ENGG*3490 Introduction to Mechatronics Systems Design
Winter 2016

UNIVERSITY of GUELPH

School of Engineering

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1 INSTRUCTIONAL SUPPORT

1.1 Instructor

Instructor: Mohammad Biglarbegian, Ph.D., P.Eng.
Office: THRN 2339, ext. 56248
Email: mbiglarb at uoguelph.ca
Office hours: By appointment

1.2 Lab Technician

Technician: Nathaniel Groendyk
Office: THRN 2308, ext. 53729
Email: groendyk@uoguelph.ca

1.3 Teaching Assistant

GTA	Email	Office Hours
MohammadAli Shahriari	mshahria@uoguelph.ca	TBA

2 LEARNING RESOURCES

2.1 Course Website

Course material, news, announcements, and grades will be regularly posted to the ENGG*3490 Courselink site. You are responsible for checking the site regularly.

2.2 Required Resources

Students are **required** and expected to attend all the lecturers. Students are **responsible** for whatever material is taught in the class. Note that the textbook may not have all the material taught in the class.

There is no single textbook that can cover all the material taught in a Mechatronics course in general, simply because Mechatronics is multidisciplinary. The following book is a great source:

"Mechatronics: A Multidisciplinary Approach", W. Bolton, 5th edition, Prentice Hall, 2011.

2.3 Recommended Resources

"Applied Mechatronics", A. Smaili, F Mrad, Oxford University Press, 2008.

"Programmable Logic Controllers", Frank D. Petruzella, 3/E, McGrawHill, 2005.

"Mechatronics", Dan S. Necsulescu, Prentice Hall, 2002.

"Principles of Robot Motion", H. Choset, K. M. Lynch, S. Hutchinson, G. Kantor, W. Burgard, L. E. Kavraki and S. Thrun, MIT Press, Boston, 2005

"Principles and Applications of Electrical Engineering", by G. Rizzoni, McGraw-Hill, 5th edition, 2007.

"Electric Machinary Fundamental", by S. J. Chapman, McGraw-Hill, 5th edition, 2011.

"Programmable Logic Controller", J. R. Hackworth, F. D. Hackworth, Jr., 4th edition, Prentice Hall, 2004.

2.4 Additional Resources

Lecture Information: **Only some supplementary parts** of the lectures notes might be posted on the web page. The reason is to ensure that students attend the classes to learn the material. Students should attend the classes and make their own notes.

Lab Information: The handouts for all the lab sessions are within the lab section. All types of resources regarding tutorials, links to web pages can be found in this section.

Homework: Download the homeworks according to the schedule given in this handout. All the solutions will be posted as indicated.

Miscellaneous Information: Other information related to Mechatronics are also posted on the web page.

2.5 Communications & Email Policy

Please use lectures and lab help sessions as your main opportunity to ask questions about the course. Major announcements will be posted to the course website. **It is your responsibility to check the course website regularly.** As per university regulations, all students are required to check their <uoguelph.ca> e-mail account regularly: e-mail is the official route of communication between the University and its student.

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3 ASSESSMENT

3.1 Dates and Distribution

Labs: 10%
See section 5.3 below for due dates

Project and report: 50%

See section 5.3 below for details

Midterm test: 15%
Tuesday, February 23, 19:00-20:30, Room MCKN 117

Final Exam: 25%
19/04/2016, 14:30 – 16:30, Room TBA on Webadvisor

Important Note regarding exams: Both midterm and final exams have problems. For both exams you are allowed to bring your own **only one-page** aid sheet (double-side) A4 size and can **only** have formulas (**No** solved problems, no derivations, no description, no explanation, no figures, no diagrams, no graphs, no curves, no tables, etc.) **Any deviations from this** will result in **40%** deduction of your exam mark.

Important Note: While you are encouraged to discuss with other classmates problems in the assignment or labs, there is zero tolerance for plagiarism or copying. A grade of 0 will be assigned to any assignment or lab report if they are copied or plagiarism is done by any means.

