Coupled Pendulum

Aim

To study normal modes of oscillations of two coupled pendulums and to measure the frequncies of these normal modes, as well as the spring constant k.

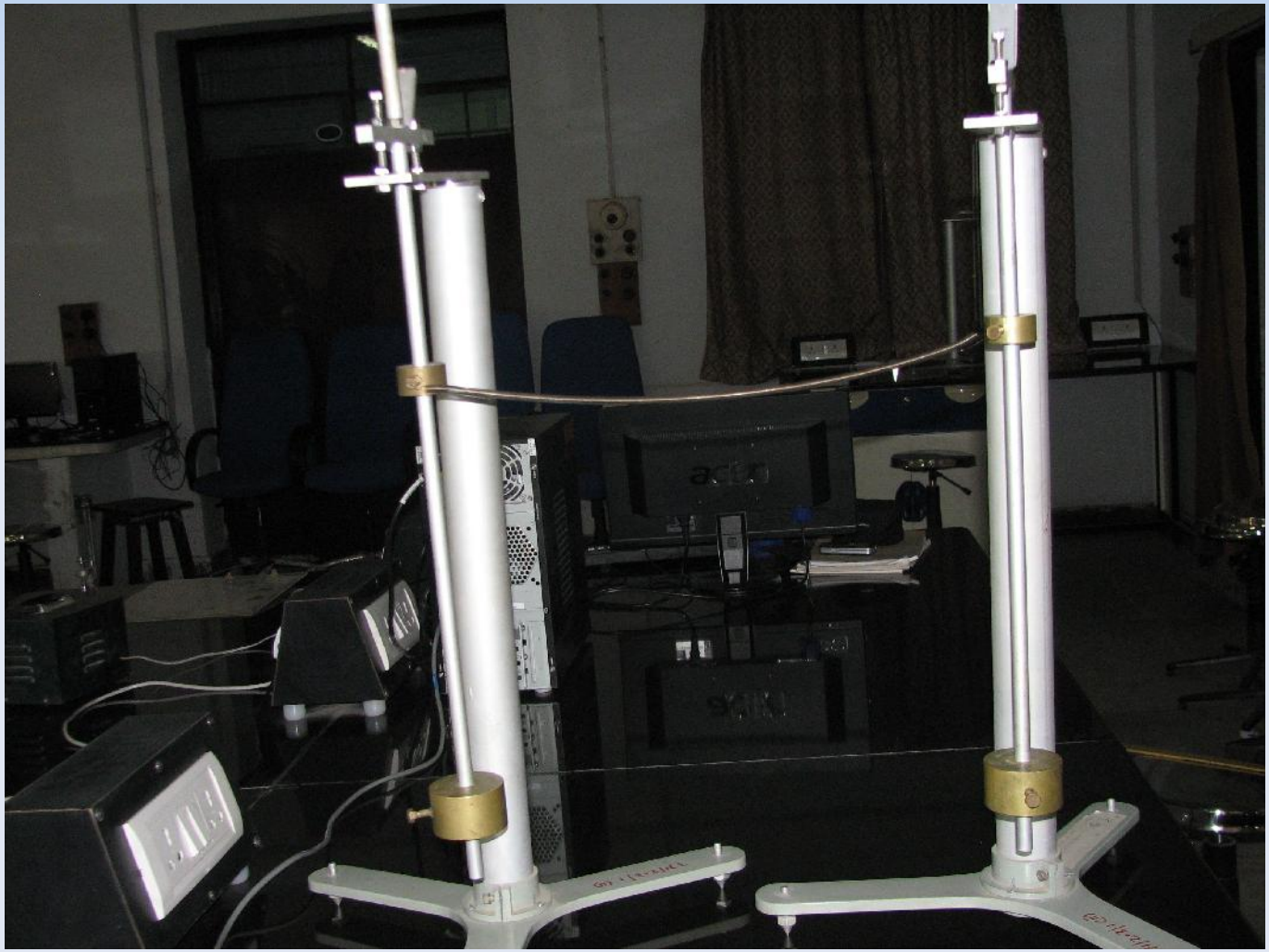
