Features

- Clarify difficult concepts of vibration theory by performing hands-on controlled experiments
- Perform both free and forced natural vibration experiments without damping
- Validate theoretical predictions of natural frequencies, mode shapes, and frequency response as a function of frequency, boundary conditions, geometry, and materials
- Validate theoretical concepts by comparing experimental results with the computer simulation of the vibration theory
- Determine the detrimental effects of vibration load transmission to the support structure and component fatigue life
- Learn to control vibration amplitude using tuned mass dampers and damping treatments
- Learn vibration measurement transducers, signal processing, data acquisition and data analysis

Tesca Vibrations Fundamentals Training Kit "Order Code-32243" is a turn-key integrated educationalpackage for teaching/learning the fundamental principles of mechanical vibration as well as engineering mechanics. It provides both a comprehensive hands-on experimental device and an instrumentation package including wireless sensors for performing laboratory exercises to enhance student understanding of vibration theory.

32243 clearly brings classical theory to life by providing a convenient mean to validate predictions and to demonstrate the influence of parameter changes on system response visually. Students can perform virtual experiments using the vibration simulation software and then verify the results with actual experiments thereby reinforcing the learning of difficult principles. 32243 provides an ideal tool for damping free vibration experiments using the wireless sensors without affected by the damping associated with the sensor cables. It is a perfect tool for teaching mechanical vibration courses both at under graduate and graduate levels.

With an increase in high speed manufacturing and automation, it has become more important to use the theory of vibration for design and maintenance of machinery. This vibration theory is even more important in the monitoring and diagnosis of machinery malfunctions. Considering the importance and complexity of vibration principles, a course curriculum should include laboratory demonstration and hands-on experiments to help students understand the somewhat abstract concepts of vibration. To this date, most academic institutions include only theoretical lectures without laboratory exercises due a lack of an apparatus combined with an instrumentation setup.

Tesca Vibrations Fundamentals Training Kit "Order Code-32243" is an innovative tool you can use for teaching the fundamental principles of mechanical vibration. 32243 is well researched and designed for immediate implementation for vibration laboratory development. It is can be easily integrated with a typical vibration course

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taught at most institutions. 32243 provides a comprehensive hands-on experimental device, an instrumentation package, and experimental program with course curriculum for performing laboratory exercises to enhance student understanding of vibration theory. The benchtop apparatus has a spacious modular design featuring versatility, operational simplicity, and robustness. Each component is machined to high tolerances so it can be operated without conflicting vibration in a totally controlled environment. The instrumentation package includes wireless less accelerometers and transducers, precision servomotor for excitation, tachometer, and four channels simultaneously sampled data acquisition hardware, signal conditioners, and time and frequency domain analysis software. Optionally included are a software simulation of theory and a well-defined experimental program for free and forced vibration experiments ranging from single degree of freedom spring mass to continuous beam with different boundary conditions.

Students can perform both hands-on and virtual experiments to optimize the learning. 32243 is designed to perform both free and forced vibration experiments with and without damping. The basic 32243 frame consists of two identical test stations mounted on a portable structure. It features into changeable restraint fixtures, optional force transducers to measure the support reactions, sensors to measure deflection and acceleration, and a variable frequency rotary shaker for forced excitation. It allows for the first time to perform almost damping free vibration experiments to verify the theory.

Experiment possibilities

- Free vibrations (oscillations) in simple, compound, filar and Kater's pendulums
- Centre of percussion
- Free vibrations in cantilevers and a mass-spring system
- Free torsional vibrations and free vibrations in a beam and spring
- Free and forced vibrations in a simply supported beam and a rigid beam with spring
- Viscous damping
- Vibration absorber

Basic kit includes

- Base platform enabling mounting of several vibration training modules
- Integrated training package including data acquisition hardware and analysis software system
- Optional, One wireless sensor, Data communication Module, USB Cable to connect to a PC/Laptop & Simulation software & Software/ manual driven variable speed shaker for excitation with tachometer display
- One degree of freedom spring mass system
- One 30mm thick aluminum beam with provision for adjusting weight location and one weight block (mass)
- Two user configurable beam supports for cantilever or simply supported configurations (adjustable length)

Specifications

- **Base Unit**: 94cm x 90cmx 40cm
- **Excitation motor**: Software/manual driven variable speed motor with built-in unbalance load
- **Vibration isolation**: 4 Rubber feet
- **Pendulum Module**: Adjustable length and weight
- **Spring Mass Module**: Spring: Three different stiffness, stackable for 2 DOF Mass: Three weights, stackable
- **Torsional Vibration Module**:
  Shaft: Three different diameters
  Rotor: Three rotors of different mass and inertia
- **Vibration Control Module**:
  Tuned mass damper: Hardware for mass-spring absorber, and hardware for beam absorber
  Beam with damping treatment: One visco-elastic layer and one constrained layer
  Torsional Damper: One dashpot and three fluids
- **Beam Vibration Module**:
  Beams: One thick steel, one aluminum, one plastic
  Mass: Three weight blocks
- **Data Acquisition**: Number of Channels: 6 DAQ specifications: simultaneous sampling, USB connection
- **Software**: DAQ and analysis software: Time waveform, spectrum, FRF, motor control
- **Sensor Kit**: Accelerometer: Two single axis wireless accelerometers, two rotational sensors, One Tachometer, six channel simultaneous sampled trans-receiver for wireless data acquisition device, one USB cable
- **Beam support force transducer**: Optionally available

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Modules

(1) Spring-Mass Module (Vertical Arrangement); Order Code - 32244

The Spring-Mass module is a perfect tool for doing classic single and two DOF experiments. Natural frequencies for different mass and spring, with and without viscous damping, can be determined under free oscillations excited by initial displacement or velocity. Tests can also be done under forced excitation at various frequencies. The forcing function can be applied either at the base or the mass.