3.2 Course Grading Policies

Missed Assessments: If you are unable to meet an in-course requirement due to medical, psychological, or compassionate reasons, please email the course instructor. See the undergraduate calendar for information on regulations and procedures for Academic Consideration: http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

Accommodation of Religious Obligations: If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor at the start of the semester to make alternate arrangements. See the undergraduate calendar for information on regulations and procedures for Academic Accommodation of Religious Obligations: http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-accomrelig.shtml

Passing grade: In order to pass the course, you must obtain a grade of 50% or higher in total.

Missed midterm tests: If you miss a test due to grounds for granting academic consideration or religious accommodation, the weight of the missed test will be added to the final exam. **There will be no makeup midterm tests.**

Lab Work: You must attend and complete all laboratories. If you miss a laboratory due to grounds for granting academic consideration or religious accommodation, arrangements must be made with the teaching assistant to complete a makeup lab.

Late Lab Reports: Late submissions of lab reports will **not** be accepted.

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4 AIMS, OBJECTIVES& GRADUATE ATTRIBUTES

4.1 Calendar Description

This course covers the design of mechatronic systems, which are synergistic, combinations of components and controls drawn from mechanical engineering, electronics, control engineering, and computer science. The course emphasizes the integration of these areas through the design process employing the two skills of (1) modeling, analysis, control design, and computer simulation of dynamic systems, and (2) experimental validation of models, analysis and the understanding of the key issues of hardware implementation. The two skills are developed though assignments emphasizing analytical analysis with complementary laboratory exercises. The material covered includes mechatronic system design; a review of kinematics, electronics, modeling, simulation, signals and control; control architectures; sensors including vision; and actuators.

Prerequisite(s): ENGG*3450

Corequisite(s): ENGG*3410

Restriction(s): ENGG*3400

4.2 Course Aims

This course covers an introduction to mechatronics systems. Mechatronics, in general, is involved with mechanical, electrical and computer systems. Recently, mechatronics have found a variety of applications in many fields especially in the automation and manufacturing industries. In this course, you will learn about mechatronics systems: how are they designed and controlled. We will cover programmable logic controller (PLC), review and modeling of mechatronic systems, sensing and measurement, sensors and applications, actuators and their applications, modeling and control of electric motors (dc and ac), as well as stepper and servo motors. You will learn important concepts such as analog/digital or digital/analog conversion. Microprocessors and microcontroller structures will be introduced and discussed. As well, some control techniques for mechatronic systems will be introduced, and finally mobile robotic systems and their recent advances will be reviewed. By the end of the term, you should have a good understanding of design, modeling and control of mechatronic systems. This course contains theory and practical

applications of those systems. More importantly, the course has hands-on and practical projects which provide you with great skill sets required to succeed in your career. This course covers the following topics:

1. Introduction to mechatronic systems: basics
2. Sensors and instrumentation
3. Modeling of Mechatronics systems
4. Response
5. Actuators and Motors
6. Microprocessor and microcontroller
6. Programmable logic controller (PLC)
8. Control
9. Robotics: mobile robots

4.3 Learning Objectives

At the successful completion of this course, the student will have demonstrated the ability to:

1. Apply the theories learned in electronics and mechanical systems to model mechatronics system.
2. Apply the theories learned to find the system response and analyze them.
3. Learn the applications of electronic and mechanical components in mechatronics systems and devices, applications, etc.
4. Learn the principles of sensing.
5. Learn, understand, analyze and synthesize sensors of different types.
6. Learn, understand, analyze and synthesize actuators.
7. Learn, understand, and be able to analyze the principles of DC motors: Brushed and Brushless, Stepper Motor, Servo Motor.
8. Learn the techniques (old and modern) used for speed control of DC motors.
9. Learn and apply the fundamentals of control in mechatronics.
10. Learn the fundamentals of state-space design for control of mechatronic systems.
11. Learn the basics of PLC, as well as programming and their applications.
12. Learn and understand mobile robots applications, and different algorithms for path planning.
13. Learn the basics of microcontroller programming as well as implementing sensors and actuators on electronic boards and use microcontroller for programming.
14. Perform experiments using sensors, actuators, switches, etc., and concisely and articulately communicate the results through formal reports.
15. Model and design a mechatronics system (from scratch) as a formal project in group, which has several deadlines and deliver the milestones, and concisely and articulately communicate the results through a formal detailed report.

