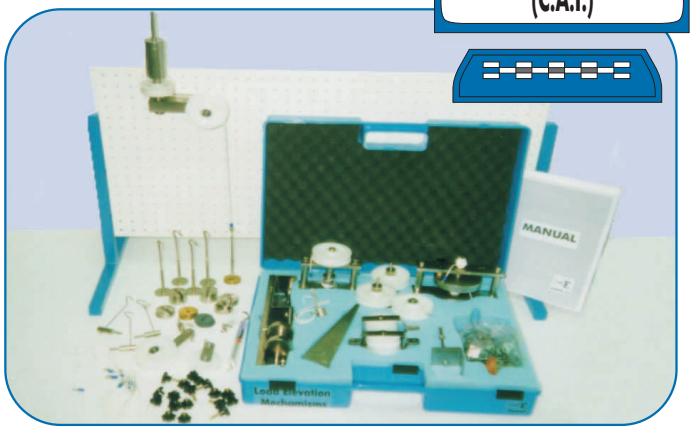
EDIBON, S.A.

Applied Mechanics MECA

BASIC MECHANICS EXPERIMENTS MODULAR SYSTEM

WITH COMPUTER AIDED INSTRUCTION SOFTWARE (C.A.I.)

MECA 1 **Statics Experiments.**



MECA 2 **Load Elevation Mechanisms Experiments.**

MECA 3 **Transmissions Experiments.**

MECA 4 **Dynamics Experiments.**

MECA 5 **Friction Experiments.**

MECA 6 **Special Mechanisms Experiments.**

The MECA system, manufactured by **EDIBON S.A.**, consists of a complete set of exercises and practical experiments belonging to the area of Applied Mechanics, in its two main subareas: Statics (the analysis of structures in balance) and Dynamics (analysis of the motion of mechanisms), divided into various experiments modules.

GENERAL DESCRIPTION

The MECA is provided with the following elements: **Mounting Panel; Experiments' Elements; and the Exercise manual**.

Students are expected to build the experiments on the mounting panel, where distance measurements are possible due to equidistant spacings between holes on the panel.

The panel may also be written upon, thus contributing to the ease of doing measurements.

Thanks to the Exercises' Manual and the necessary theoretical knowledge imparted by the teacher, students shall be able to do all the measurements.

The MECA system is split up into six parts, named "Modules" or "Cases", each of which contain the elements needed for completing a specific group of related exercises and experiments.

SYSTEM CONTENTS:

MECA 1.	**Statics** experiments module.
MECA 2.	**Load Elevation Mechanisms** experiments module.
MECA 3.	**Transmission** experiments module.
MECA 4.	**Dynamics** experiments module.
MECA 5.	**Friction** experiments module .
MECA 6.	**Special Mechanisms** experiments module.

COMMON ELEMENTS INCLUDED IN ALL MODULES:

- Pivot screws.
- Adjustable hooks.
- Set of weights(0.01N to 5 N)
- Weight hooks.
- Light weight hooks.
- Pulleys.
- Adjustable pulley.
- Single pulley block.
- Screws.
- Support screws.
- Nuts.
- Tensor spring.
- Compression spring.
- Dynamometers.
- Cords & Ring.
- Mounting panel.

MODULES DESCRIPTION AND PRACTICAL POSSIBILITIES

MECA 1. STATICS EXPERIMENTS MODULE

DESCRIPTION:

Statics is the part of Mechanics that studies any kind of structure or element in balance-equilibrium. Basically the module consists of experiments in which the student shall learn to deduce the main principles of Statics and its most important applications.

Specific elements contained in MECA 1 Module:

Diagram board; centres of gravity plates; 3 and 5 cords rings; beam balance, the simple pendulum, beam simple.

