre strumenti utili per lo studio e per il lavoro. La sezione Safety affronta la tematica della sicurezza. La sezione Applying for a job propone attività che consentono agli studenti di acquisire il vocabolario, le conoscenze e le competenze utili per l'inserimento nel mondo del lavoro.



Il modulo Culture and Society offre approfondimenti tematici e contenuti di attualità collegati al mondo della cultura tecnologica. Sono presenti attività di comprensione sulla tipologia delle prove INVALSI per accompagnare gli studenti nella preparazione all'Esame di Stato.



A fine volume, un glossario inglese-italiano riepiloga i vocaboli più ricorrenti nel testo e specifici della materia.

# INDICE

## WHAT IS MECHATRONICS?

The rise of Mechatronics 1

## MECHANICS

UNIT	Competences	Lessons	
<b>1</b> <b>MATERIALS</b> <b>IN ENGINEERING</b>	<ul style="list-style-type: none"> <li>Describe and compare the properties of materials</li> <li>Understand and explain the different types of materials according to their properties</li> <li>Analyse, evaluate and describe the properties of objects</li> <li>Understand the presentation of a new project</li> <li>Work in a team</li> <li>Develop critical thinking</li> <li>Describe the properties and other characteristics of a product</li> </ul>	<b>1 Materials and their properties</b> 8 <b>2 Metals</b> 12 <b>3 Polymers: plastics and rubbers</b> 14 <b>4 Other types of materials</b> 16	
<b>2</b> <b>MECHANICAL</b> <b>DRAWING</b>	<ul style="list-style-type: none"> <li>Describe technical drawing and its basic tools</li> <li>Describe the main conventions used in technical drawing</li> <li>Describe the most important technical representations</li> <li>Describe CAD</li> <li>Work in a team</li> <li>Develop critical thinking</li> <li>Give information about measurements and calculations</li> </ul>	<b>1 Technical drawing</b> 26 <b>2 Lines and other conventions</b> 28 <b>3 Technical representations</b> 30 <b>4 CAD (Computer Aided Design)</b> 32	
<b>3</b> <b>MACHINE TOOLS</b>	<ul style="list-style-type: none"> <li>Describe machine tools and their main parts</li> <li>Describe how machine tools work</li> <li>Work in a team</li> <li>Develop critical thinking</li> <li>Ask for information</li> </ul>	<b>1 Different types of machine tools</b> 42 <b>2 Drilling, turning and milling machines</b> 44 <b>3 Other machine tools</b> 48	
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	Expand your vocabulary	Language in action	Professional communication	What do you remember?	Digital Area
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	<ul style="list-style-type: none"> <li>Metalworking processes 66</li> </ul>	<ul style="list-style-type: none"> <li>Passive forms 68</li> </ul>	<ul style="list-style-type: none"> <li>Requesting information about courses 70</li> <li>KEY LANGUAGE 70</li> </ul>	<ul style="list-style-type: none"> <li>Concept map 72</li> </ul>	<ul style="list-style-type: none"> <li>Exercises</li> <li>Listening exercises</li> <li>Video</li> </ul>

UNIT	Competences	Lessons	
<b>5</b> ENGINES	<ul style="list-style-type: none"> <li>Describe the main components of an internal combustion engine and explain their functions</li> <li>Describe and compare internal combustion petrol and Diesel engines</li> <li>Understand and explain the operation of internal combustion engines</li> <li>Describe the main engine systems and explain their function</li> <li>Interpret and summarize information</li> <li>Analyse and evaluate basic vehicle maintenance procedures</li> <li>Work in a team</li> <li>Develop critical thinking</li> <li>Offer solutions</li> </ul>	<ol style="list-style-type: none"> <li>Engines: the basics 74</li> <li>The four-stroke cycle 76</li> <li>The Diesel engine 78</li> <li>The engine systems 80</li> </ol>	
<b>6</b> HEATING AND REFRIGERATION SYSTEMS	<ul style="list-style-type: none"> <li>Describe different types of heating systems</li> <li>Explain the basic operation of heating, refrigeration and air conditioning systems</li> <li>Understand and provide suggestions to choose a heating system and to reduce energy consumption</li> <li>Describe different types of pumps</li> <li>Work in a team</li> <li>Develop critical thinking</li> <li>Speak on the phone</li> </ul>	<ol style="list-style-type: none"> <li>Heating systems 90</li> <li>Refrigeration systems 92</li> <li>Hydraulic machines: pumps 94</li> </ol>	
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## ELECTRICAL ENGINEERING