4.4 Graduate Attributes

Successfully completing this course will contribute to the following CEAB Graduate Attributes:

Graduate Attribute	Learning Objectives	Assessment
1. Knowledge Base for Engineering	1, 2	Assignments
2. Problem Analysis	14,15	Exams, Assignments
3. Investigation	14,15	Lab, project
4. Design	14	Exams, Lab, Assignments
5. Use of Engineering Tools	2, 3,4	Exams, Assignments
6. Communication	10	Labs, project
7. Individual and Teamwork	-	-
8. Professionalism	-	-
9. Impact of Engineering on Society and the Environment	-	-
10. Ethics and Equity	-	-
11. Environment, Society, Business, & Project Management	-	-
12. Life-Long Learning	-	-

4.5 Instructor's Role and Responsibility to Students

The instructor's role is to develop and deliver course material in ways that facilitate learning for a variety of students. Selected lecture notes will be made available to students on Courselink/D2L but these are not intended to be stand-alone course notes. During lectures, the instructor will expand and explain the content of notes and provide example problems that supplement posted notes. Scheduled classes will be the principal venue to provide information and feedback for tests and project.

4.6 Students' Learning Responsibilities

Students are expected to take advantage of the learning opportunities provided during lectures and tutorials. Students, especially those having difficulty with the course content, should also make use of other resources recommended by the instructor. Students who do (or may) fall behind due to illness, work, or extra-curricular activities are advised to keep the instructor informed. This will allow the instructor to recommend extra resources in a timely manner and/or provide consideration if appropriate.

4.7 Relationships with other Courses & Labs

Previous Courses:

ENGG*2340: Systems, first-order, 2nd order systems, signals

ENGG*3450: Fundamentals of DC and AC circuits, KVL, KLC

Courses:

ENGG*3410: Control systems, feedback, etc.

Follow-on Courses:

ENGG*4480: Advanced Mechatronics

ENGG*4030: Manufacturing System Design

ENGG*4480: Advanced Mechatronic Systems Design

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5 TEACHING AND LEARNING ACTIVITIES

5.1 Timetable

Lectures:

Tuesday	10:00 am–11:20am	CRSC 117
Thursday	10:00 am–11:20am	CRSC 117

Laboratory:

Thursday	3:30pm - 5:20pm	THRN 2307
Friday	1:30pm - 3:20pm	THRN 2307

5.2 Lecture Schedule

Lectures	Lecture Topics	References(*)	Learning Objectives
1	Background and Review	-	1
2-3	Electrical/Electronic Systems Modeling with Applications	Class lectures	1,2
4-5	Mechanical Systems Modeling	Class lectures	1,2
5-6	System response	Class lectures	1,2,3
6	Principles of sensing	Class lectures	2,3
7-10	Sensors	Class lectures	4
11-13	Actuators and Motors	Class lectures	5
13-15	PLC	Class lectures	5,6
14	Control concepts	Class lectures	7
15-16	Control design: state space	Class lectures	8
17	Mobile Robots and Application	Chapter 3	8
17-18	Mobile Robot Motion Planning	Chapter 8	8
-	Estimation (not mandatory)	Class lectures	-

*** Note:** The chapters mentioned here are only used as a reference. The instructor may not necessarily follow exactly the material covered in the chapters. Students are responsible for **whatever is taught** in the class.