Coupled Pendulum

Apparatus

- Two compound pendulums
- Coupling spring
- Stop watch

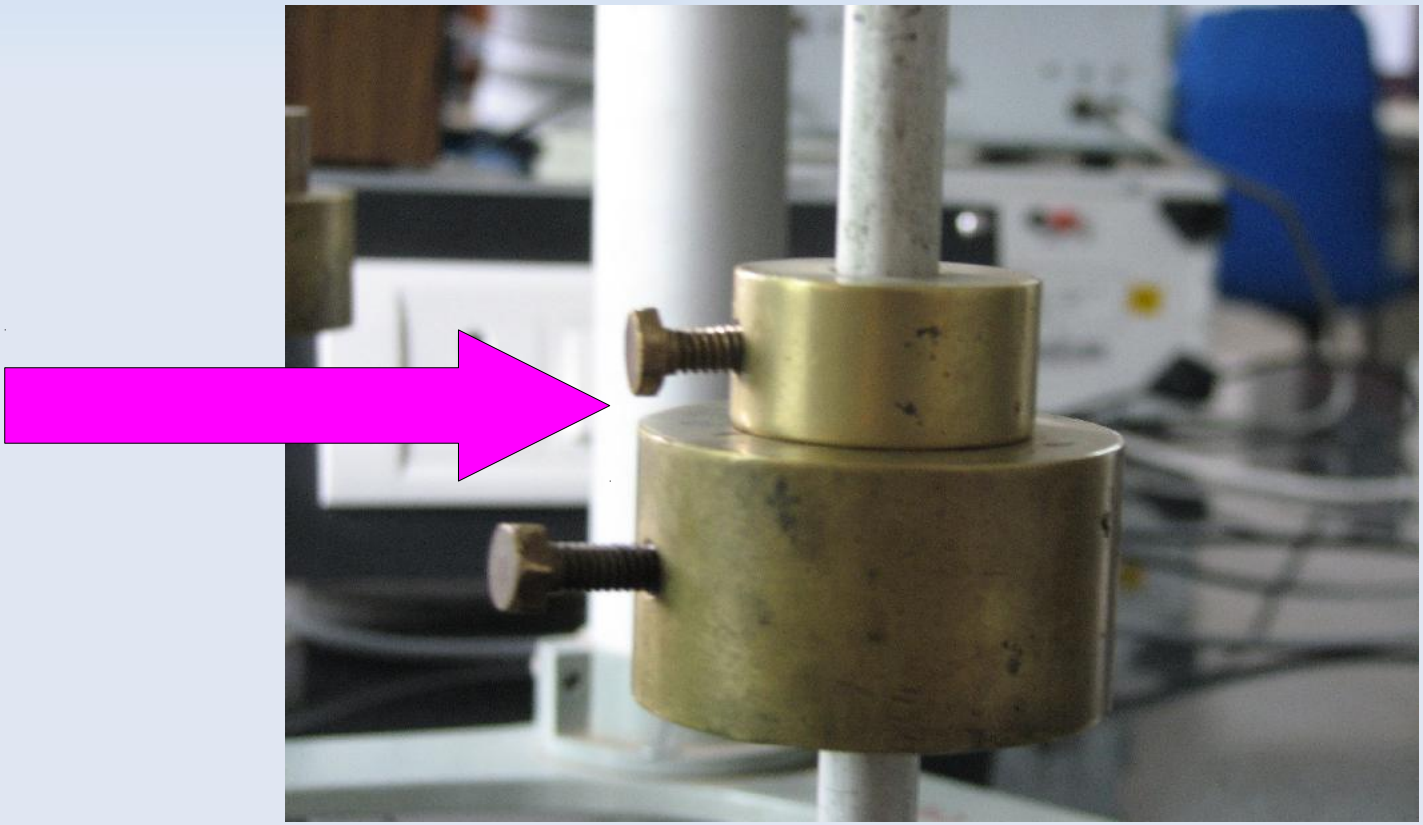
Coupled Pendulum

The Set-up



Procedure (Part I)

