# ME352 – Mechanical Vibrations

# Computer Assignment 2: Harmonically Excited Vibrations

**Assignment report to be submitted on Canvas by 11.00 pm on Sunday, March 31st, 2024.**

*Note: No submissions will be accepted after this date.*

**Problem:** The rotational system shown in Figure 1, which consists of a rotating component, with a mass moment of inertia of 0.5 kg.m$^2$, connected at the mid-point of a shaft housed at both ends and driving a gear. During operation, the rotating component is subjected to a harmonic torque of:

$$M(t) = 100 \cos \omega t \quad \text{(Nm)}$$

where $\omega$ is the operating frequency. The system is operated under three standard conditions, namely at (i) 1000 rpm, (ii) 1500 rpm and (iii) 2000 rpm. The shaft is manufactured from stainless steel with a Young's modulus and Poisson's ratio of 209 GPa and 0.3, respectively. The shaft has a diameter of 25 mm and total length of 1.0 m. For the initial system design, the damping ratio is 0.4.

Develop a numerical code which will allow you to:

   (i)    Plot the total response of the system for the three standard operating conditions if an initial angular displacement of 0.005 rad is applied to the system.
   (ii)   Investigate the effect of mass moment of inertia, shaft diameter and material on the overall response of the system.
   (iii)  In conjunction with the initial applied angular displacement, discuss the effects of imparting an initial angular velocity in the range of 0.05 rad.s$^{-1}$ to 2 rad.s$^{-1}$ to the system.
   (iv)   Determine the total response of the system, for all three operating conditions, if the damping ratio is varied from zero to unity, inclusive.
   (v)    Plot the magnification factor versus frequency ratio for operating frequencies up to 400 Hz and for damping ratios from zero to 5.0.

**Note:** The polar second moment of area for a rotating shaft is:

$$J = \frac{\pi d^4}{32}$$
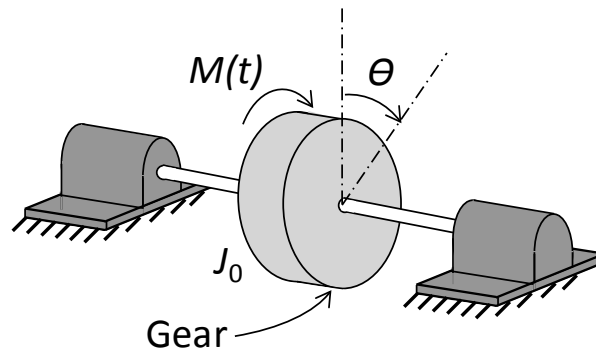
where *d* is shaft diameter.

Figure 1: Schematic representation of the gear setup.

## Report Structure and Marking Scheme

Your report must include the following:

- Introduction, including problem definition. **[5 marks]**
- Methodology, including assumptions, mathematical model, and flowchart. **[15 marks]**
- Verification against theoretical solutions, where possible. **[5 marks]**
- Computer code script (.m code appended to report). **[20 marks]**
- Results including system responses across the range of loading conditions. **[30 marks]**
- Brief discussion and conclusions of results. **[10 marks]**
- Report layout. **[15 marks]**

## Report Deadline

The report is to be submitted via Canvas (Turnitin Assignment) by **11 pm on Sunday, March 31st, 2024**. The report must be submitted as a single PDF only and must include a signed discipline cover sheet. **Failure to submit as a single PDF with signed cover sheet, including the plagiarism statement, will result in an automatic grade of zero.**

## Generative Artificial Intelligence

The use of generative artificial intelligence (GenAI) tools (e.g. ChatGPT, Copilot, DALL-E, etc.) is **acceptable** for this assignment for these activities:

- Brainstorming and fine-tuning your ideas;
- Refining your research questions;
- Researching your subject matter;
- Drafting a plan of your ideas;
- Checking grammar, spelling, and punctuation.

The use of GenAI tools is **not acceptable** for this assignment for these activities:

- To generate work that you present as *your own* in your assignment;
- Writing a draft of your assignment;
- Writing entire sentences, paragraphs, or sections that you present as your own;
- Paraphrasing text written by others (or output from GenAI);
- Using generated information without verification.

If you choose to use GenAI tools, your use should be appropriately documented and cited. Your assignment should include a statement describing what tools you used (see below), for what purposes, and to what extent. Use the appropriate citation style for your discipline. For example, see the current guidelines on citing GenAI output from MLA, APA, and Chicago.

## Statement of Use of Artificial Intelligence

All reports must include a ***Statement of Use of Artificial Intelligence (AI)***. This statement is a summary of what you have (or not) used AI for in your report, the AI programme used, where you have found AI to be beneficial and not beneficial, etc. **Failure to include this statement in your report will automatically receive a grade of zero.** The aim of this statement is to generate feedback on the use of AI. However, it is critical to remember that AI is only a mimicking tool and can result in erroneous statements, which at times may appear to be (close to) correct. The Statement of Use of Artificial Intelligence should be located inside the cover sheet of your report.