5.3 Lab and Project Schedule

Week	Topic	Due
1	Introduction to Lab Equipment, Safety Training, Course Project, and Group Formation	
2	**Lab 1: Sensor Measurements**	**Week 3**
3	**Lab 2: Stepper Motors**	**Week 4**
4	Project Work Period, questions/answers regarding project/course	
5	Project Work Period, questions/answers regarding project/course	
6	**Project Milestone: Integration of Sensors with Arduino**	**Week 6**
7	Project Work Period, questions/answers regarding project/cours	
8	**Project Milestone: Loading Station Base Completed**	**Week 8**
9	PLC Presentation	
10	**Project Milestone: All Machining Completed**	**Week 10**
11	**Project Milestone: Final Demonstrations**	**Week 11**
12	Questions Regarding Course Material	

Course Project

The primary objective of the course is to provide students with hands-on experience in applying principles of engineering design to simple projects. Through application of formal design procedures, students will gain hands on experience in effective decision making and execution of engineering design.

Note1: Each group consists of at least 3 people (4 at most). Each group **must** contain **at least** one mechanical student due to shop policies. It is also **recommended** that your group include one ES&C student if possible.
Note2: There is no late policy for the final demo. Late demonstration is not acceptable. Each group needs to demonstrate their project (whatever they have done by the deadline).

Table 1(a): Important dates

Item	Assigned / Start	Due / Finish
Sorting Mechanism	Jan 12	March 31 for Thursday Labs April 1 for Friday Labs
Final Design Report	---	**April 5**

Table 1(b): Project Completion Intermediate Milestones

Milestones	Due by / Finish
Interfacing Sensors (IR, Hall effect, LED, touch sensors etc.)	Feb 11 for Thursday Labs Feb12 for Friday Labs

Nuts loading station	March 17 for Thursday Labs March 18 for Friday Labs
All machining parts done	March 24 for Thursday Labs March 25 for Friday Labs

Report deliverables will be marked based on the requirements detailed in the Report Deliverables Section. All reports are to be submitted on-time. The design will be scored such that the best design in each category will receive the highest mark for that respective category.

Sort and Feed Mechanism Project

Project description

For the course project you are required to design a nut sorting mechanism that is capable of separating four types of nuts: small steel nuts, medium brass nuts, large brass nuts, and large nylon nuts. Please visit the course webpage on the Courselink for information about the dimensions and weights of the nuts. The sorting mechanism should be able to identify the type and size of the nut and then feed it into the correct container for shipping. In total, you will be required to sort 12 nuts, 3 of each class. The nuts will be initially loaded in an arbitrary order and the mechanism should be able to separate them correctly and dispose every nut in the correct container. The containers used resemble coffee mugs and have the dimensions listed below. Moreover, during the competition, every group is required to provide **1 toonie**, **2 loonies**, and **4 quarters** that will be placed randomly by the instructor between the 12 nuts during sorting. Your design should be able to differentiate the coins from the nuts and avoid dispensing coins in any of the 4 containers. This will show the robustness of your design. Every coin "accidently" dispensed in a container during sorting will result in 1 mark deduction from the total mark. Your sort and feed mechanism should be placed on a platform table with dimensions given in the figure below. **Every group is required to design their own platform table** using wood, Plexiglas, etc. (should conform to the dimensions provided below). Each group will be provided with a design kit that includes a microcontroller and several types of sensors. Groups are strongly encouraged to utilize the kit to design the nut sorting mechanism