- **Uncouple the two pendulums (remove the spring) and bring the peg to which the spring is attached at the bottom.**

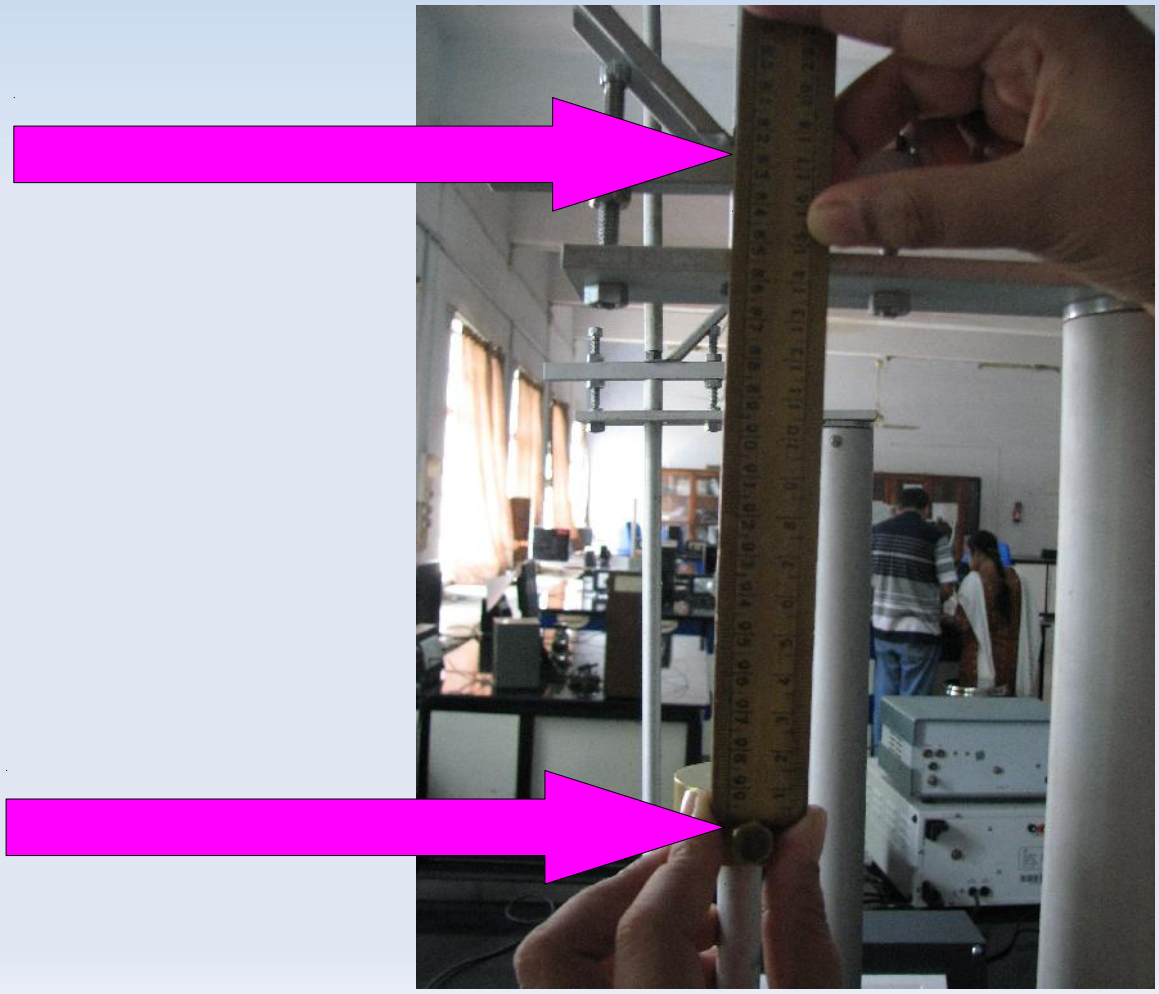


Procedure (Part I)

