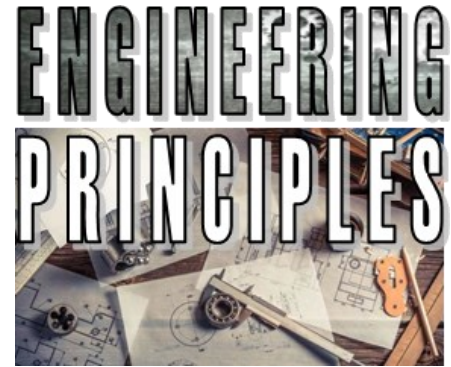


ENG 100M

MECHANICAL ENGINEERING PRINCIPLES LABORATORY



The **ENG 100M Laboratory** provides a complete set of total 8 kits that students can use in experiments in fundamental Mechanical engineering science topics.

The **ENG 101M** Laboratory set includes a mobile cart with one set of total 8 kits of which:

- ◆ 7 components kits
- ◆ one kit with data acquisition equipment
- ◆ a set of auxiliary parts for using in experiments

All Theory and Lab work topics are covered by the ENG 100 application software which directs a step-by-step procedure in every experiment, offering simulations of certain experiments, simulation of measurements and multimedia, sensor simulations and more facilities.

The **ENG 102M** Laboratory set provides a complete set of kits for theory and experiments in fundamental Static - Mechanics engineering topics.

The ENG 102M includes:

- ◆ A mobile cart – optional – to store the kits and install the experimental boards provided with all the equipment. It is a convenient facility for the instructor.
- ◆ Mechanics experimental board using different assembly methods, which can be installed on the mobile cart (optional) or any laboratory bench. All mounting frame is provided for setup of experiments in statics, strength of materials and dynamics experiments.

The **ENG100 application** is a powerful teaching tool which assists the teacher to present the theory on each topic addressed, demonstrate the experiments to the students, student experiments relative to teacher demonstrations, practice theory and lab preparation on Simulators, use the iLab Data Acquisition System in order for the students to comprehend better the concept of the topic and the measurements taken. ENG 100 comes with a vast variety of support tools, as terminology, inventory, on-line manuals, videos and multimedia presentations.

The **ENG 112M** laboratory set allows the investigation of the conservation of mechanical energy using:

1. A Maxwell disk.
2. A set of springs.
3. A Pendulum Apparatus.

ENG 101M

Mechanics & Mechanisms
Laboratory

ENG 102M

Statics-Beams-Strain Gauges
Laboratory

ENG100

Application

ENG 112M

Conservation of Mechanical
Energy

ENG 101M Mechanics & Mechanisms Laboratory

The **ENG 101M Laboratory** provides a complete set of total 8 kits that students can use in experiments in fundamental Mechanical engineering science topics. The Laboratory includes a mobile cart with one set of total 8 kits of which:

- ◆ 7 components kits
- ◆ one kit with data acquisition equipment
- ◆ a set of auxiliary parts for using in experiments

All Theory and Lab work topics are covered by the ENG 100 application software which directs a step-by-step procedure in every experiment, offering simulations of certain experiments, simulation of measurements and multimedia, sensor simulations and more facilities.

HARDWARE

All kit components are modular and light weighted (mostly used aluminum or plastic for their manufacture) with sensible size parts.

All equipment are to be fitted either by bolted fittings or magnetic bases onto the Work Board for experiments and classroom demonstrations. Mechanisms are designed to interconnect and create complex mechanical operations. All activities are using digital measurements to introduce the students to modern methods of measurements, besides the conventional ones. Kits are stored in hard-wearing storage trays. All parts are rugged and durable for safe 'hands-on' experiments. It contains all parts, main and auxiliary, needed for the Curriculum/Experiment works provided in the ENG 100 application. The assembly of apparatus on the Work Board on the ENG 100M cart is easy and simple using magnetic attachments and/or screws.

SOFTWARE

The **ENG100 application** is a powerful teaching tool which assists the teacher to present the theory on each topic addressed, demonstrate the experiments to the students, use the Data Acquisition System in order for the students to comprehend better the concept of the topic and the measurements taken. It comes with a vast variety of support tools, as terminology, inventory, on-line manuals, videos and multimedia presentations.



LABORATORY CURRICULUM

The topics covered by ENG 100 application and the mobile lab set of kits are:

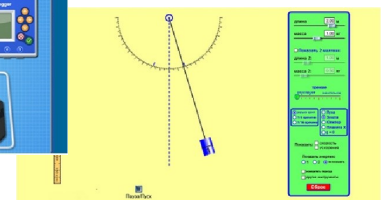
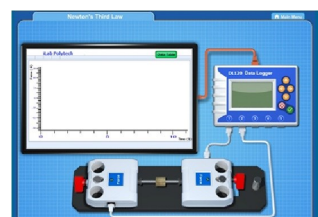
PART 1 - Principles in Mechanics (P100.1 module)

- Center of mass
- Composition of concurrent forces
- Composition of parallel forces
- Decomposition of forces
- Elasticity & Spring systems
- Hooke's law
- Moments
- Levers 1/2/3 degree
- Sliding friction
- Rolling friction
- Pulleys in series
- Pulleys in parallel
- Centripetal Force – Rotational velocity
- Basic measurements in mechanics

This set of equipment is provided for teacher demonstration and student experimentation, in Mechanics / Mechanisms basic principles. For students sets is recommended 5 sets per 20 students per lab workshop.