PRACTICAL POSSIBILITIES:

- **Centres of gravity**: Specification of the centre of gravity of plates of different shapes using the simple pendulum and graphical methods.
- **Triangle of forces**: To test that three non-parallel forces in equilibrium acting in the same plane can be represented by a Triangle of Forces.
- **Parallelogram of forces**: When three non-parallel forces in the same plane are in equilibrium, their lines of action meet at a point, and hence to show that the resultant of two forces can be found using the Parallelogram of Forces.
- **Polygon of forces**: Verification of the fact that four or more forces in equilibrium acting on the same point, can be represented by a Polygon of Forces.
- **Principle of Moments**: Verification of the principle of moments for parallel and nonparallel forces.
- **The Pivot or beam balance**: Demonstrate that the action of weighing with a beam balance or slide balance is based upon the principle of moments .
- **Levers**: Determine the mechanical advantage of various types of levers using the ratio resistance/power (W/P) and to verify that this is the same as the ratio between distances.
- **Beam reaction forces**: Verification of the fact that a distributed load applied over a beam may be considered as an equivalent concentrated load applied at the centre of gravity of the distributed load. Reactions located at supports due to the load acting on the simply supported beam may be calculated using the momentum principle, independent of the position of these beam supports.

MECA 2. LOAD ELEVATION MECHANISMS EXPERIMENTS MODULE

DESCRIPTION:

Experimenting with the main mechanisms used for Load Elevation. Analysis of their work and efficiency.

Specific elements contained in MECA 2 Module:

Systems of two and three pulleys; the differential wheel and axle; Weston differential chain block and Screw Jack.

PRACTICAL POSSIBILITIES:

- **Simple pulleys**: Verification of the variation of cable tension in a pulley with the cable's direction as it passes over the pulley. Determine the mechanical advantages of a simple combination of fixed and movable pulleys.
- **Pulley blocks**: Analysis of the mechanical features of a set of pulley blocks, which has three sheaves in the upper block and two pulleys in the lower block.
- **Single axle and wheel**: Determine the law of the Machine for a simple axle and wheel, and the variation of mechanical advantage and efficiency with load.
- **Differential axle and wheel**: Determine the law of the Machine for differential axle and wheel. Verification that the mechanical advantage and efficiency increases with load up to a limiting maximum.
- **Weston differential chain blocks**: Analysis of the specific characteristics of these chains.
- **Screw Jack**: To measure the effort required to raise various loads using a simple form of screw jack and to determine how the mechanical advantage and efficiency varies with load.

MECA 3. TRANSMISSIONS EXPERIMENTS MODULE

DESCRIPTION:

Most recent machines require the transmission of motion between elements to attain the desired mechanical result. The mechanisms studied in this module are those that transmit motion between two axles.

Specific elements contained in the MECA 3 Module:

System of belt drive (flat belt, round belt, and leather strip); chain drive; system of gears; bevel gears; worm gears; the universal coupling.

PRACTICAL POSSIBILITIES:

- **Belt drive:** Verification of the direction of rotation of open and crossed belt drives. Verification of the speed of rotation of the two pulleys is inversely proportional to their diameters. To measure the difference intension between the two sides of a belt drive and to determine the efficiency of drive transmission.
- **Chain drive:** Verification of the speed ratio of a chain drive. Measurement of the efficiency of drive transmission.
- **The Geared winch**(two parallel axles): Comparison of the velocity ratios of a system of single-stage and double-stage geared winch. Specification of their corresponding mechanical advantages and efficiencies under varying loads.
- **Bevel gears** (two intersecting axles): Verification of the efficiency velocity-ratio and mechanical advantages of the Bevel Gear unit under different loads.
- **Worm drive** (two crossed axles): Verification of the speed ratio of a worm and specification of the transmission efficiency under different loads**.**
- **Universal coupling:** To investigate the effect of introducing universal couplings to a simple drive shaft.

MECA 4. DYNAMICS EXPERIMENTS MODULE

DESCRIPTION:

Dynamics is the part of Mechanics that analyzes the motion of an element or mechanism caused by a force. Thus the study concentrates on the basic laws of Dynamics.

Specific elements contained in the MECA 4 Module:

The spring balance, pendulum or plummet, flywheel; system for the study of centrifugal force; system for studying friction, flat belt, and a friction plate.

PRACTICAL POSSIBILITIES:

- **Spring balance:** To verify that the extension of a coiled spring is proportional to the load applied, to show the principle of a spring balance.
- **Simple pendulum:** To show that the time of a simple pendulum depends only on the length of the pendulum, and to determine the value of the force of gravity using a simple pendulum.
- **Kinetic and potential energy:** Analysis of some features of kinetic and potential energy and to show that Energy exists, that is may be transformed, and that it may be "stored" and "given back" .
- **Inertia:** The flywheel. To find the energy stores in a flywheel by supplying a known quantity of energy .
- **Belt-pulley friction:** Verification of the fact that the driving force of a transmission belt increases with the helical angle.
- **Centrifugal force:** Demonstration of the laws of the centrifugal force.