- **Set small oscillations in both the pendulums individually and measure period T for 20 oscillations. Calculate natural frequency ω_0.**

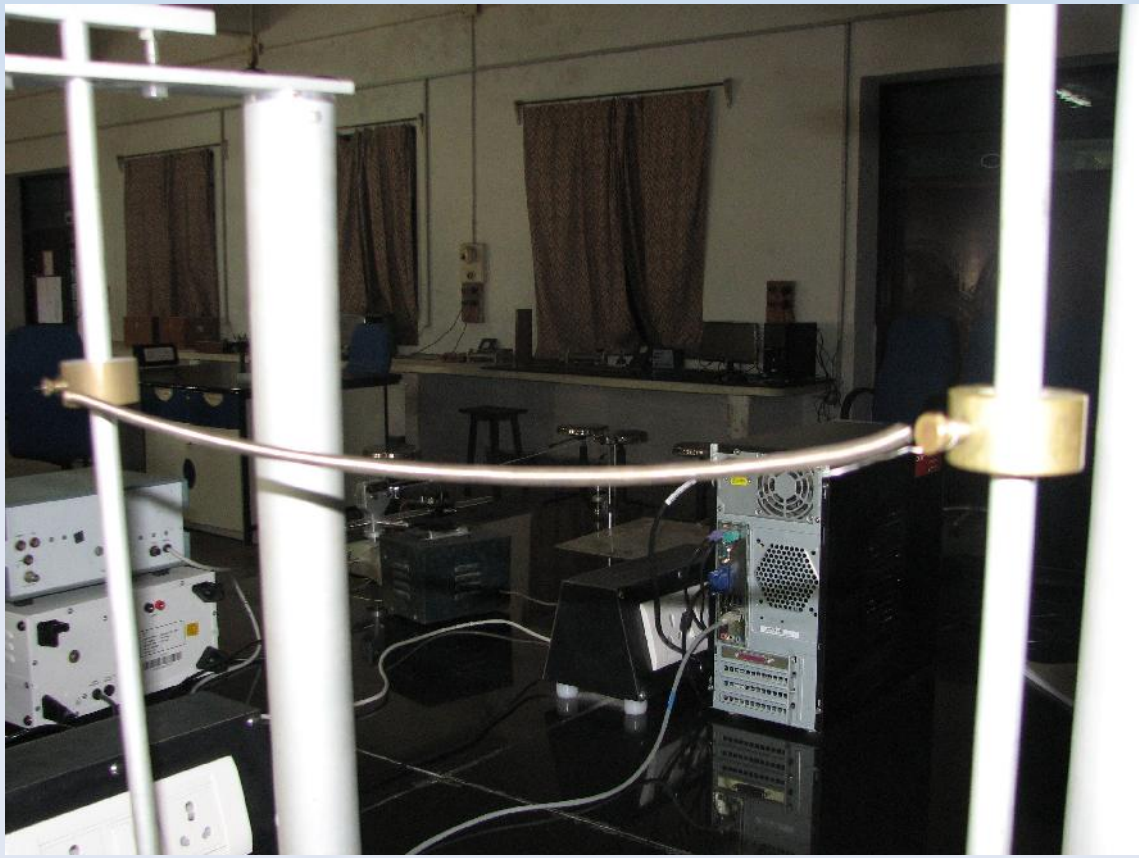
Procedure (Part I)

- **The height l (10, 15, and 20 cm) of the peg to which spring is attached is measured from the mid point of the peg to the pivot.**



