

**CARLETON UNIVERSITY**

**Department of Mechanical and Aerospace Engineering**

**MECH 4104: Vibration Analysis**

**Course Outline - Winter 2022**

**Instructor:** Prof. Fred F. Afagh, Room 3904 CB; Tel. ext. 5705; [fred.afagh@carleton.ca](mailto:fred.afagh@carleton.ca)

**Lecture Times:** Tu, Th: 10:05-11:25

**Lecture Venues:** a) January 10 to January 31<sup>st</sup>: HyFlex, SA 404 or Zoom Lectures (for invitation to Zoom Lectures see this course's site on BrightSpace)  
b) February 1, to April 12<sup>th</sup>: Stacie Building Rm 103

**IMPORTANT NOTICES** : Please read the following carefully.

1. Since due to possible future development of COVID 19 Pandemic the conditions of the delivery of this course may change requiring adjustments to the structure, delivery and evaluation of the course, the provisions of this Course Outline are considered to be conditional. You will be informed of any such changes in due time through BrightSpace announcements.
2. Please be aware that by registering in this course you acknowledge that this course may use online proctoring tools. These online proctoring tools could require you to identify yourself via webcam. Additionally, while you are completing a proctored exam, your activities will be monitored. This could include direct observation via webcam and through the use of screen recording software.
3. Any evidence of violation of Academic Integrity Policy of the Carleton University in especially during an exam or a quiz will be treated seriously. Please review this policy thoroughly at:  
<https://carleton.ca/secretariat/wp-content/uploads/Academic-Integrity-Policy.pdf>

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**Lectures Outline:**

1. Fundamental concepts: Classification of vibration problems; Basic components of vibratory systems. Modelling basic components of vibratory systems; Harmonic motions.
2. Free vibration of SDOF systems: Undamped translational systems; Undamped torsional systems; Stability considerations; Rayleigh's Energy Method; Viscously damped systems; Coulomb and Hysteretic damping.
3. Harmonically excited SDOF systems: Undamped systems; Damped systems; Harmonic motion of the base; Damped systems under rotating unbalance.
4. SDOF systems excited by general forcing functions: General periodic forcing function; Impulsive forcing function; General forcing function; Response Spectrum; Laplace Transformation.
5. 2DOF systems: Free vibration of undamped systems; Coordinate coupling and Principal coordinates; Forced vibration of damped systems; Vibration absorbers.
6. Introduction to MDOF systems: Undamped systems; Influence coefficients; Lagrange's Equations; Eigenvalue problem; Expansion Theorem; Forced undamped systems; Viscously damped forced systems.

**Text Book:** *Mechanical Vibrations* by Singiresu S. Rao; 6<sup>th</sup> Edition; Pearson/Prentice Hall 2017

**Suggested Supplemental References:**

1. *Elements of Vibration Analysis*; by Leonard Meirovitch; McGrawHill 1986
2. *Theory of Vibration with Applications*; by W.T. Thomson & M.D. Dahleh, 5<sup>th</sup> Edition, Prentice Hall, 1998

**Course Notes and Assignments:**

Posted on BrightSpace

**Office Hours:**

Tuesdays and Thursdays 13:05 – 14:25

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#### Assessment:

Midterm Examination:-----40%

***Open Notes only***

*Thursday, March 03, 2022*

*10:05-11:25*

Final Examination:-----60%

***Open Notes only***

*As Scheduled by Examinations Scheduling Office*

- **Only non-communicating calculators can be used during the midterm and final exams.**
- The final exam is for evaluation purposes only and will not be returned to students.

#### Additional Information

- The lectures will be offered synchronously.
- Students must pass the final examination to pass the course.
- Assignment problems will be posted on BrightSpace but they will not be marked.
- Due to a new regulation recently passed by the University Senate, students who withdraw from any course after the full fee adjustment date will have a WDN for that course appear on their official and unofficial Carleton University transcripts.

#### Academic Accommodation

##### **Requests for Academic Accommodation**

You may need special arrangements to meet your academic obligations during the term. For an accommodation request, the processes are as follows:

##### **Pregnancy obligation**

Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, visit the Equity Services website:

[carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf](http://carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf)

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##### **Religious obligation**

Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, visit the Equity Services website:

[carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf](https://carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf)

##### **Academic Accommodations for Students with Disabilities**

If you have a documented disability requiring academic accommodations in this course, please contact the Paul Menton Centre for Students with Disabilities (PMC) at 613-520-6608 or [pmc@carleton.ca](mailto:pmc@carleton.ca) for a formal evaluation or contact your PMC coordinator to send your instructor your Letter of Accommodation at the beginning of the term. You must also contact the PMC no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, meet with your instructor as soon as possible to ensure accommodation arrangements are made. [carleton.ca/pmc](https://carleton.ca/pmc)

##### **Survivors of Sexual Violence**

As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and its survivors are supported through academic accommodations as per Carleton's Sexual Violence Policy. For more information about the services available at the university and to obtain information about sexual violence and/or support, visit: [carleton.ca/sexual-violence-support](https://carleton.ca/sexual-violence-support)

##### **Accommodation for Student Activities**

Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience. Reasonable accommodation must be provided to students who compete or perform at the national or international level. Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist.

<https://carleton.ca/senate/wp-content/uploads/Accommodation-for-Student-Activities-1.pdf>

For more information on academic accommodation, please contact the departmental administrator or visit:

[students.carleton.ca/course-outline](https://students.carleton.ca/course-outline)

Fred F. Afagh  
January 2022