MECA 5. FRICTION EXPERIMENTS MODULE

DESCRIPTION:

This module considers the most important phenomenon of Dynamics: Friction. It is a manifestation of the energy loss due to contact that happens in every real-world mechanism.

Specific elements contained in MECA 5 Module:

System for the study of friction, friction block and rope, friction plates, a roller, a block of wheels with ropes, a block of supported rollers, a system of wedges (large angle and small angle), bearings, and pendulum or plummet.

PRACTICAL POSSIBILITIES:

- **Sliding friction:** Verification of the laws of friction and to measure the coefficient of friction for different materials.
- **Inclined plane:** Analysis of the forces acting on an inclined plane due to a weighted of a roller supported on the plane. Calculation of the starting force needed for dragging a block on the plane.
- **Angle of friction:** Measurement of the angle of friction and from it find the coefficient of friction. To show that the coefficient of friction is equal to tangent of the angle of friction.
- **Friction:** To show the extent to which friction is reduced by using wheels and rollers and to compare the effects of different bearing surfaces.
- **The wedge:** Determine mechanical advantage and efficiency obtained using two different wedges, and to show that overhaulling may be prevented if the angle of inclination of a wedge is small.
- **Bearings:** Comparison of the resistance to turning due to friction of four bearings made of different materials, and to show something of the progress made in bearing development.

MECA 6. SPECIAL MECHANISMS EXPERIMENTS MODULE

DESCRIPTION:

This module considers various mechanisms frequently used in industrial processes; without them some operations would not be possible with the same efficiency. Here these mechanisms are shown and their function analyzed.

Specific elements contained in MECA 6 Module:

Cam and Roller mechanism; Geneva Motion; Ratchet mechanism; Scotch yoke; Crank mechanism; quick return mechanism.

PRACTICAL POSSIBILITIES:

- **Cam and roller:** To study the difference aspects of cam design.
- **Geneva Motion:** Verification of how the circular motion of the drive unit is transformed into the intermittent motion of the Geneva Motion, and of how this mechanisms accelerate and decelerate during the transmission process.
- **Ratchet mechanism:** Examination of the parts of the Ratchet Assembly supplied in which a swinging lever is fitted with two pawls.
- **Scotch yoke:** Analysis and verification of the motion of a driving crank and its relation to the reciprocal element of motion.
- **Crank mechanism:** Analysis of tha features of a crank mechanism, drawing a rotation torque diagram and deducing the relation between the crank rotation and the slide platform movement.
- **Quick return mechanism:** To show a quick return mechanism at work and to record the relationship between the rotation of the crank and the movement of the slide.

MECHANICS COMPUTER AIDED INSTRUCTION SOFTWARE (C.A.I.)

1.- CLASSROOM MANAGEMENT SOFTWARE (for teacher) "MECA/SOF"

The TEACHER, using his or her computer (PC) , may do the following operations:

- Create databases for inclusion or exclusion of students.
- Analysis of database contents and statistical comparations.
- Report printing.
- Development of his or her own examinations and detecting each student´s progress and difficulties.

2.- COMPUTER AIDED INSTRUCTION SOFTWARE (for student):

* Software options are presented by pull-down menus and pop-up windows.
* The program includes an online help which facilitates customizing configuration variables.
* The student can use in his or her own PC a pedagogical software related to every experiment module, with various chapters.

Each Software Package contains the following parts:

- **A theoretical basis:** Pointing out the necessary concepts and skills for completing the exercises properly.
- **Practices and exercises:**
  * Each module presents various chapters grouped by thematic areas.
  * Each chapter has various exercises/practices to be completed progressively by the student, simultaneously with the modules.
- **Self-evaluation:** This part of the program consists of a series of test questions posed to the student to measure by himself or herself the productivity obtained with the exercises.
- **Statistical analysis:** Various graphics representing the student´s total productivity are possible due to individual storage of his or her results.

