

MECHENG 2B03/2BA3 Mechanical Engineering Measurements Syllabus for Winter 2024

Instructors: **Dr. Amir Partovi (A-series labs and lectures)**
Dr. Zahra Motamed (B-series labs and lectures)

Email: mecheng.measurements@gmail.com

Office: Dr. Partovi: JHE-326; Dr. Motamed: ABB-C 307

Lectures: **ME 2B03:** Mondays and Thursdays; 5:30 - 6:20 pm
ME 2BA3: Fridays; 2:30 to 4:20 pm

Course website: <https://avenue.cllmcmaster.ca/>

Office hours: Dr. Partovi: Thursdays, 2 to 4 pm
 Dr. Motamed: Thursdays, 3:30 to 5 pm
 For meetings out of those hours with Dr. Partovi or Dr. Motamed, please send an email to make an appointment.

1 Lecture Schedule and Study Materials

This course consists of two parts: **(1) A-series lectures (Dr. Partovi) in the first half of the semester which will start in the week of January 8th**; **(2) B-series lectures (Dr. Motamed) in the second half of the semester which will start in the week of February 26th**. Each instructor will announce details of **their instructional methods for their parts of the course separately in the beginning of each series**. Announcements will be made in class and will also be posted on the course website (*Avenue*). **All lectures, Quizzes and labs are in person.**

This course builds up steadily and rapidly. Do not fall behind. The lectures will be a blend of pre-recorded videos posted on Avenue and in-person lectures. **The instructional course materials will be available on Avenue** in forms of [videos and course notes](#).

2 Labs Schedule and Training

Laboratories:

A-series labs: **1st lab starts week of January 15th**

B-series labs: **1st lab starts week of March 4th**

Location of all labs: ABB C202

2B03:

L02 Tuesday	2:30-5:20 pm
L03 Friday	2:30-5:20 pm
L04 Thursday	8:30-11:20 am

L05 Wednesday 7-10 pm
L06 Thursday 2:30-5:20 pm

2BA3:

L01 Wednesday 2:30-5:20 pm
L03 Monday 2:30-5:20 pm
L04 Wednesday 8:30-11:20 am

Teaching Assistants:

	Name	Email	Office Hours
1	Shivam GUPTA (130)	gupts44@mcmaster.ca	Office hours for all TAs are available upon request
2	Christian Brice TONGKOUA BANGMI (130)	tongkouc@mcmaster.ca	
3	Hadi MOHAMMADI DANIALI (130)	mohamh46@mcmaster.ca	
4	Kaustubh DALMIA (130)	dalmiak@mcmaster.ca	
5	Daniel MAESTRE (130)	maestred@mcmaster.ca	
6	Reza HOSSEININEJAD (130) – <i>only marking</i>	hosser6@mcmaster.ca	
7	Saeid JORKESH (130)	jorkeshs@mcmaster.ca	
8	Mohamed HEFNY (130)	hefnym1@mcmaster.ca	
9	Javad HASHEMI (130)	hashemij@mcmaster.ca	
10	Sam HEMMING (130)	hemmings@mcmaster.ca	
11	Harsh Dipakkumar PATEL (130)	pateh123@mcmaster.ca	
12	Hatem SOLIMAN (130)	solimh1@mcmaster.ca	
13	Hasan Sohail SYED (130)	syedh39@mcmaster.ca	
14	MohammadAli DAEIAN (65)	daeianm@mcmaster.ca	
15	Maedeh KHODAMORADI (130) (TAs coordinator; A-series)	khodamom@mcmaster.ca	
16	Mohamed ABDELKHALEK (130) (TAs coordinator; B-series)	abdelm57@mcmaster.ca	

Labs training:

Experiment A1 : Dimensional Measurements

Experiment A2 : Statistical Analysis of Measurements

Experiment A3 : Electrical Measurements and Calibration
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Experiment B1 : Measurement of Force and Strain
Experiment B2 : Fluid Flow Measurements
Experiment B3 : Characterisation of a Motor and Gear Box

3 Course Outline

Objective: To understand the principles of measurement systems as well as the methods of measuring mechanical quantities. The student's abilities to analyze the experimental data are emphasized through 6 laboratory works.

