

# MECH ENG 2B03/2BA3 MECHANICAL ENGINEERING MEASUREMENTS

## COURSE OUTLINE- WINTER TERM 2019

**INSTRUCTORS:** Dr. Tohid Didar and Dr. Zahra Motamed

**EMAIL:** [mecheng.measurements@gmail.com](mailto:mecheng.measurements@gmail.com)

**OFFICE:** Dr. Didar: JHE-308A, Dr. Motamed: JHE A416

**COURSE WEBSITE:** <https://avenue.cllmcmaster.ca/>

**OFFICE HOURS:** Dr. Didar: Tuesdays 2:30 pm - 4:30 pm, JHE-308A,  
Dr. Motamed: Tuesdays 2 pm - 4 pm, Room: JHE-A416

### TEACHING ASSISTANTS:

	TA	email	Office hour*	Room
1	Dalia Mahmoud	<a href="mailto:mahmoudd@mcmaster.ca">mahmoudd@mcmaster.ca</a>	TBA	TBA
2	Hossein Rezaeifar	<a href="mailto:rezaeifh@mcmaster.ca">rezaeifh@mcmaster.ca</a>	TBA	TBA
3	Mohamed Balbaa	<a href="mailto:balbaam@mcmaster.ca">balbaam@mcmaster.ca</a>	TBA	TBA
4	Daniel Barroso	<a href="mailto:barrosod@mcmaster.ca">barrosod@mcmaster.ca</a>	TBA	TBA
5	Nikrouz Bahadormanesh	<a href="mailto:bahadorn@mcmaster.ca">bahadorn@mcmaster.ca</a>	TBA	TBA
6	Shahryar Asgardoust	<a href="mailto:asqardos@mcmaster.ca">asqardos@mcmaster.ca</a>	TBA	TBA
7	Ali Ghasemi	<a href="mailto:ghasemia@mcmaster.ca">ghasemia@mcmaster.ca</a>	TBA	TBA
8	Jack Gillies	<a href="mailto:gillij2@mcmaster.ca">gillij2@mcmaster.ca</a>	TBA	TBA
9	Najmeh Ghorbani	<a href="mailto:ghorban@mcmaster.ca">ghorban@mcmaster.ca</a>	TBA	TBA
10	Rohit Gupta	<a href="mailto:guptas70@mcmaster.ca">guptas70@mcmaster.ca</a>	TBA	TBA
11	Mukhopadhyay	<a href="mailto:mukhopas@mcmaster.ca">mukhopas@mcmaster.ca</a>	TBA	TBA
13	Ali Aliakbari	<a href="mailto:aliakbaa@mcmaster.ca">aliakbaa@mcmaster.ca</a>		

\* Students are advised to confirm an appointment with the TA by email

**ANNOUNCEMENTS:** Important announcements will be made in class and will also be posted on the course website. It is the student's responsibility to check the course website on a regular basis and review these announcements, review posted lecture materials and laboratory documents.

**LECTURES:**    **2B03:** Mondays 3:30–4:20 pm and Tuesdays 4:30–5:20 pm in **ITB-137**  
                  **2BA3:** Wednesdays 9:30-11:20 am in **T13 125**

**Note:** These two classes will be taught in parallel. You should attend your designated class.

**LABORATORIES:**

**2B03:**  
L01 Friday           2:30-5:20 pm  
L02 Monday         8:30-11:20 am  
L03 Wednesday    14:30-17:20 pm  
L04 Thursday      14:30-17:20 pm  
L05 Thursday      8:30-11:20 am

**2BA3:**  
L01 Tuesday        2:30-5:20 pm  
L02 Monday        2:30-5:20 pm

**Labs start on the week of Jan 21st.**

**Second ME 2B03/2BA3 lecture on Jan. 8<sup>th</sup> for 2B03 and Jan. 10<sup>th</sup> for 2BA3 will address the Health & Safety rules in Mechanical Engineering laboratories and workshops: ME 2B03, ME 2C04, ME 3M03, ME 4P02 and ME 4M06 (attendance will be taken).**

**GENERAL COURSE TOPICS (to be covered in the Laboratory and/or in the Lectures):**

- 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 velocity, power, etc.)
- Thermo-Fluid Measurements (e.g. pressure, flow, temperature)
- Measurements of Mechanical Properties of Materials (stress & strain domain)
- Digital Image Based Measurements

**TEXTS:** The lectures will refer in part the following sources:

**“Theory and Design for Mechanical Measurements, 6<sup>th</sup> Ed.”, by R.S. Figliola and D.S. Beasley, John Wiley and Sons, Inc., 2005.**

“Materials and Processes in Manufacturing”, 9<sup>th</sup> 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.

