ME 621 **Project 1 – Vibrations** **Fall 2017**

Project Due Date

Tuesday, December 12, 5:00 PM - 7:30 PM. Reports should be received by 2:00 PM of this date.

Requirements:

1. Working in groups of two, conduct an experimental modal analysis on a mechanical/structural system of your choice. The system chosen and the experimental design must be reviewed by me.
2. Acquire data using daq_gui.
3. Use the Quadrature Method to identify a three mode modal model (i.e., natural frequencies, damping ratios and mode shapes).
4. To check system identification accuracy, synthesize all measured frequency response functions.
5. Using modal modification, predict the effects on the natural frequencies and mode shapes when adding a mass to one of the measurement locations.
6. Verify the prediction by repeating Requirements 1 – 4 for the modified system.

Report Outline (one report per group)

E-mail me (chris.richards@louisville.edu) your report titled your last names separated by an underscore in MS word. Also, put your last names separated by an underscore in the subject heading of the email. Report should consist of only the following *Sections* formatted in MS Word as a Heading 1 Style:

1 Introduction.

1.1 Physical Vibration System.

Description, drawings with relevant dimensions and clear photographs.

1.2 Experimental Design.

Discussion of the choice of response and excitation locations, excitation type, signal processing parameters and boundary conditions. Include drawings with relevant dimensions indicating response and excitation locations, and boundary locations. Also include clear photographs of the experimental setup.

2 Results and Discussion.

2.1 Unmodified System.

Tabulate natural frequencies and damping ratios from Requirement 3 in a single table. Do not tabulate the mode shapes. Instead plot the mode shapes one figure per mode. Note that since mode shapes can be 3-dimensional (e.g., 2 spatial coordinates and one perpendicular response direction), modes shapes should reflect the physical system's appearance. Also, superimpose mode shapes over the system's static shape.

2.2 Modified System.

Tabulate the natural frequencies predicted from Requirement 5 and from the modal model experimentally determined from Requirement 6. Include percentage errors in this table. Do not tabulate the mode shapes; instead, follow the aforementioned practice and overlay predicted versus measured mode shapes.

3 Conclusions.

Draw conclusions about discrepancies in the different methods drawing upon assumptions made, data processing and methodology.

Appendices. Plot the following spectral functions within the frequency range of interest only, i.e., in the frequency range containing the three identified modes of vibration.

4 Appendix A – Measured Frequency Response and Coherence Functions.

All measured frequency response and coherence functions. Place magnitude of each frequency response and corresponding coherence function on their own page column-wise.

4.1 Appendix A1 – Unmodified Physical System.

Measured Frequency Response and Coherence Functions from original physical system (n x m figures).

4.2 Appendix A2 – Modified Physical System.

Measured Frequency Response and Coherence Functions from system with added mass (n x m figures).

5 Appendix B – Measured and Synthesized Frequency Response Functions.

Magnitude and phase of all synthesized frequency response functions superimposed with corresponding measured frequency response functions. Place magnitude of each frequency response & corresponding phase on their own page column-wise.

5.1 Appendix B1 – Unmodified Physical System.

Measured and Synthesized Frequency Response Functions from original physical system (n x m figures).

5.2 Appendix B2 – Modified Physical System.

Measured and Synthesized Frequency Response Functions from system with added mass (n x m figures).

All figures and tables should be labeled with a caption that includes the figure or table number and a standalone description of the figure or table using full sentences. Figure axes should be labeled with proper variables, their respective embellishments & correct units. Make figures as large as possible to fit oriented portrait on a single page.

Presentation (one report per group)

ALL STUDENTS ARE REQUIRED TO BE PRESENT DURING THE FINAL EXAM PERIOD.

Prepare a 7 to 10-minute presentation of your report. Not all of the audience will have access to your report. Therefore, it is expected that the presentation be thorough, covering all aspects of the project in detail. The presentation should cover each section of the report and students should ensure that all overhead slides (including axis labels) are clearly legible prior to presentation.

By 2:00 PM of the due date, send me electronic copies of your slides along with your report.

Each presentation will be followed by a ~5-minute question and answer session. Students in the audience are required to ask questions. Participation will be included in your grade even when you are not a member of the presenting group. Students' questions will be followed by questions from me that may be directed towards only one of the students or the group as a whole. All questions can come from any material covered throughout the course. It is encouraged that course notes be organized for promptness to answer the questions asked.