UNIVERSITY OF NAIROBI

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

FME 411 - MECHANICAL VIBRATIONS

TWO DEGREE OF FREEDOM VIBRATION EXPERIMENT

OBJECTIVE

To determine the Natural Frequency of the system both experimentally and calculation.

➢ Description of Apparatus:

The Laboratory setup consists of **TWO Hinged Beams** each, of which has attached a number of masses and they are **inter-connected** and supported in a rigid frame by **three springs.**
One of the beams is excited by a motor driving an **unbalanced flywheel.**
The **Two Degrees Of Freedom** are measured by the **Angles of Rotation of the Beams,** and as usual, we make the assumption that the angles are small so that sin, etc.
Mounted on each beam is a **Vibration Pickup** whose **electrical output** is fed into a **Scope** as well as a **Frequency/Period Digital Meter** and a **Precision Voltmeter.**
Thus, output information of **Frequency and Amplitude** are obtainable. The Amplitude Output is in **Volts,** which is sufficient for this experiment since only **Relative Magnitudes are of interest.**

➢ Experimental Procedure:

- Excite the system at various frequencies by operating the Motor at various speeds.
- Start at **zero speed** and go up in increments beyond the **Second Natural Frequency,** then go back down to **zero.**
- At each running speed, record the **Amplitudes of the output voltage** from the two pickups.
- Record the exciting frequency by reading both the input **speed in revs/min.** as well as the output of the **Digital Meter.**
- They should be the same.
- Plot curves of **amplitude versus frequency** for each pickup.
- Each of these curves should have **one peak at the two natural frequencies.**
- ***Label the two natural frequencies.***

➢ Analytical Determination of Natural Frequencies:

In order to get the Moment of Inertia of the two beams including the attached masses, measure their Geometry and estimate the masses of their parts. Some of the weights can be estimated by measurement of volume and knowledge of the Specific Gravity of Steel and Aluminium.
Other weights will be given to you, if available.
The Spring Constants are known. **(See table on notice board).**

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The Moments of Inertia are to be calculated from the relation $J = \sum_{i=1}^{N} m_i r_i^2$, which one hopes, is familiar to the students.

Set up the equations of motion for the system, preferably in Matrix Format, and solve for the Natural Frequencies. (In case this procedure of solution has not been covered in the lecture, defer this last part until you have been instructed).

- **Conclusion:**

Compare results and make some intelligent and appropriate comments.

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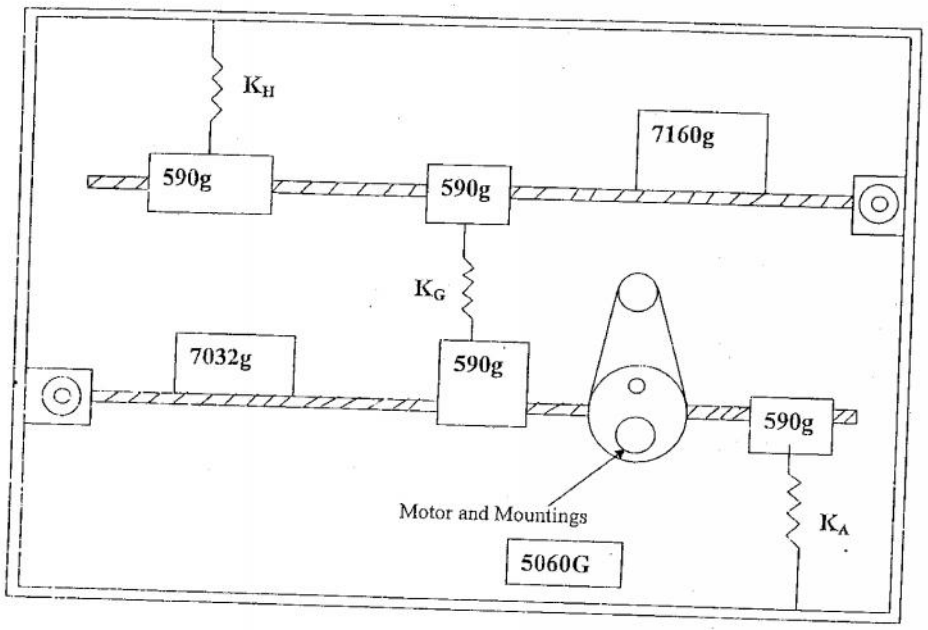
DEGREE OF FREEDOM EXPERIMENT DIAGRAM



NOTES:-

1) Cross section of beams 25.4×12.7mm (1×1/(2).
2) Masses in grammes.
3) Spring constants as given on the Notice Board.