Course outline:

- Laboratory Health & Safety
- Process of Measurement: An Overview
- Standards, Dimensions and Units
- Dimensional Measurements - Metrology & elements of ISO GD&T
- Elements of Statistical Analysis of Measurements
- Uncertainty Analysis of Measurement and Error Propagation
- Measurement Systems and Measurement System Element
- Fundamental Measurement and Instrumentation Concepts
- Measurements of Surface Roughness and Hardness
- Mechanical Measurements (e.g. force, power, etc.)
- Fluid Measurements (e.g. pressure, flow)
- Measurements of Mechanical Properties of Materials (stress & strain domain)

4 References

“Theory and Design for Mechanical Measurements, 6th Ed.”, by R.S. Figliola and D.S. Beasley, John Wiley and Sons, Inc., 2015.

“Materials and Processes in Manufacturing”, 9th edition, P. DeGarmo *et al.*, John Wiley & Sons, Inc., Prentice-Hall, 2003

“Measurements and Instrumentation - Theory and Application”, A.S. Morris and R. Langari, 2012 Elsevier Academic Press.

“Introduction to Probability and Statistics”, 11th Ed., by B.M. Beaver and R.J. Beaver, Brooks /Cole a division of Thomson Learning Inc., 2003.

“Managing, Controlling and Improving Quality”, D.C. Montgomery, C.L. Jennings, M.F. Pfund, John Wiley and Sons, Inc., 2011.

Publications of The National Institute of Standards and Technology (NIST),
<http://www.nist.gov/publication-portal.cfm>

5 Course Assessment

The following distribution of marks will be used unless there is valid and compelling reason to use an alternative weighting scheme. A mark of zero will be assigned for all coursework (laboratories and examinations) which is not submitted on the assigned submission time/date without legitimate and documented reasons. All discussions concerning missing course work must be directed to Dr. Partovi and Dr. Motamed.

Component	Weight %
A Series Labs:	15
B Series Labs:	25
2 Quizzes (A Series Lectures)	30
2 Quizzes (B Series Lectures)	30
Total	100

Quizzes will be taken during lecture hours and the exact timing of each quiz will be announced on the Avenue.

Please check Section 6.3 of this outline for important information about MSAF of the labs and quizzes.

See the below sections for details concerning each of the above assessment elements.

6 Laboratory Experiments and Reports

Students registered in MECHENG 2B03/2BA3 will complete six laboratories in total, three in cycle A and three in cycle B. Each student should come to the lab session that they registered for. Laboratory Teams will consist of teams of 2 to 6 students, assigned by the instructor. Students should be noted that their team numbers and the team members will likely be different between the A (small groups) and B (large groups) cycle labs. It is the student's responsibility to determine their team number and the laboratory they are performing prior to the start of the laboratory session. The list of the teams and the laboratory schedules are posted under "Schedules" on the course home page. Please note that separate schedules are posted for each laboratory section.

Participation in the laboratory during the assigned laboratory section is compulsory and attendance will be taken. Failure to attend the assigned laboratory session will result in a mark of **zero** being assigned for the laboratory without legitimate and documented reasons. It is the

student's responsibility to direct all matters concerning laboratory attendance to **Dr. Partovi (A-series)** and **Dr. Motamed (B-series)** at the earliest possible opportunity. Instructions for each experiment are provided on the course website under content in the "Laboratories" section and in the "Lab manuals" sub-section. It is the student's responsibility to download the instructions, review them carefully and be prepared for the lab. **We also strongly recommend that students watch the lab videos on Avenue prior to the labs to be prepared.**

Students are required to submit in individual, independently written reports for each experiment. Full details of the required elements of the lab report and marking scheme can be found in the document "Laboratory Report Writing Guidelines" on the course website (Content/Laboratories/Lab Report Writing Guidelines).