PART 2 - Engineering Applications

- Beams
- Bending
- Hooke's Law extension & compression spring tests
- Simple harmonic motion
- Forces on an Inclined Plane
- Power transfer mechanisms
- Machine Cam and Crank
- Gear and Transmissions – Gear box
- Motion conversion and Links



ENG 102M

Statics-Beams-Strain Gauges Laboratory

The ENG 102M Laboratory provides a complete set of kits for theory and experiments in fundamental **Static - Mechanics** engineering topics.

The ENG 102M Laboratory includes:

102MCA. A mobile cart – optional – to store the kits and install the experimental boards provided with all the equipment. It is a convenient facility for the instructor.

102MCB.01 or 02. Mechanics experimental board using different assembly methods, which can be installed on the 102MCA or any laboratory bench. All mounting frame is provided for setup of experiments in statics, strength of materials and dynamics experiments.

102MSK.01 to 04. A set of experimental components kits which include:

- ♦ One kit with data acquisition equipment: **102MSK.01DL.**
- ♦ Three kits with experimental assembly devices and auxiliaries for the teaching of **Mechanics – Statics and basic mechanisms: 102MSK.02,03 and 04.**

The experiment devices are clearly laid-out and housed securely in plastic storage boxes.

The complete experimental setup is arranged in the 102MCB.0X frames. The above set comes with the ENG100 CAI teaching application and the iLab Data acquisition application. Both applications run on a PC Windows 10 OS (Not offered - optional).

102MSK.05A. An experimental set that introduces students to the principles of shear forces, bending moments on a beam with two supports: shear force & bending moment diagrams at a section on the Beam. It operates in conjunction with 102MSK.01DL, the iLab application and any 102MCB.0X frame.

102MSK.05B. An experimental set that introduces students to the comparison of different methods to determine the elastic line: virtual work, Mohr's analogy, statically determinate and indeterminate systems, point loads and bending moments. It operates in conjunction with 102MSK.01DL, the iLab application and any 102MCB.0X frame. It is an add-on to 102MSK.05 set.

102MSK.06 An experimental set that introduces the fundamentals principles of tension, bending and torsion of different materials by the measurement with strain gauges and load cells in tensile tests.



General overview

All kit components are **modular** and **light weighted** (mostly used aluminum acrylic wood or plastic for their manufacture) with sensible size parts. All equipment are to be fitted either by bolted fittings or magnetic bases onto the 102MCB.0X for experiments and classroom demonstrations.

All activities are using **digital measurements** to introduce the students to modern methods of measurements, besides the conventional ones. Kits are stored in hard-wearing storage trays. All parts are rugged and durable for safe 'hands-on' experiments.

It contains all parts, main and auxiliary, needed for the Curriculum/Experiment works provided in the **didactic application** which includes:

- ♦ **ENG 100:** Didactic application with theory presentations, experimental setups, Lab simulations, Multimedia, Instruction guides etc.
- ♦ **iLAB:** a Data acquisition system with state-of-the-art features for data collection and analysis.

ENG 100 Didactic application

The ENG100 application is a powerful teaching tool which assists the teacher to present the **theory** on each topic addressed, **demonstrate the experiments** to the students, **student experiments** relative to teacher demonstrations, practice theory and lab preparation on **Simulators**, use the **iLab Data Acquisition System** in order for the students to comprehend better the concept of the topic and the measurements taken. ENG 100 comes with a vast variety of **support tools**, as **terminology**, **inventory**, on-line **manuals**, **videos** and **multimedia** presentations.

The curriculum topics are presented below:

Level 1 - Principles in Mechanics /Statics

- Center of mass
- Composition of concurrent forces
- Composition of parallel forces
- Decomposition of forces
- Elasticity & Spring systems
- Hooke's law
- Moments of forces
- Levers 1/2/3 degree
- Sliding friction
- Rolling friction
- Pulleys in series
- Pulleys in parallel
- Basic measurements in mechanics

Level 2 - Principles in Mechanics II

Beams I

- Beam balances
- Beams as 1st, 2nd and 3rd order levers
- Beam reactions
- Beam length and deflection
- Beam material and deflection (Young's Modulus)
- Beam supports

