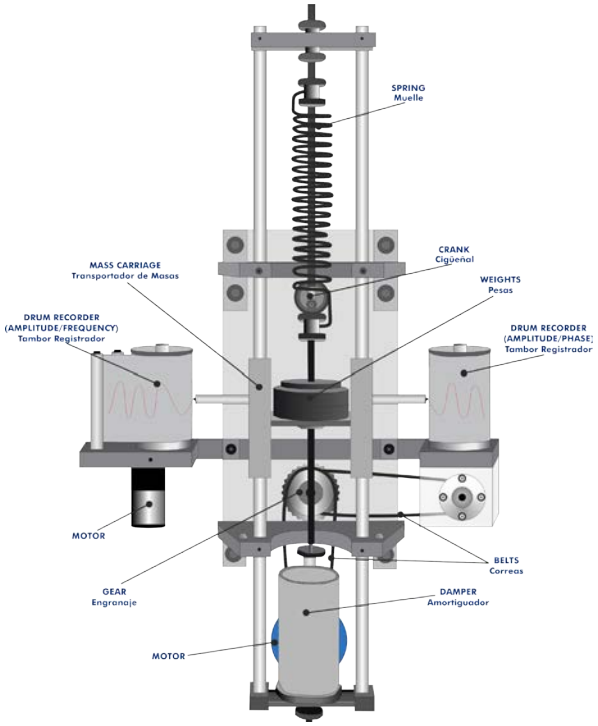
Free & Forced Vibration Unit

MVLF

Engineering and Technical Teaching Equipment

www.edibon.com
PRODUCTS
70.- MECHANICS

PROCESS DIAGRAM AND UNIT ELEMENTS ALLOCATION



ISO 9001: Quality Management (for Design, Manufacturing, Commercialization and After-sales service)

European Union Certificate (total safety)

Certificates ISO 14001 and ECO-Management and Audit Scheme (environmental management)

Certificate and Worlddidac Member

INTRODUCTION

Vibration is defined as the motion of a particle, body or system of connected bodies displaced from a position of equilibrium. Most vibrations in machines and structures are undesirable because they increase stresses, raise energy losses, create additional noise, etc.

Vibrations can be classified into two categories: free and forced. Free vibrations of a system are vibrations that are caused by an initial input and then are allowed to vibrate freely without the application of any external forces. In forced vibration, an external force acts on the system and supplies it with energy. In addition, a damper can be used in a free vibration system to dissipate a certain percentage of energy with each cycle of vibration.

The Free & Forced Vibration Unit, "MVLF", has been designed to perform demonstrations and experiments which provide an understanding of the free and forced vibrations of a simple spring-mass-damper system.

GENERAL DESCRIPTION

The Free & Forced Vibration Unit, "MVLF", has been developed to cover a range of demonstrations and experiments which provide the user with an understanding of the free and forced vibrations of a simple spring-mass-damper system. Simple adjustments can be made to the unit and the motion of the mass can be readily observed and recorded on the pen recorders provided.

A feature of the unit which approaches the problems of forced damped vibrations for the first time, is the simple way in which it is presented so that free and forced vibration phenomena can be readily observed.

Experiments can be carried out by the students to investigate the relationship between the mass of the body, the stiffness of the spring and the period/frequency of oscillation and to observe the effect of viscous damping on the system.

The basic components of the unit consist of a rigid frame with vertical mass carriage guides, an upper mounting plate for the spring, a lower mounting plate for the damper and a variable speed motor and drive unit for the forced vibration experiments. The mass carriage is constrained by rollers which run along on the vertical guides to provide a single degree of freedom with minimum uncontrolled damping.

Frequency of the oscillations can be measured with an optical sensor.

Two pens, attached to the vibrating frame, and two paper strips provide a means of producing amplitude/time recordings and amplitude/phase recordings.

Two methods of forcing vibrations are provided: a rotating out-of-balance mass and a periodic displacement to the point of support of the spring.

