**YTÜ Mechanical Engineering Department**

**Machine Theory, System Dynamics and Control Division - MAK 4981 LABORATORY**

**Dynamics of Machinery – Lab Report**

**Lab. Date:                               Number:**

**Name & Surname:**

**Lab. Instructor:             Group/Sub‐group: ….. / ….**

**Location:** A Blok – Machine Theory Laboratory

**Name:** Dynamics of Machinery

**Subject:** Resonance Analysis

**Device and Material:**

- Vibration Test Beam Setup

- Ruler

- Sample mass



Figure Experimental Test Setup

**Required**

For given Experimental Test Setup;

1. Determine the natural frequency of the system experimental method.
2. Determine the parameters of the system with experiment.

**Experimental Study:**

To begin with,

1. Measure the distance between the referance point of the ruler and the beam ……. (m).
2. Fill the table given below with respect to the dispacements of the beam.

|  |  |  |  |
| --- | --- | --- | --- |
| System Frequency | Frequency:f (x100/2,5) (Hz) | Frequency$$ω=2πf$$ | Displacement(m) |
| 2,5 | 100 | 10,47 |  |
| 5 | 200 | 20,93 |  |
| 5,5 | 220 | 23,03 |  |
| 6 | 240 | 25,12 |  |
| 6,5 | 260 | 27,21 |  |
| 7 | 280 | 29,31 |  |
| 7,5 | 300 | 31,40 |  |
| 8 | 320 | 33,49 |  |
| 8,5 | 340 | 35,59 |  |
| 9 | 360 | 37,68 |  |
| 9,5 | 380 | 39,77 |  |
| 10 | 400 | 41,87 |  |
| 12,5 | 500 | 52,33 |  |

1. Plot amplitude versus frequency with respect to your displacement measurements.
2. Find the natural frequency of the system. (Recall: the peak point of the graph shows the natural frequency of the system.)



Amplitude (mm)

Actuator Frequency (rad/sec)

**Analytical Study**

1. **Step:** Calculation of the stiffness constant
	1. Measure the distance between two end points of the spring in steady state condition: ….(m)
	2. Disassemble the spring. Measure the distance between two end points of the spring: ….(m)
	3. Attached some weight to the spring. Measure the distance between two end points of the spring: ….(m)

|  |  |  |
| --- | --- | --- |
| Added Mass (kg) | $δ\_{(c-b)}$ (mm) (c-b) | $δ\_{(a-b)}$ (mm) (a-b) |
|  |  |  |

* 1. Calculate the stiffness of the spring (K)

**Hint:** $F=kδ\_{3-2}$;

 Where, g=9.81 and F is the applied force on the spring

1. **Step:** Calculation of the natural frequency
	1. Calculate the mass of the system

Hint: Take the moment of the system with respect to the fixed point of the beam (O)

$F\_{Spring=}\frac{M\_{system}δ\_{(a-b)}}{δ\_{(c-b)}}$ 

* 1. The differential equation is as follows;

$$J\ddot{ϑ+kL\_{2}^{2}θ=F\left(t\right)L\_{1}}$$

Where, $J=M\_{system}L\_{1}^{2}$=………(kg.m2)

Finally, the natural frequency of the system;

$$ω\_{n}=\sqrt{\frac{kL\_{2}^{2}}{J}}$$

**Results**

|  |  |  |  |
| --- | --- | --- | --- |
| $ω\_{n}$ obtained from the experimental test | K(N/m) | J(kg.m2) | $ω\_{n}$ obtained from the experimental test |
|  |  |  |  |

**Discussion**

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