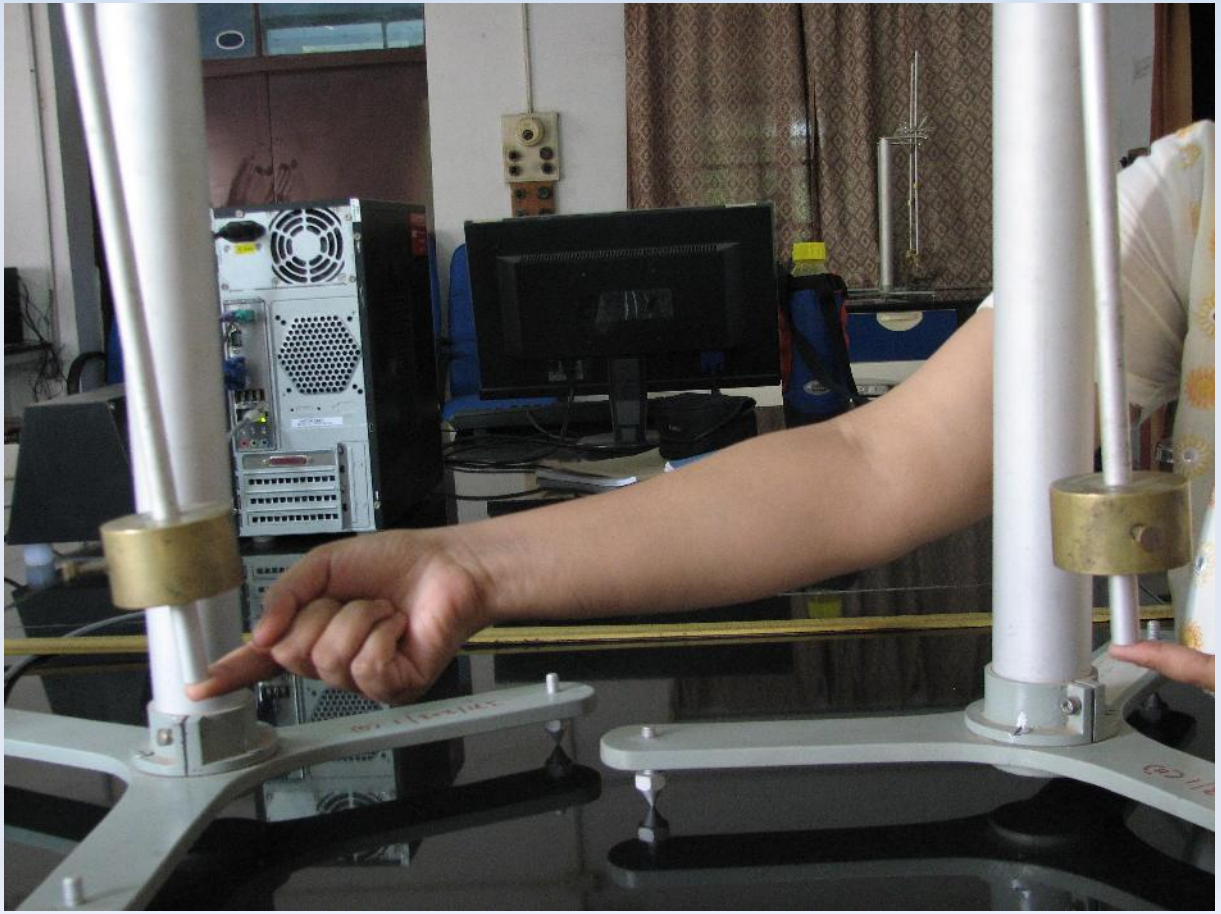
Procedure (Part I)

- **Hook the spring at l=10 cm. Make sure the spring should neither slack nor stretch.**