Springs of various stiffness and suitable masses are supplied. The damper is adjustable to provide a wide range of damping.

A control console attached to the frame contains the speed control unit and a frequency indicating meter.

SPECIFICATIONS

The main structure of the unit is a rigid frame, made of steel and aluminum, with two vertical guides, an upper mounting plate for the spring, a lower mounting plate for the damper, a variable speed motor and a drive unit. This rigid frame supports the different elements of the unit.

The mass carriage, to which various slotted weights may be attached, is constrained by rollers which run along the vertical guides to provide a single degree of freedom with minimum uncontrolled damping. The lower end of the spring is attached to the mass carriage and the upper end is attached to the frame. This section of the frame is adjustable so that the free position of the carriage may be varied.

The system uses two mechanical strip chart recorders that consists of a drum recorder and a pen holder:

The first records amplitude and frequency measurements. It has a drum recorder that is attached to the rigid frame and consists of a drum, driven by a synchronous motor, and a roll of paper. Before being rolled around the drum, the paper passes through a tensioning device that provides enough tension to ensure that the paper speed is constant (0.02 m/s).

The second records amplitude and phase measurements. It also has a drum recorder that is attached to the rigid frame and consists of a drum, wrapped in recording paper, driven by the main drive unit at the applied forcing angular frequency.

Both pen holders are attached to the mass carriage and use a spring to maintain continuous contact between the pen tip and the paper on the drum.

The variable speed motor and drive unit are attached to the rigid frame and provide two methods of forcing vibrations:

An unit consisting of two contra-rotating out-of-balance discs (mass = 0.742 Kg) may be attached to the mass carriage and are driven by a flexible drive which is connected to the main drive unit. This provides a periodic disturbing force to the mass carriage.

A crank rotated by the drive unit and a connecting rod, which can be attached to the crank and the upper spring mounting, provides a periodic displacement to the point of support of the spring.

Frequency of the oscillations can be measured with an optical sensor.

An electronic console is used to switch the synchronous motor on and off, control the speed of the forced vibrations motor and display the frequency.

Three springs, with varying stiffness, can be interchanged as the connection between the rigid frame and the mass carriage:

Spring 1: k = 3.30 kN/m. Spring 2: k = 1.22 kN/m. Spring 3: k = 0.47 kN/m.

Five weights of 1kg each can be added and secured to the mass carriage An adjustable oil damper provides controlled damping and can be attached to the carriage by means of a screw.

Oil is provided to fill the damper.

Cables and Accessories, for normal operation.

Manuals: This unit is supplied with the following manuals: Required Services, Assembly and Installation, Start-up, Safety, Maintenance and Practice Manuals.

EXERCISES AND PRACTICAL POSSIBILITIES

1.- Investigation of the relationship between the mass of the body, the stiffness of the spring and the period/frequency of oscillation for a simple spring mass system with one degree of freedom.

2.- Investigation of the relationship between the applied force, the viscosity of the oil and the velocity for various settings of the adjustable oil damper.

3.- Observation of how varying the degree of damping affects the response of a second order mechanical system to a step input.

4.- Observation of the free vibrations of a system having one degree of freedom.

5.- Study of the effect of viscous damping on the free vibrations of a simple spring-mass-damper system.

6.- Determination of the damping ratio for a given spring-massdamper system.

7.- Investigation of the relationship between the amplitude of the steady state vibration of the vibrating mass and the forcing frequency for various damping ratios. Vibrations induced by applying a periodic disturbing force to the mass.

8.- Investigation of the relationship between the amplitude of the steady state vibration of the vibrating mass and the forcing frequency for various damping ratios. Vibrations induced by a periodic displacement of the point of support of the spring.

9.- Investigation of the phase relationship between the vibrating mass and the periodic displacement of the spring support for varying damping ratios.

10.-Study of the vibrations induced by applying a periodic disturbing force to the mass in a viscous damped system.

11.-Study of the vibrations induced by a periodic displacement of the point of support of the spring in a viscous damped system.