The system response could be measured at one frequency at a time or over the entire frequency range by selecting the sine sweep excitation. The data is easily stored and plotted with the software data processing capabilities to obtain the frequency response function. With the multi-plot feature of the analysis software, the system response to controlled variables (k, m, and c) can be easily
compared.
Includes: Three springs of different stiffness, three different weight blocks, low frequency excitation
system, PID control software.

(2) Spring-Mass Module (Horizontal Arrangement); Order Code - 32245

Designed to perform the experiments with spring-mass laid horizontally on a hard plate using ball bearings. This module gives an ability to do both free and forced vibration experiments.
Includes: Hardware and mounting brackets for installation of one and two degrees of freedom springmass systems, ball bearing system for linear motion of masses.

(3) Torsional Vibration Module; Order Code - 32246

Torsional vibration issues are important in design and diagnostics of turbomachinery, internal combustion engines, and many other applications. The fundamental concept of torsional vibration is similar to the flexural and longitudinal vibration, but students often find difficulty both with calculations and the measurements. The 32243 addresses both of these issues. The torsional vibration module consists of a stainless steel shaft, several rotors, a torsional viscous damper, and mounting hardware. The unit can be configured as one and two degrees of freedom systems for free and forced vibrationexperiments. It can also be configured with different rod length, diameter, and material to vary system stiffness, with different disks to vary the mass, and with or without a dashpot.
Includes: Three rods of different diameters and three rotors of different mass moment of inertia.

(4) Vibration Control Study Module; Order Code - 32247

32243 is an ideal platform for not only to understand basic vibration principles, but also to learn passive vibration control. Students can even learn to alter excitation frequency, change resonance frequency by modifying modal mass and/or stiffness, and add damping to bring vibration levels to acceptable values. Students can also design tuned-mass damper to absorb vibration in a springmass system or on beam a beam using a leaf spring with sliding masses. The student can then hold the vibrating masses to transfer the vibratory motion back to the original structure. A complete kit is provided for the experimentations. The vibration control study module also provides a constrained layer viscoelastic sandwich beam to study the effect of viscoelastic damping in vibration control. This is a more advanced topic for graduate level program, but students can use this module to study the relationship between system damping ratio/loss factor and the damping materials, damping layer thickness and damping coverage, etc.
Includes: Hardware and software for Tuned-Mass-Damper, one constraint layer and without constraint layer Viscoelastic beams, and two viscous damping setups-one for linear and one for torsional vibration control.

(5) Beam Vibration Module; Order Code - 32248

This module allows to study natural frequencies, mode shapes, and damping in beams of different materials such as steel, aluminum, and plastic. The beam length is fully adjustable and can be configured as simply supported or cantilever (at either of the beam ends), and overhung. This adaptable mounting allows determining effects of various

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boundary conditions in real applications.

Provisions to mount rigid masses at different locations and dashpot make beam completely customizable. Custom built force transducers can be mounted to measure the support reaction forces and determine transmissibility factor. External unbalance force of variable frequency may be applied to excite natural frequencies and produce visible mode shapes. The rotational speed is displayed digitally and a TTL pulse is available to trigger a data acquisition system or an external stroboscope.

The amplitude of deflection during resonance may be measured any point along the length of the beam. By directing a stroboscope at the beam the user can clearly see the natural mode shape predicted by classical beam theory, including the second, third, and even higher order modes. The standard beam restraint fixtures accept up to 50mm wide x 3mm, 4mm, and 6mm thick bar stocks and offer fixed, sliding, and hinged restraint modes. Point, distributed, and twisting moment loading patterns can be applied. To add interest, customer designed beams or trusses may be installed for design competition and special projects. 32243 can also be used for a simple modal test and vibration control experiments. Students can perform modal tests by using a hammer or shaker.
Includes: Three different beams (aluminum, steel, and plastic), mode shape animation software and shaker frequency sweep software for excitation of different modes, and three masses.

(6) Vibration Transmissibility Module - Order Code - 32249
Conduct tests to measure vibratory force/motion transmitted to the supporting structure at different frequencies of excitations.
Includes: Once force transducer and signal conditioner, transmissibility software

(7) Wireless Sensor Kit - Order Code - 32250
This kit provides all the necessary sensors that you need to take the measurements while doing the experiments using VFT.
Includes: Four single axis accelerometers, One Tachometer, Two DC response capacitive accelerometers for spring-mass experiments, one digital stroboscope

(8) Pendulum Vibration Module - Order Code - 32251
The pendulum vibration module includes a rod on which one or more mass can be attached. This basic module is designed to teach the fundamental principles such as frequency and period, and the concept of equivalent mass.
Includes: One slotted pendulum with adjustable weight block and its anchor.

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