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	Expand your vocabulary	Language in action	Professional communication	What do you remember?	Digital Area
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	Expand your vocabulary	Language in action	Professional communication	What do you remember?	Digital Area
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UNIT	Competences	Lessons	
<b>8</b> ENERGY SOURCES	<ul style="list-style-type: none"> <li>Describe the different types of energy</li> <li>Classify the different sources of energy</li> <li>Work in a team</li> <li>Develop critical thinking</li> <li>Take part in a debate</li> </ul>	1 What is energy?	126
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## ELECTRONICS AND CONTROL SYSTEMS

UNIT	Competences	Lessons	
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	Expand your vocabulary	Language in action	Professional communication	What do you remember?	Digital Area
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	Expand your vocabulary	Language in action	Professional communication	What do you remember?	Digital Area
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	<ul style="list-style-type: none"> <li>• Control systems 166</li> </ul>	<ul style="list-style-type: none"> <li>• Infinitives and gerunds: the basics 168</li> </ul>	<ul style="list-style-type: none"> <li>• Making and responding to complaints 170</li> <li>• KEY LANGUAGE 171</li> </ul>	<ul style="list-style-type: none"> <li>• Concept map 172</li> </ul>	<ul style="list-style-type: none"> <li>✓ Exercises</li> <li>▶ Listening exercises</li> <li>▶ Video</li> </ul>

UNIT	Competences	Lessons	
<b>11</b> <b>ROBOTICS</b>	<ul style="list-style-type: none"> <li>• Explain what a robot is</li> <li>• Identify the elements of a robot and describe its mechanical structure</li> <li>• Describe the different types of industrial robots</li> <li>• Describe the main parts of a robotic arm and explain their features</li> <li>• Describe different types of end-effectors</li> <li>• Explain how to choose an end-effector</li> <li>• Work in a team</li> <li>• Develop critical thinking</li> <li>• Describe graphs and charts</li> </ul>	<b>1 Robotics: the basics</b> 174 <b>2 Industrial robots</b> 176 <b>3 The robotic arm</b> 178	
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	Expand your vocabulary	Language in action	Professional communication	What do you remember?	Digital Area
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# L'OFFERTA DIDATTICA HOEPLI

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## Edizione **OPENSCHOOL**



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# WHAT IS MECHATRONICS?



# THE RISE OF MECHATRONICS

## Warm up

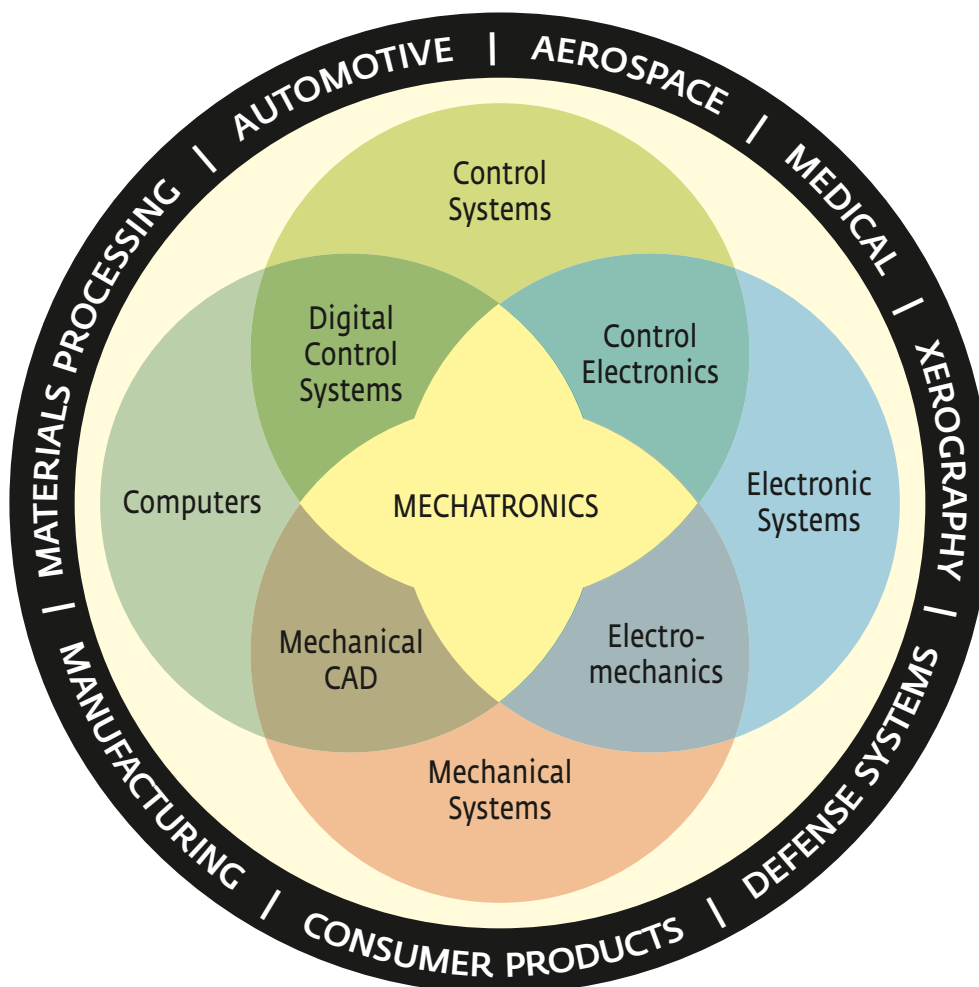
- 1 Why would you like to study Mechanics and Mechatronics?
- 2 What activities do you think you will do?

