SENSORS FOR RESEARCH & DEVELOPMENT

EXPERIENCE IS THE BEST TEACHER

DEVELOPING TOMORROW'S ENGINEERS

PHYSICS LABORATORY PROGRAM

DISCOUNTED SENSOR KIT ■ EXPERIMENTS (INSTRUCTOR'S GUIDE) ■ INDUSTRY EXPERT LECTURE ■ POSTER

Álava Ingenieros
GRUPO ÁLAVA

MODEL # 300A35

www.PCB.com/university | info@pcb.com | 800.828.8840

PCB PIEZOTRONICS INC.
MTS SYSTEMS CORPORATION

PHYSICS LABORATORY PROGRAM

Physics is the study of matter and its behavior and motion through both space and time. Researching the transfer of energy and forces helps students better understand the behavior of the universe. This Physics Program provides commonly used sensors and accessories and a step-by-step Instructor's Guide for a variety of experiments. These experiments include stresses and strains on a cantilever beam, measuring impulse momentum, and velocity response in a speaker. The program also includes an industry expert lecture and technical poster.

INCLUDED PRODUCTS	MODEL	QTY
Impact Hammer 500 lbf, 10 mV/lb	086C03	1
Accelerometer 100 mV/g, 0.5 to 3 kHz	333B30	2
1/2" Array Microphone, BNC connector 24 dBA to 122 dB and 10 Hz to 20 kHz	130F20	2
Strain Sensor	740B02	2
Acoustic Calibrator	CAL200	1
1/4" Calibrator Adapter	ADP024	1
Cable - 10 ft. (BNC to BNC)	002T10	6
Cable - 10 ft. (10-32 to BNC)	002C10	4
1/2" Microphone Holder	079A11	4

OPTIONAL PRODUCTS	MODEL
Handheld Shaker	394C06
Force Sensor	208C02
Smart Shaker	K2007E01
Tachometer (LT2 Kit)	LT2
Digiducer	333D01
4-Channel Signal Conditioner	482C15
1-Channel Battery Powered Signal Conditioner	480E09

All sensor kits and optional products are new and within specification.

LABORATORY EXPERIMENTS

Learning Objectives

#1 - CANTILEVER BEAM MOTION

Learn about transverse waves in cantilever beams.

#2 - IMPULSE AND MOMENTUM

Learn about impulse, momentum, and using numerical integration to calculate velocity from acceleration.

#3 - NEWTON'S SECOND LAW

Learn about Newton's Second Law, mass loading, and comparison calibration.

#4 - MICROPHONE CALIBRATION

Learn how to perform an "in-field" single point, single frequency calibration and check microphone linearity to verify that the microphones are measuring accurately.

#5 - HARMONIC OSCILLATIONS

Learn about single degree of freedom oscillators using a moving coil loudspeaker.

#6 - VELOCITY OF SOUND

Learn how to calculate the speed of sound using the time delay between incident and reflected waves displayed on an oscilloscope. Also learn about the temperature dependence of sound speed on ambient conditions during an experiment.

#7 - SOUND PRESSURE RELATIVE TO DISTANCE

Learn about spreading of pressure distribution (1/r) with the distance from the source.

#8 - CONSTRUCTIVE & DESTRUCTIVE INTERFERENCE

Learn how pressure amplitude changes depending on the frequency and phase of two sources.

#9 - COHERENT & INCOHERENT ADDITION

Learn about pressure addition between multiple sound sources of the same frequency and relative phase versus sources of different frequencies and relative phases.

Step-by-step Instructor's Guide to experiments is provided.

POSTERS

- Acoustics
- Pressure
- Vibration
- Force & Industrial Strain

INDUSTRY EXPERT PRESENTATIONS

- Acoustics - Overview of how and why to measure sound, source-path-receiver theory, coherent and incoherent sources, and microphone sensor options.
- Pressure - Overview of sensor design, key specifications, common applications, mounting, and pressure sensor options.
- Vibration - Overview of piezoelectric theory, common terminology, accelerometer construction, mounting, and accelerometer sensor options.
- Force & Industrial Strain- Overview of sensor construction, key specifications, operational basics, mounting, and force & strain sensor options.

ADDITIONAL UNIVERSITY PROGRAM BENEFITS

- Sensor samples (non-functioning) as available
- Discounted PCB® seminar registration fees for professors and students
- “White Papers for Sensors” program for professors and students
- “Share your experiments” (photos and step-by-step) for discounts against future sensor purchases

Edificio Antalia. Albasanz 16. 28037 Madrid
915 679 700 | grupoalava.com | alava@grupoalava.com
Madrid | Barcelona | Zaragoza | Lisboa | Lima | Texas

PCB PIEZOTRONICS INC.
MTS SYSTEMS CORPORATION

3425 Walden Avenue, Depew, NY 14043-2495 USA
Toll-Free in the USA: **800.828.8840** | 24-hour SensorLine℠: **716.684.0001**
Fax: **716.684.0987** | Email: **info@pcb.com**

| VISIT US AT WWW.PCB.COM |

PCB® is a designer and manufacturer of microphones, vibration, pressure, force, torque, load, and strain sensors, as well as the pioneer of ICP® technology used by design engineers and predictive maintenance professionals worldwide for test, measurement, monitoring, and control requirements in automotive, aerospace, industrial, R&D, military, educational, commercial, OEM applications, and more. With a worldwide customer support team, 24-hour SensorLine℠, and a global distribution network **PCB® IS COMMITTED TO TOTAL CUSTOMER SATISFACTION.**