REQUIRED SERVICES

- Electricity supply: single-phase, 220 V/50 Hz or 110 V/60 Hz.
- Oil for the damper.

DIMENSIONS AND WEIGHTS

MVLF:

Unit:

-Dimensions: 660 x 560 x 1030 mm approx.
(25.98 x 22.04 x 40.55 inches approx.)

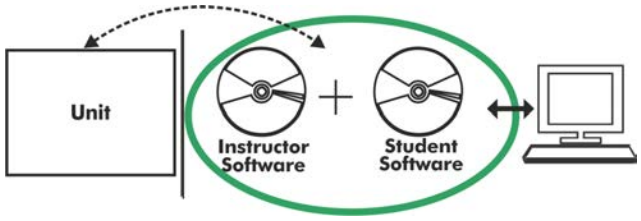
-Weight: 30 Kg approx
(60.13 pounds approx.)

Electronic console:

-Dimensions: 300 x 190 x 130 mm approx.
(11.81 x 7.48 x 5.11 inches approx.)

-Weight: 2.5 Kg approx.
(5.51 pounds approx.)

MVLF/ICAI. Interactive Computer Aided Instruction Software System:



With no physical connection between unit and computer, **this complete software package consists of an Instructor Software (EDIBON Classroom Manager -ECM-SOF) totally integrated with the Student Software (EDIBON Student Labsoft -ESL-SOF).** Both are interconnected so that the teacher knows at any moment what is the theoretical and practical knowledge of the students.

Instructor Software

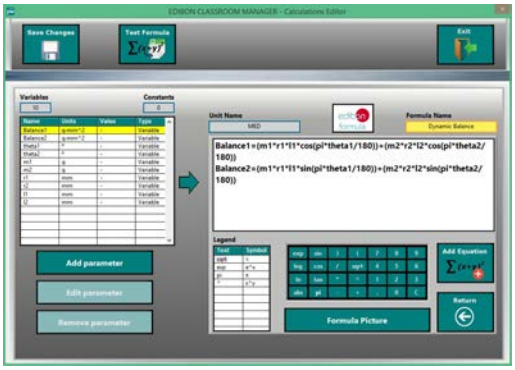
- ECM-SOF. EDIBON Classroom Manager (Instructor Software).

ECM-SOF is the application that allows the Instructor to register students, manage and assign tasks for workgroups, create own content to carry out Practical Exercises, choose one of the evaluation methods to check the Student knowledge and monitor the progression related to the planned tasks for individual students, workgroups, units, etc... so the teacher can know in real time the level of understanding of any student in the classroom.

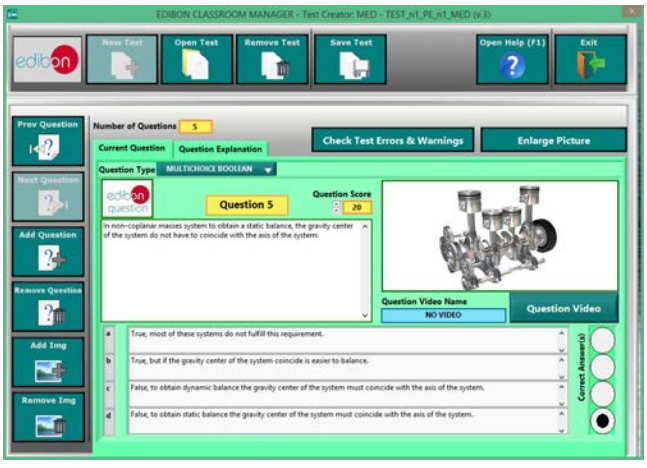
Innovative features:

- **User Data Base Management.**
- **Administration and assignment of Workgroup, Task and Training sessions.**
- **Creation and Integration of Practical Exercises and Multimedia Resources.**
- **Custom Design of Evaluation Methods.**
- **Creation and assignment of Formulas & Equations.**
- **Equation System Solver Engine.**
- **Updatable Contents.**
- **Report generation, User Progression Monitoring and Statistics.**