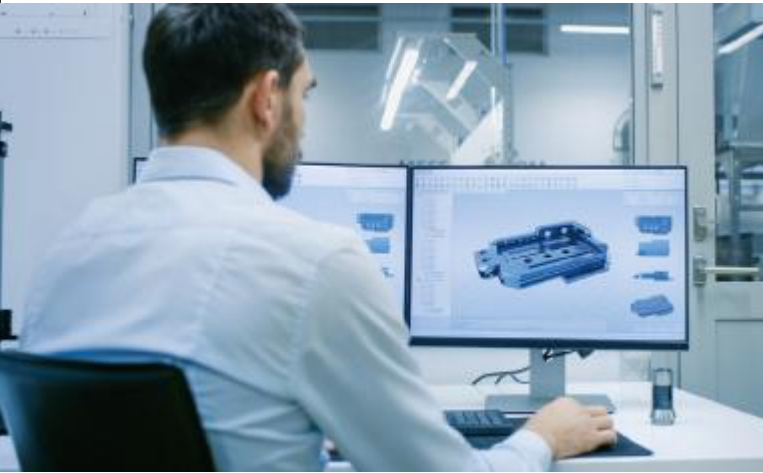
The fourth Industrial Revolution has begun and new technologies are used to improve the quality of production and work conditions. Mechanical, electronic and informatics systems have merged and have been integrated into new smart, automated systems. This marked the birth of a new branch of Engineering, called **Mechatronics**, a word that is a combination of Mechanics and Electronics.

In fact, Mechatronics Engineering deals with the design, construction and maintenance of **computer-controlled electromechanical** systems. It includes several disciplines, in particular:

- **mechanical technology**;
- **electronics**;
- **electrotechnology** and **electrical engineering**;
- **computer science and informatics**.

The new mechatronic systems are composed of traditional mechanical components, but also have electronic parts. In them, **sensors, actuators** and **computers** are all interconnected in a new system that can be programmed to act automatically according to the instructions given by the user, while computers control the process.





An engineer is designing an object.

These systems can be applied to a variety of fields, such as automotive, aerospace, medicine, industrial manufacturing and materials processes.

### The profile of the Mechatronic technician

The fast evolution of industrial technologies has changed the professional profiles of mechanical engineers and technicians, because today companies require more and more skilled workers. The graduate in Mechanics, Mechatronics and Energy should have specific skills such as:

- **understanding the properties of materials** related to their use and the manufacturing process;
- **measuring, elaborating and evaluating technical characteristics** using the correct instruments;
- organizing the manufacturing process, defining the **design, construction, control** and **test** of the product;
- following the industrial processes, elaborating the working cycles, analyzing and evaluating the costs;
- **designing** structures and systems applying also Maths processes and analysing the answers to the mechanical, thermal and electrical stresses;
- **assembling and testing** components, machines and thermo-technical systems; certifying the results and writing technical instructions and texts;
- **organising and running maintenance processes** according to the correct procedures;

- defining, classifying and programming the integrated **automated systems** and applying **robotics** to the manufacturing processes;
- running projects according to the procedures and the standards required by the **quality and safety systems** of the company;
- understanding the specific problems linked to the **use of energy**; managing energy use and its control to optimize its consumption and protect the environment.