Cycle A laboratories are relatively straightforward experiments involving small scale metrology instruments and apparatus. **Reports for the A cycle experiments will be written during the laboratory period and submitted to the associated TA at the end of laboratory. A deduction of 10% per working day will be assessed for late reports. All late laboratory reports** must be submitted to the Avenue **within two days** passed the due date. It is expected that the students will be prepared to analyze the experimental data and write up the laboratory, including the possession of a calculator, a straight edge to construct any required plots, graph paper and writing instruments.

Cycle B labs are more complex, involving measurements associated with the measurement of mechanical properties of materials, fluid flow and etc. Students should note that they will likely be assigned to different lab groups for rotations A and B. **Reports for the B cycle experiments will be written outside of regular laboratory hours and submitted to the course website (Avenue) one week following the performance of the laboratory.** A deduction of 10% per working day will be assessed for late laboratories. All late laboratory reports must be submitted to the Avenue within two days passed the due date. **Under no circumstances should students submit late labs to the course drop box as this location will not be checked for the lab reports.**

6.1 Assignments

Assignments will cover the material discussed during the recent lectures. The exams will include some of the problems posted as assignments. Assignments should not be handed in and there is no mark for the assignments. The assignment solutions will be presented during the lectures or will be posted on Avenue to Learn.

6.2 Requests for re-marking

Your lab reports will be kept by the TAs. You may inquire about your mark for the lab report during the TAs office hours. Any requests for re-marking of the lab reports or assignments must be submitted to the TA who marked your work with a written explanation of the reason for re-marking **within two weeks** after the marks are released and before the end of the term.

6.3 Missed work and/or missed deadlines

All requests for an alternative course of action must be submitted using the MSAF <http://www.degroote.mcmaster.ca/ug/msaf.htm>.

MSAF the labs: For the first MSAF of one of the labs in both A-series and B-series, the weight of the lab will be redistributed among all other labs in both A and B series. For the second MSAF (and more), the student must contact the instructor to reschedule the lab.

MSAF the quizzes: Similarly, the first MSAF for any of the 4 quizzes will result in redistributing the weight of the 3 remaining quizzes. For the second or more MSAFs, the student must contact the instructor to retake the exam later. Retake the exam for these students will be done in April after finishing all lectures (during **the week of April 8th** and during **the lectures times**)

7 Learning Outcomes

By the end of the Mechanical Measurements 2B03/2BA3 course the student should be able to:

1. Perform measurements of fundamental mechanical properties such as linear and angular dimensions of machine parts, force, torque, stress, strain, flow, etc.
2. Use common mechanical shop measurement tools.
3. Understand ISO 286 based GD&T specifications.
4. Use a DC bridge circuit-based sensor with a signal conditioner/amplifier;
5. Analyze and calculate the uncertainty of measurement and error propagation
6. Conduct measurements and collect data as a member of a team;
7. Construct a written measurement report with appropriate graphs and charts;
8. Calculate parameters used by Statistical Process Control (SPC);
9. Recommend the type and capability of a measurement system based on the time domain characteristics of the measured quantity;

8 Graduate Attributes

The Mechanical Design 2B03-2BA3 course provides the student the opportunity to develop competence in the following CEAB graduate attributes:

Graduate Attributes	Learning Outcome Measurement Point
Knowledge base for engineering: (1.03, 1.04)	1,3,8,9
Problem analysis: (2.0x)	5
Use of engineering tools: (5.01, 5.02)	1, 2,4
Individual and team work: (6.0x) - team work on Conceive-Design-Implement-Operate (CDIO) mechanical design project	1
Communication skills: (7.03) – writing design project report and presenting the design to a large audience	7

9 Notice Regarding Possible Course Modification

The instructor and university reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If any modifications become necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course websites weekly during the term and to note any changes

Equity, Diversity, and Inclusion

Every registered student belongs in this course. Diversity of backgrounds and experiences is expected and welcome. You can expect your Instructor to be respectful of this diversity in all aspects of the course, and the same is expected of you. The Department of Mechanical Engineering is committed to creating an environment in which students of all genders, cultures, ethnicities, races, sexual orientations, abilities, and socioeconomic backgrounds have equal access to education and are welcomed and treated fairly. If you have any concerns regarding inclusion in our Department, in particular if you or one of your peers is experiencing harassment or discrimination, you are encouraged to contact the Chair, Associate Undergraduate Chair, Academic Advisor or to contact the [Equity and Inclusion Office](#).