Bending

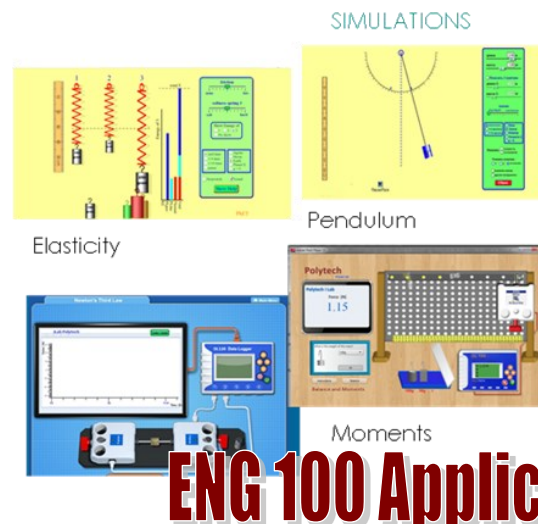
- Force and bending angle
- Torque and bending

Hooke's Law extension & compression spring tests

- Hooke's Law compression and extension spring tests
- Parallel and series spring systems

Simple harmonic motion

- Simple pendulum of different length and mass
- Simple harmonic motion of a spring with different masses, and a simple spring rate test
- Simple harmonic motion of a compound serial or parallel spring assembly
- Simple harmonic motion and gravity
- Kinetic and potential energy in a pendulum
- Extension Springs, Kinetic and Potential energy



Level 3 - Measurements and Gauges

Principles of Electronic Measurements

1. Load cells –Force sensor
2. Angle measurement sensor
3. Photo-gate operation
4. Distance and Motion sensor
5. Data acquisition systems and applications

Strain gauges applications

1. Strain gauge mechanical deformations under: tension, bending and torsion.
2. Electrical signal and mechanical strain
3. Strain gauge module of elasticity
4. Material and variations of measurements under Tensile tests for:
 - Brass strain gauge
 - Aluminum strain gauge
 - Cooper strain gauge

Level 4 - Beam Sections

- Reactions under static equilibrium
- Section Method to calculate the internal forces and moments under point, multiple points and distributor loads
- Shear force measurements and diagram
- Bending moment measurement and diagram
- Elastic line of a beam by:
 1. Virtual work calculation
 2. Mohr's analogy – Area moment graph
- Superposition principle
- Measure the max. beam deflection and the angle of inclination in sections of a beam
- Compare the measurements versus theoretical values

In most cases ,theory and Lab work topics are covered by the ENG 100 application software which directs a step-by-step procedure in every experiment, **offering simulations** of certain experiments, **simulation of measurements** and **multimedia**, sensor simulations and more facilities.

* Note: The general information is provided for the cases wherever this information is applicable.

ENG 112M

Conservation of Mechanical Energy

The apparatus allows the investigation of the **conservation of mechanical energy**, using:

1. **A Maxwell disk** - Potential, Kinetic, Rotational energy, moment of Inertia.
2. **A set of springs** - Potential, Kinetic Energy and Elasticity principle.
3. **A Pendulum Apparatus** - Oscillations and Energy Conservation.



Apparatus

A Maxwell disk, unroll with its horizontal axis attached on two cords, while moves downwards in the gravitational field. Potential energy, energy of translation, and energy of rotation are converted into one another and are determined as a function of time.

Aim

1. Determine the moment of inertia.
2. Using the Maxwell disk motion determine as a function of time and the transformation of:
 - the potential energy;
 - the energy of translation;
 - the energy of rotation.

Using the 2 Photogates and the Motion Sensor user can verify theory ,graph their results and get a deep comprehension the aim of the experiment.

The set of springs, elongate and oscillate, based on Hook's law. Students can see, by using the force sensor and the motion sensor the conservation of the Kinetic and Potential energy. Potential energy, energy of translation, and energy of rotation are converted into one another and are determined as a function of time.

Aim

1. Determine Hooks Law of Elasticity.
2. Measure the Displacement, Velocity, Force/ Acceleration of the mechanical oscillation as a function of time and get Graphs of it.
3. Using the spring set motion determine as a function of time and the transformation of the potential energy.

The pendulum, fixed on the retort stand will oscillate.

Students can measure, by using the sensors, the conservation of the Kinetic and Potential energy during a period of an harmonic oscillation. Measure the frequency and period of the oscillation and get graphs of their measurements.

Experiment's Equipment

- Support base, with Maxwell wheel
- Retort stand set
- Set of Springs ,K=1
- Pendulum axis and weigh set.
- Meter scale, l = 1000 mm

Pre-required Auxiliaries

- Data-logger DL100
- 2 x Photogate sensors
- 1 Motion sensor
- 1 Force sensor

Pre-requirement

In all 3 cases, the ENG 201MB DL1 set of Data Acquisition must be used, so students can perform their experiments and receive measurement data using the Sensors and the Data Acquisition application iLAB provided. The DL1 set gives to the students a graphical representation and analysis of the energy transformations and verify the law of energy conservation in all cases.