### Where Mechatronic technicians work

Mechatronic technicians can work in mechanical and manufacturing companies in the following fields: production of pneumatics, industrial hydraulic and **automation, CNC machines programming**, projecting and **technical drawing**, also using CAD.

**Energy** is a field that offers many job opportunities. There is a need for many technicians and skilled workers whose work consists in generating energy and providing it to people for everyday life and tasks. There is also a need for individuals studying new methods of energy generation. The energy field includes utilities, gas and oil companies, government and research groups, energy education or environmental regulation agencies, nonprofit energy awareness and conservation organizations and many others. People who want to work in the energy field can enroll at any university course, but it is better to have an Engineering degree.



An engineer is inspecting some products.

## Design

### Skills Required:

CAD, CAE, ThermoFluids, Stress Analysis, FEA

### Job Roles

- Structural Engineer
- CFD Engineer
- Design Engineer
- HVAC Engineer
- Piping Engineer



## Maintenance

### Skills Required:

Machine Design, Engineering Systems, Control and Instrumentation

### Job Roles

- Power Engineer
- Maintenance Engineer
- Systems Engineer
- Site/Field Engineer



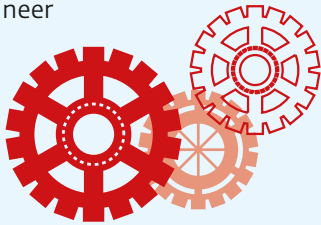
## Production

### Skills Required:

Industrial Engineering, Mechatronics, Production/Operation Management

### Job Roles

- Production Engineer
- Fabrication Engineer
- Drilling Engineer



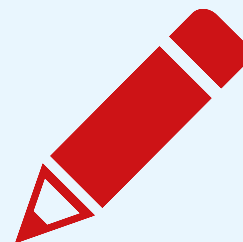
## Planning

### Skills Required:

Project Management, Spreadsheet Calculations

### Job Roles

- Project Engineer
- Logistics Engineer
- Project Manager



## Sales & Other

### Skills Required:

Spreadsheet Calculations, Modelling and Simulation

### Job Roles

- Quality Manager
- Safety, Health and Environment Manager
- Financial Forecaster
- Sales Engineer



# MECHANICS



- 1 Materials in engineering
- 2 Mechanical drawing
- 3 Machine tools
- 4 Metal working processes
- 5 Engines
- 6 Heating and refrigeration systems

## Work it out!

- Ready to skate
- Let's draw: a video tutorial
- Take care of your car





# Unit 1

## MATERIALS IN ENGINEERING

### LEARN ABOUT...

- 1 Materials and their properties
- 2 Metals
- 3 Polymers: plastics and rubbers
- 4 Other types of materials: ceramics, composites and smart materials

### EXPAND YOUR VOCABULARY

- ▶ Materials in engineering

### LANGUAGE IN ACTION

- ▶ Grammar: comparative and superlative adjectives of majority; other comparative and superlative adjectives

### PROFESSIONAL COMMUNICATION

- ▶ Describing a product

### COMPETENCES

- ▶ Describe and compare the properties of materials
- ▶ Understand and explain the different types of materials according to their properties
- ▶ Analyse, evaluate and describe the properties of objects
- ▶ Understand the presentation of a new project
- ▶ Work in a team
- ▶ Develop critical thinking
- ▶ Describe the properties and other characteristics of a product

### WHAT DO YOU REMEMBER?

- ▶ Concept map

Digital Area

✔ Exercises

🔊 Listening exercises

▶ Video

# MATERIALS AND THEIR PROPERTIES

## Warm up



- 1 Would you buy a glass football? Why?
- 2 Would you use a wooden knife? Why?
- 3 Would you use iron chairs in your class? Why?

## Types of materials

Materials science is central to engineering and to industries. In fact, manufacturers and engineers need to know the structures and properties of materials to select the best one for a particular use, as well as to improve the efficiency of the final products.

The main categories of materials used in engineering are **metals**, **polymers**, including plastics and rubbers, **ceramics**, **composites** and **smart materials**.

Materials can be identified through their main properties: physical, chemical and mechanical.

## Properties of materials: physical and chemical properties

The **physical properties** are the characteristics of a material that we can observe, for example colour, melting point, thermal and electrical properties. They define how the material reacts to external factors such as heat, electricity or gravity without changing its chemical structure. The most important are the following.

- **Melting point:** the temperature at which the substance changes from a solid to a liquid state.
- **Thermal conductivity:** the ability of a material to conduct heat.

