Physics course: Introduction

A. Arciniegas

IUT Cergy-Pontoise, Dep GEII, site de Neuville

Contents

Foreword

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- Engineering 1st year mathematics: differential calculus, differential equations...
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Course progression

- Lessons and exercises sessions
- 2 Exams (3h) : 1h (coeff 1) et 2h (coeff 2)
- Others (see full syllabus)

Interlude

https://www.youtube.com/watch?v=SPvi1AyShzw?

Physics reminders

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with:
F: force in newton (N)
m: mass in kilogram (kg)
a: acceleration in ($m.s^{-2}$)

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- **Dimensions:** (P) = $M.L^2.T^{-3}$
- **Units:** watt (W)

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3. Work of a constant force: $W = \vec{F} \cdot \vec{d} = F.d.cos\theta$

   with:
   d: the length of segment AB
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1 Joule: the work of a force of 1 Newton whose point of application moves 1 m in the direction of the force.

1 Watt: is the power of a force providing work of 1 Joule for 1 second.

Definitions: Work-Energy theorem

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Work-Energy theorem

$$\Delta E_c = \sum W_k \tag{2}$$

$$E_{cf} - E_{ci} = \sum W_k \tag{3}$$

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- gravitational (weight): mgh, with h the height
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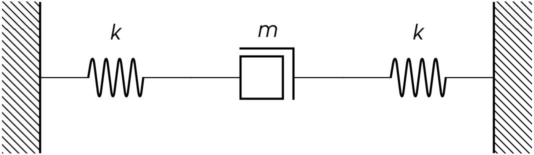
Dissipative system: system in which among the forces applied there are *non-conservative forces* (such as friction) and in which the mechanical energy of the system decreases. The dissipated mechanical energy is then found in another form.

First example: Simple Harmonic Oscillator

We will study the spring-mass system:



Exercise

Principle of the Space Linear Acceleration Mass Measurement Device (SLAMMD)

In the International Space Station (ISS), missions last an average of six months and it is necessary to check the mass of the astronauts in order to monitor the atrophy of their muscles due to microgravity.

Thus, to achieve the medical monitoring of astronauts, a system had to be invented to measure their mass in the absence of gravity in the oscillating chair.

The device consists of a seat mounted on a rail and fixed to one end of a spring (stiffness k), the other being connected to a fixed point of the spacecraft.

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2. In the case of the Skylab mission, the stiffness constant of the spring $k = 606$ N.m^{-1} and the oscillation period of the empty chair $T_0 = 0.90149$ s. Calculate the mass of the chair.

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3. When an astronaut is in the chair, the oscillation period is $T_t = 2.01167$ s. Calculate the mass of the astrounaut.