KSM-054

FREE VIBRATION APPARATUS

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 addition, a damper can be used in a free vibration system to dissipate a certain percentage of energy with each cycle of vibration.

Free Vibration Apparatus Model KSM-054 has been designed to perform demonstrations and experiments that provide an understanding of the free vibrations of a simple spring-mass-damper system. Demonstrations may be carried out to illustrate free and damped vibrations of a simple spring-mass system having one degree of freedom and the response of a second-order mechanical system to a step input.

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, as well as 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, and a lower mounting plate for the damper. The mass carriage is constrained by rollers, which run along the vertical guides to provide a single degree of freedom with minimum uncontrolled damping. A pen, attached to the vibrating frame, and a paper strip, drawn by a synchronous motor, provide a means of producing amplitude-time recordings.

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

Specifications

- **Main Structure**:
  - Rigid frame made of steel and aluminum.

  - Includes two vertical guides.
  - Upper mounting plate for the spring and lower mounting plate for the damper.
  - Supports various elements of the unit.
- **Mass Carriage**:
  - Can attach various slotted weights.
  - Constrained by rollers running along the vertical guides.
  - Provides a single degree of freedom with minimum uncontrolled damping.
  - Lower end of the spring is attached to the mass carriage; upper end is attached to the frame.
  - Adjustable frame allows variation in the free position of the carriage.
- **Mechanical Strip Chart Recorder**:
  - Produces amplitude vs. time recordings.
  - Composed of a drum recorder and pen holder.
  - Drum recorder is driven by a synchronous motor.
  - A roll of paper, passing through a tensioning device, ensures constant paper speed (0.02 m/s).
  - Pen holder attached to the mass carriage with a spring maintaining continuous contact between the pen and paper.
- **Electronic Console**:
  - Used to switch the synchronous motor on and off during experiments.
- **Springs** (Interchangeable):
  - **Spring 1**: k = 3.30 kN/m
  - **Spring 2**: k = 1.22 kN/m
  - **Spring 3**: k = 0.047 kN/m
- **Weights**:
  - Five 1 kg weights can be added and secured to the mass carriage.
- **Adjustable Oil Damper**:
  - Provides controlled damping.
  - Attaches to the carriage via a screw.
  - Requires oil for filling.
- **Cables & Accessories**:
  - All necessary cables and accessories for normal operation are included.
- **Manuals Provided**:
  - Required Services Manual
  - Assembly and Installation Manual
  - Start-up Manual
  - Safety Manual
  - Maintenance Manual
  - Practice Manual

Experiment Possibilities

- Investigation of the relationship between mass, spring stiffness, and the period/frequency of oscillation in a simple spring-mass system with one degree of freedom.
- Investigation of the relationship between applied force, oil viscosity, and velocity for various settings of the adjustable oil damper.
- Observation of the effect of varying damping on the response of a second-order mechanical system to a step input.
- Observation of the free vibrations in a system with one degree of freedom.
- Study of the effect of viscous damping on the free vibrations of a simple spring-mass-damper system.
- Determination of the damping ratio for a given spring-mass-damper system.

Services Required

- Mains Supply:
- 220V Single Phase / 440V Three Phase; 50Hz

Note: Specifications and Photos can be altered without prior notice in our constant efforts for improvement.