“Theory and Design for Mechanical Measurements, 4<sup>th</sup> Ed.”, by R.S. Figliola and D.S. Beasley, John Wiley and Sons, Inc., 2005.

“Introduction to Probability and Statistics”, 11<sup>th</sup> 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>

**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. Didar and Dr. Motamed.

**A Cycle Labs:** 15% (1<sup>st</sup> lab starts week of January 14<sup>th</sup>)

**B Cycle Labs:** 21% (1<sup>st</sup> lab starts week of March 4<sup>th</sup>)

**Labs total:** 36%

**Midterm:** 27% (Thursday Feb. 14th at 7pm, location TBD)

**Final exam:** 37%

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

**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. 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. Didar (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.

Students are required to hand 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). It is the student’s responsibility to review and understand the required laboratory report elements and format as deductions will be made for non-conformance.

**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 TA prior to the end of the laboratory.** It is expected that the student will arrive in the lab 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. Ink or pencil can be used for the A cycle lab reports. **Under no circumstances should students submit A cycle labs to the course drop box as this location will not be checked.**

**Cycle B** labs are more complex, involving measurements associated with the measurement of mechanical properties of materials, fluid flow and etc. **In general, the B rotation schedule is a one week on, one week off schedule. 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 drop box in JHE 307 by 14:30 one week following the performance of the laboratory.** Access to room JHE 307 is during the week days between 8:30 and 16:30 only. Neat, clear hand-written reports are permitted as are typewritten reports. Students should note that it is their responsibility to ensure that their laboratory reports are handed in a timely manner to the correct location.

Late penalties for laboratory reports are severe and will be enforced by the TAs without legitimate and documented reasons. A deduction of 20% per working day will be assessed for late laboratories. **All late laboratory reports** must be handed to the TA supervising the experiment 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 late labs.**

**ASSIGNMENTS:** Assignments will cover the material discussed during the recent lectures. The final exam 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.

**EMAIL POLICY:** All emails must be sent to: [mecheng.measurements@gmail.com](mailto:mecheng.measurements@gmail.com) and should include a clear subject line.

**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.

**FINAL EXAM:** The final exam will comprise a three-hour closed book exam covering all lecture materials and A & B cycle laboratories. Only McMaster Standard calculators may be used on the final exam.

**FINAL MARK:** in order to pass the course students are required to achieve a minimum mark of:

18% out of 37% on the final examination,  
18% out of 36% on the lab mark component,  
and have the overall mark of 50%.

**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>. Use of the MSAF form as an accommodation for a missed work will automatically result in the marks allocated for that assignment being shifted to the Final Exam.

**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;

**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
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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

## POLICY REMINDERS ON ACADEMIC INTEGRITY

### POLICY STATEMENTS:

*Academic dishonesty consists of misrepresentation by deception or by other fraudulent means and 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. It is your responsibility to understand what constitutes academic dishonesty. For information on the various kinds of academic dishonesty please refer to the Academic Integrity Policy, specifically Appendix 3, located at*

*[http://www.mcmaster.ca/senate/academic/ac\\_integrity.htm](http://www.mcmaster.ca/senate/academic/ac_integrity.htm)*

*The following illustrates only three forms of academic dishonesty:*

- 1. Plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained. (Assignments must be one's own work. Submission of any part of an assignment copied from someone else constitutes plagiarism.)*
- 2. Improper collaboration in group work. (Assignments in this course represent individual work and therefore must be done entirely by each student. It is appropriate to work in pairs/groups to learn how to solve the problems, but it is unacceptable for individuals in a group to share/copy solutions.)*
- 3. Copying or using unauthorized aids in tests and examinations.*

### DISCRIMINATION:

**THE FACULTY OF ENGINEERING IS CONCERNED WITH ENSURING AN ENVIRONMENT THAT IS FREE OF ALL ADVERSE DISCRIMINATION. IF THERE IS A PROBLEM THAT CANNOT BE RESOLVED BY DISCUSSION AMONG THE PERSONS CONCERNED, INDIVIDUALS ARE REMINDED THAT THEY SHOULD CONTACT THEIR DEPARTMENT CHAIR, THE SEXUAL HARASSMENT OFFICE OR THE HUMAN RIGHTS CONSULTANT, AS SOON AS POSSIBLE.**

*"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 either type of modification becomes 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."*