**MARMARA UNIVERSITY**

**FACULTY OF ENGINEERING**

**DEPARTMENT OF MECHANICAL ENGINEERING**

**ME4111/ME4011/ME411 EXPERIMENTAL METHODS IN MECHANICAL ENGINEERING**

**EXPERIMENT NO. 5**

**DESIGN OF AN EXPERIMENT FOR DETERMINING THE DAMPING RATIO OF A CANTILEVER BEAM BY USING THE LOGARITHMIC DECREMENT TECHNIQUE**

1. **Objective**

In this experiment, the damping ratio of a cantilever beam is aimed to be determined by means of an accelerometer.

1. **Introduction**

The free vibration equation of motion of a single degree-of-freedom damped vibratory system is of the form

 (1)

where  is the undamped natural frequency of the system, and  the damping ratio. If , the system is called an *underdamped* system.

1. **Theoretical background of the logarithmic decrement technique**

Logarithmic decrement can be used to find the damping ratio of an underdamped system. The logarithmic decrement  can be found as the natural logarithm of the ratio of any two adjacent peaks [1]:

 (2)

where , , and  denote the *j*th peak value of the displacement, velocity and acceleration variables, respectively. The damping ratio can then be found as [1]

 (3)

1. **Experimental procedure**
* Vibrate the beam by giving a small initial displacement at the free end and then releasing.
* Record the output of the accelerometer.
1. **Required calculations**
* Plot the acceleration data.
* Calculate the damping ratio using all the adjacent peaks.
* Express your estimation of the damping ratio of the beam as Mean ± Standard Error of the Mean (SEM).
1. **Required report format**
* The report should be organized as follows: Title Page, Introduction, Experimental Setup and Procedure, Theoretical Background and Calculation Details, Results and Discussion, Conclusions, References and Appendices (if any).
* Results should be presented in tabular form.
* Show all details of your calculations.
* Discuss the possible sources of errors.
* Make recommendations for improving the experimental procedure.

**References**

1. A. Palazzolo, *Vibration Theory and Applications with Finite Elements and Active Vibration Control*, Wiley.