Physical and Mental Health

For a list of McMaster University's resources, please refer to the [Student Wellness Centre](#). There is also a list of resources appended to this document.

Academic Integrity

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity. **It is your responsibility to understand what constitutes academic dishonesty. Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage.**

This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university. For information on the various types of academic dishonesty please refer to the [Academic Integrity Policy](#), located at <https://secretariat.mcmaster.ca/university-policies-roceduresguidelines/>

The following illustrates only three forms of academic dishonesty:

- plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
- improper collaboration in group work.
- copying or using unauthorized aids in tests and examinations.

Authenticity / Plagiarism Detection

Some courses may use a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work. For courses using such software, students will be expected to submit their work electronically either directly to Turnitin.com or via an online learning platform (e.g. A2L, etc.) using plagiarism detection (a service supported by Turnitin.com) so it can be checked for academic dishonesty. Students who do not wish their work to be submitted through the plagiarism detection software must inform the Instructor before the assignment is due. No penalty will be assigned to a student who does not submit work to the plagiarism detection software. All submitted work is subject to normal verification that standards of academic integrity have been upheld (e.g., on-line search, other software, etc.). For more details about McMaster's use of Turnitin.com please go to www.mcmaster.ca/academicintegrity.

Courses with an On-Line Element

Some courses may use on-line elements (e.g. e-mail, Avenue to Learn (A2L), LearnLink, web pages, capa, Moodle, ThinkingCap, etc.). Students should be aware that, when they access the electronic components of a course using these elements, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in a course that uses on-line elements will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure please discuss this with the course instructor.

Online Proctoring

Some courses may use online proctoring software for tests and exams. This software may require students to turn on their video camera, present identification, monitor and record their computer activities, and/or lock/restrict their browser or other applications/software during tests or exams. This software may be required to be installed before the test/exam begins.

Conduct Expectations

As a McMaster student, you have the right to experience, and the responsibility to demonstrate, respectful and dignified interactions within all of our living, learning and working communities. These expectations are described in the [Code of Student Rights & Responsibilities](#) (the "Code"). All students share the responsibility of maintaining a positive environment for the academic and personal growth of all McMaster community members, **whether in person or online.**

It is essential that students be mindful of their interactions online, as the Code remains in effect in virtual learning environments. The Code applies to any interactions that adversely affect, disrupt, or interfere with reasonable participation in University activities. Student disruptions or behaviours that interfere with university functions on online platforms (e.g. use of Avenue 2 Learn, WebEx or Zoom for delivery), will be taken very seriously and will be investigated. Outcomes may include restriction or removal of the involved students' access to these platforms.

Academic Accommodation of Students with Disabilities

Students with disabilities who require academic accommodation must contact [Student Accessibility Services \(SAS\)](#) at 905-525-9140 ext. 28652 or sas@mcmaster.ca to make arrangements with a Program Coordinator. For further information, consult McMaster University's [Academic Accommodation of Students with Disabilities](#) policy.

Academic Accommodation for Religious, Indigenous or Spiritual Observances (Riso)

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the [RISO](#) policy. Students should submit their request to their Faculty Office *normally within 10 working days* of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

Copyright and Recording

Students are advised that lectures, demonstrations, performances, and any other course material provided by an instructor include copyright protected works. The Copyright Act and copyright law protect every original literary, dramatic, musical and artistic work, **including lectures** by University instructors.

The recording of lectures, tutorials, or other methods of instruction may occur during a course. Recording may be done by either the instructor for the purpose of authorized distribution, or by a student for the purpose of personal study. Students should be aware that their voice and/or image may be recorded by others during the class. Please speak with the instructor if this is a concern for you.

Extreme Circumstances

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email.