AVAILABLE SOFTWARE PACKAGES

MECA1/SOF **Statics.**	MECA4/SOF **Dynamics.**
MECA2/SOF **Load Elevation Mechanisms.**	MECA5/SOF **Friction.**
MECA3/SOF **Transmissions.**	MECA6/SOF **Special Mechanims.**

SPECIFICATIONS

- The MECA system, manufactured by EDIBON S.A., consists of a **complete set of exercises and practical experiments belonging to the area of Applied Mechanics, in its two main subareas: Statics** (the analysis of structures in balance), and **Dynamics** (analysis of the motion of mechanisms), divided into various experiment modules.
- **Modular system**.
- The MECA system is supplied with the following elements: **mounting panel; Experiments' elements; and the Exercise Manual**.
- Experiments elements in **anodized steel**.
- **High quality and precision Experiment's Elements** to obtain 100% accuracy in practices carrying out.
- Students are expected to **build the Experiments on the mounting panel**, where distance measurements are possible due to equidistant spacings between holes on the panel.
- **The panel may also be written upon**, thus contributing to the ease of doing measurements.
- Thanks to the **Exercises' manual** and the necessary theoretical knowledge imparted by the teacher, students shall be able to do all the measurements.
- **The MECA system is split up into six parts named "Modules" or "Cases"**, each of which contain the elements needed for completing a specific group of related exercises and experiments:
  - * MECA 1. **Statics experiments module.**
    - Centres of gravity.
    - Triangle of forces.
    - Parallelogram of forces.
    - Polygon of forces.
    - Principle of moments.
    - The Pivot or beam equilibrium.
    - Levers.
    - Beam reaction forces.
  - * MECA 2. **Load Elevation Mechanisms experiments module.**
    - Simple pulleys.
    - Pulleys blocks.
    - Single axle and wheel.
    - Differential axle and wheel.
    - Weston differential chains blocks.
    - Screw Jack.
  - * MECA 3. **Transmission experiments module**.
    - Belt drive.
    - Chain drive.
    - The Geared winch.
    - Bevel gears.
    - Worm drive.
    - Universal coupling.
  - * MECA 4. **Dynamics experiments module**.
    - Spring balance.
    - Simple pendulum.
    - Kinetic and potential energy.
    - Inertia.The flywheel.
    - Belt-pulley friction.
    - Centrifugal force.
  - * MECA 5. **Friction experiments module**.
    - Sliding friction.
    - Inclined plane.
    - Angle of friction.
    - Friction.
    - The wedge.
    - Bearings.
  - * MECA 6. **Special Mechanisms experiments module**.
    - Cam and roller.
    - Geneva Motion.
    - Ratchet mechanism.
    - Scotch yoke.
    - Crank mechanism.
    - Quick return mechanism.
- It includes, as complementary option**, Mechanics Computer Aided Instruction Software (C.A.I.)** for the student and the teacher:

  1. Classroom Management Software (for teacher) "MECA/SOF". (Running on Windows).
  - Real time control of students' behaviour.
  - Results analysis.
  - Individual and global statistics.
  - Development of examinations.

  2. Computer Aided Instruction Software (for student). (Running on Windows).

  Instructs the student following a self-taught method:
  - Theoretical principles and concepts.
  - Exercises and practices.
  - Self corrections.

  Available software packages:

  MECA1/SOF **Statics**.
  MECA2/SOF **Load Elevation Mechanisms**.
  MECA3/SOF **Transmissions**.
  MECA4/SOF **Dynamics**.
  MECA5/SOF **Friction**.
  MECA6/SOF **Special Mechanisms**.

DIMENSIONS AND WEIGHTS

- **Modules(in cases)**:
  - * Total weight of the six modules approx.: 41 Kgr.
    - MECA 1 weight: 5 Kgr.
    - MECA 2 weight: 9 Kgr.
    - MECA 3 weight: 7 Kgr.
    - M ECA 4 weight:7 Kgr.
    - MECA 5 weight: 6 Kgr.
    - MECA 6 weight: 7 Kgr.
  - * Module dimensions approx.: 500x360 x120 mm.
- **Mounting panel**:
  - * Dimensions:950 x400x550 mm.
  - * Perforation distances between hole centres: 25 mm.
- **Total shipping volume** of the whole system: 0,2 m^3.

REQUIRED SERVICES

- Minimum Hardware required for Mechanics C.A.I. Software:
  - * Computer (PC): 486 or higher.
  - * 1 MB RAM memory.
  - * SVGA graphical display.

✱ Specifications subject to change without previous notice, due to the continuous improvements of the product.

EDIBON, S.A.

TEACHING EQUIPMENTS

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