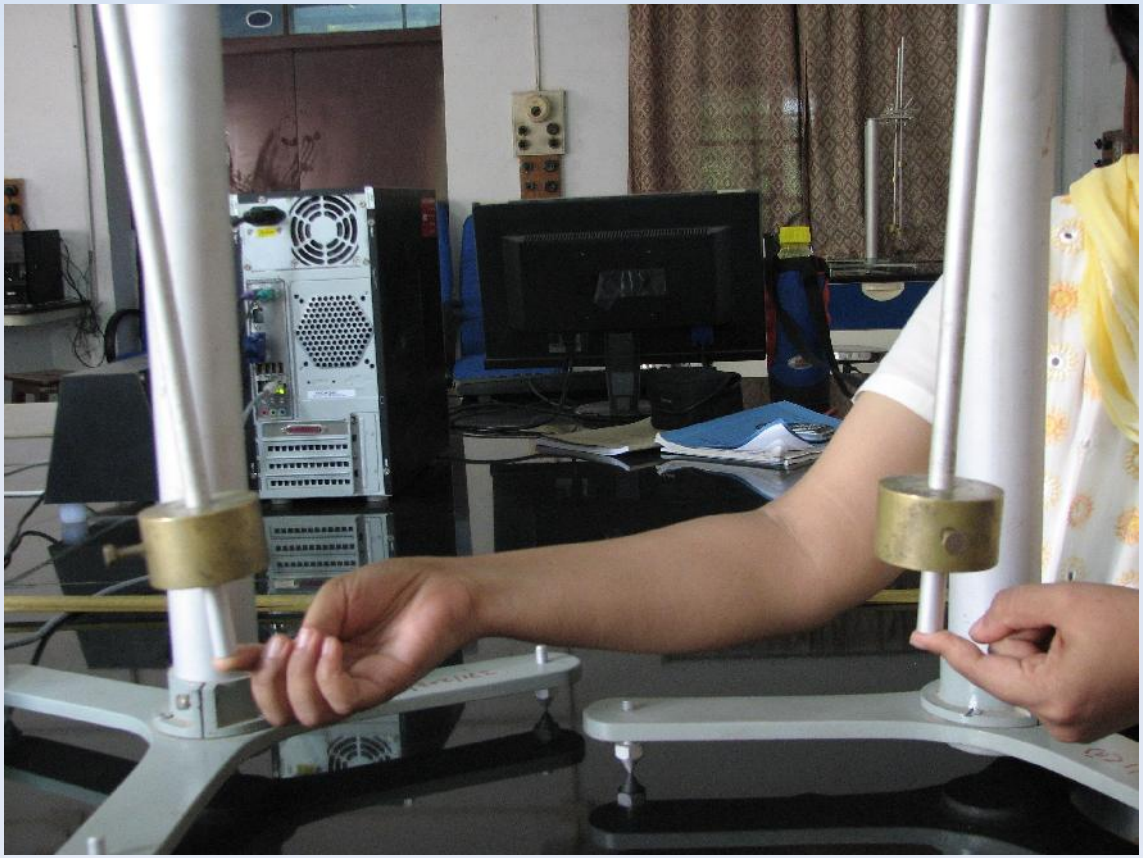
Procedure (Part I)

- **Displace both the pendulums SLIGHTLY in one direction by the same amount to excite the in-phase normal mode. Calculate T_1 and ω_1 for 20 oscillations.**



Procedure (Part I)

- **Now displace both the pendulums SLIGHTLY in opposite directions by the same amount to excite the out-of-phase normal mode. Calculate T_2 and ω_2 for 20 oscillations.**



Procedure (Part I)

- **Repeat the procedure for l=15 cm and l=20 cm.**

Procedure (Part II)

- **Set l=10 cm.**
- **Displace any one pendulum by a small amount.**
- **Measure T for a single (one) oscillation. (For this, measure T for 20 oscillations and divide the number by 20.)**
- **Measure time period ΔT between two successive stops of the same pendulum.**
- **Using these T and ΔT, verify the frequencies, ω_1 and ω_2 , measured in part I.**

Calculations and Graphs

- **Plot $\frac{\omega_1^2}{\omega_0^2}$ versus l^2 and $\frac{\omega_2^2}{\omega_0^2}$ versus l^2.**
- **From the slope of $\frac{\omega_2^2}{\omega_0^2}$ versus l^2, calculate the spring constant of the coupling spring.**

  Slope = 2k/mgL

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