ECM-SOF. EDIBON Classroom Manager (Instructor Software) Application Main Screen



ECAL. EDIBON Calculations Program Package - Formula Editor Screen



ETTE. EDIBON Training Test & Exam Program Package - Main Screen with Numeric Result Question

ERS. EDIBON Results & Statistics Program Package - Student Scores Histogram

Optional

Student Software

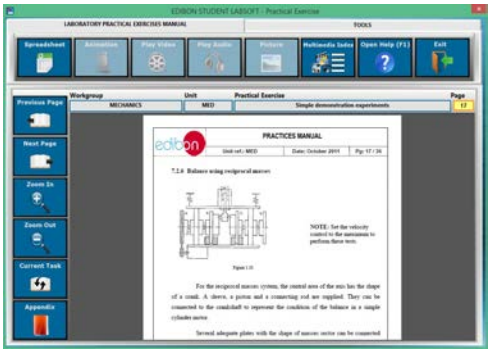
- ESL-SOF. EDIBON Student Labsoft (Student Software).

ESL-SOF is the application addressed to the Students that helps them to understand theoretical concepts by means of practical exercises and to prove their knowledge and progression by performing tests and calculations in addition to Multimedia Resources. Default planned tasks and an Open workgroup are provided by EDIBON to allow the students start working from the first session. Reports and statistics are available to know their progression at any time, as well as explanations for every exercise to reinforce the theoretically acquired technical knowledge.

Innovative features:

- **Student Log-In & Self-Registration.**
- **Existing Tasks checking & Monitoring.**
- **Default contents & scheduled tasks available to be used from the first session.**
- **Practical Exercises accomplishment by following the Manual provided by EDIBON.**
- **Evaluation Methods to prove your knowledge and progression.**
- **Test self-correction.**
- **Calculations computing and plotting.**
- **Equation System Solver Engine.**
- **User Monitoring Learning & Printable Reports.**
- **Multimedia-Supported auxiliary resources.**

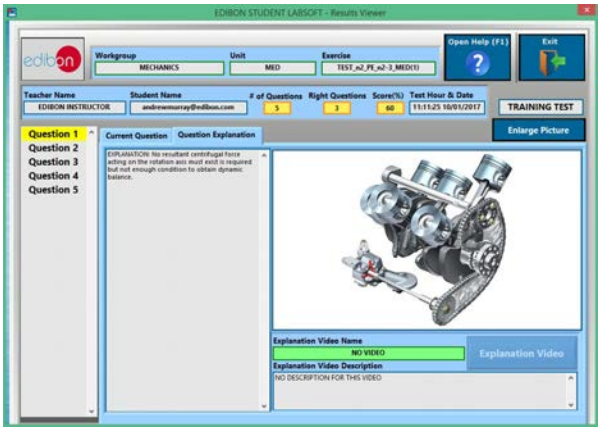
ESL-SOF. EDIBON Student LabSoft (Student Software) Application Main Screen



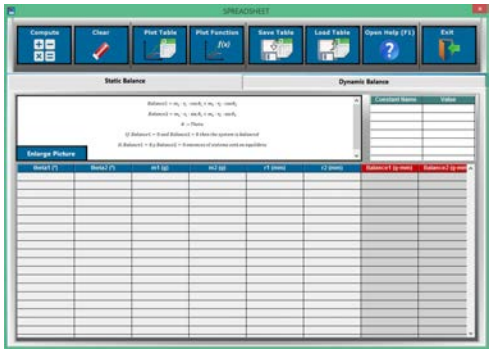
EPE. EDIBON Practical Exercise Program Package Main Screen

For more information see **ICAI** catalogue. Click on the following link:

www.edibon.com/en/files/expansion/ICAI/catalog



ERS. EDIBON Results & Statistics Program Package - Question Explanation



ECAL. EDIBON Calculations Program Package Main Screen

✱ Specifications subject to change without previous notice, due to the convenience of improvement of the product.

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Edition: ED01/18
Date: January/2018

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