- **Thermal expansion:** the tendency of matter to change in **shape**, area and volume in response to a change in temperature.
- **Electrical conductivity:** the ability of a material to conduct electricity. The opposition of a material to the **flow** of electric current is called **electrical resistivity**.

The **chemical properties** refer to changes in the chemical composition of a material because it interacts with other substances. The chemical properties include reactivity, flammability and **oxidation** states.

- **Corrosion resistance:** the ability of a material to resist the oxidation in atmospheric conditions.

## Properties of materials: mechanical properties

The **mechanical properties** determine the behaviour of a material in response to the type of **load** (external force) applied or the type of **stress** (internal force) the material must **withstand**. The most important are the following.

- **Strength:** the ability of a material to resist forces without breaking, **bending** or changing permanently.
- **Hardness:** the ability of a material to resist scratching, abrasion and **indentation**.



## GLOSSARY \*

**shape:** forma

**flow:** flusso

**oxidation:** ossidazione

**load:** carico, sollecitazione

**stress:** tensione, sforzo

**withstand:** resistere, sopportare

**to bend:** piegarsi, curvarsi

**indentation:** penetrazione

- **Elasticity:** the ability of a material to return to its original shape when a force is removed.
- **Plasticity:** the ability of a material to be deformed permanently without breaking or fracturing. Two more properties associated with plasticity are **ductility:** the ability of a material to be deformed plastically when it is stretched, and **malleability:** the ability of a material to be deformed plastically when it is compressed.
- **Stiffness:** the ability of a material to resist deformation in response to an applied force or load.
- **Toughness:** the ability of a material to resist shock or impacts and plastically deform without

breaking. It is a combination of strength and plasticity.

- **Brittleness:** the tendency of a material to break under stress before it deforms.
- **Fatigue:** the ability of a material to resist repeated stress cycles, bending or tension.



4 • **VOCABULARY** Read the text and find the English equivalent of the following words.

- |                          |                            |
|--------------------------|----------------------------|
| 1 punto di fusione ..... | 5 tenacità .....           |
| 2 sostanza .....         | 6 fragilità .....          |
| 3 materia .....          | 7 graffiare .....          |
| 4 rigidità .....         | 8 allungare, stirare ..... |

5 •• **READING COMPREHENSION** What properties do these objects (a-h) have? Match them to the appropriate properties (1-6). You can use the properties more than once.

- |               |                           |
|---------------|---------------------------|
| 1 hardness    | 5 electrical conductivity |
| 2 plasticity  | 6 corrosion resistance    |
| 3 toughness   | 7 strength                |
| 4 brittleness | 8 malleability            |



a *hardness, brittleness*



b .....



c .....



d .....



e .....



f .....

6 ●● **READING COMPREHENSION** Answer the following questions.

- 1 What are the physical properties of materials?
- 2 What are the mechanical properties of materials?
- 3 What is the difference between thermal conductivity and thermal expansion?
- 4 What is strength?
- 5 What is hardness?
- 6 What is the difference between malleability and ductility?

7 ●●● **PET READING COMPREHENSION** Choose the correct answer. Only one is right.

- 1 A material is tough when
  - a it doesn't deform
  - b it is brittle
  - c it is strong and plastic
  - d it doesn't withstand shocks or sudden impacts
- 2 If a material can be permanently deformed when stretched, without breaking, it is
  - a ductile
  - b malleable
  - c elastic
  - d brittle
- 3 If a material is hard, but easily broken, it is
  - a strong
  - b stiff
  - c brittle
  - d plastic
- 4 Which statement is not correct?  
Malleable materials
  - a can be deformed permanently
  - b can't be deformed permanently
  - c can be deformed by hammering or pressing
  - d don't return to their original shape when they are compressed
- 5 Chemical properties refer to
  - a the ability of the materials to resist external forces
  - b the general characteristics of the materials
  - c changes of a material when a chemical reaction occurs
  - d resistance to corrosion only

**EXPANSION**

8 ●● **READING COMPREHENSION** Look at the pictures (1-5): they show different types of stress which materials can undergo. Match them to their definition (a-e) and draw the missing one.

- a **Torsional stress:** it is caused in the material by twisting forces.
- b **Tensile stress:** it is caused in the material by stretching or pulling forces.
- c **Shear stress:** it is caused in the material by sliding forces.
- d **Compressive stress:** it is caused in the material by pushing forces.
- e **Bending stress:** it is caused in the material by forces inducing curvature.