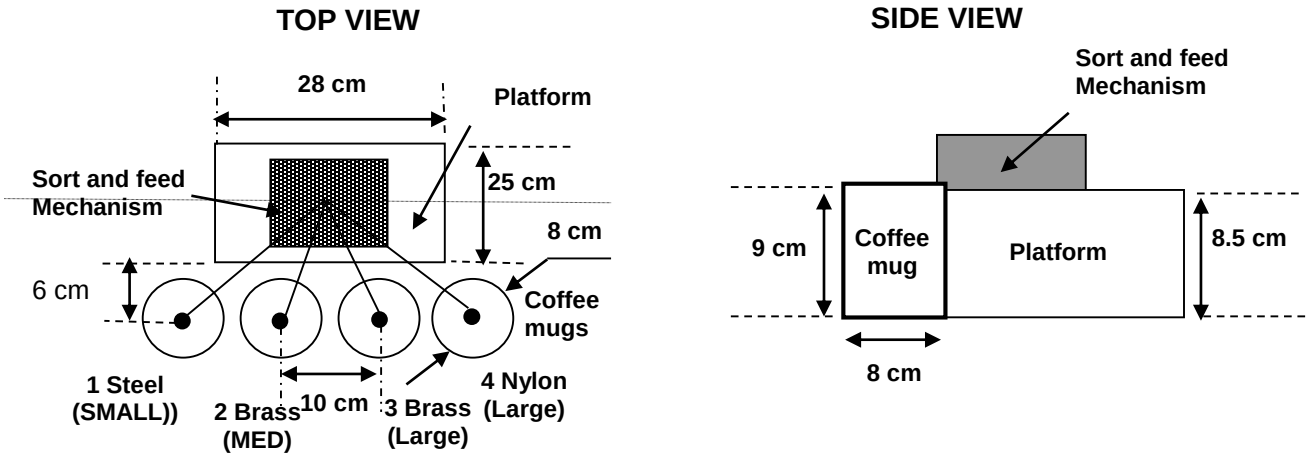

Fig 1: required layout of the packaging stations

Project Kit

Each group will be provided with a kit that consists of an Arduino board plus some sensors and switches. The project kit with all the items must be returned at the end of the term. In the first three weeks during the lab sessions, the TA will introduce the Arduino board and provide the students with training on how to work with the board, implementing sensors, to help familiarize the students with the microcontroller board which will cover: (1) integration of components onto the Arduino board, (2) installation of board software and programming the controllers, (3) interfacing sensors and actuators, (4) implementation of position/velocity control for actuators/motors, and (5) troubleshooting tips and instructions for proper use of the microcontroller and peripherals.

The course project kit includes the following. Note that some additional equipment is available from the lab technician upon request:

(1) Arduino Mega 2560 (http://arduino.cc/en/Main/ArduinoBoardMega2560)
(1) Breadboard
(1) Wiring & Resistor Kit
(1) Multimeter
(3) 5/16" Steel Nuts
(3) 3/8" Brass Nuts
(3) 3/4" Brass Nuts
(3) 3/4" Nylon Nuts
(1) 0.25" Magnet Square (https://www.sparkfun.com/products/8643)
(1) Flexiforce Load/Force Sensor (http://www.digikey.ca/product-search/en/sensors-transducers/force/1966743?k=30056-ND)
(1) AD22151 Linear Output Magnetic Field Sensor (http://www.digikey.ca/product-detail/en/AD22151YRZ/AD22151YRZ-ND/936656)
(2) VT43N3 500 kΩ, 400 mW Photoconductive Cell (http://canada.newark.com/excelitas-tech/vt43n3/ldr-500kohm-400mw-vt400-series/dp/96F9263?Ntt=96F9263)
(1) Sharp GP2D120 Infrared Range-Finder(http://www.sharpsma.com/webfm_send/1205)
(1)Sharp GP2Y0A02YK0F Long Range Infrared Range-Finder (https://www.sparkfun.com/products/8958)
(1)Negative Temperature Coefficient (NTC) Thermistor (http://canada.newark.com/epcos/b57891m103j/ntc-thermistor/dp/21C9772?Ntt=21C9772)
(1)Maxbotix LV-EZ1 Ultrasonic Range Finder (https://www.sparkfun.com/products/639)
(1)9 Degrees of Freedom Sensor Stick, Contains Accelerometer, Magnetometer, and Gyro (https://www.sparkfun.com/products/10724)
(1) Interlink Electronics 0.2" Circular Force Sensing Resistor (FSR) (http://www.robotshop.com/productinfo.aspx?pc=RB-Int-01&lang=en-US)
(1) Break-Beam Optosensor (http://www.robotstorehk.com/H21A1.pdf)
(4) HS-645MG Servo Motors (http://www.robotshop.com/ca/productinfo.aspx?pc=RB-Hit-29&lang=en-US)

(4) Texas Instruments L293NE IC Motor Drivers (http://canada.newark.com/texas-instruments/l293ne/ic-motor-driver-half-h-1a-dip-16/dp/06F9524?Ntt=06F9524)
(3) 4V, 1.2 A, 36oz-in Unipolar Stepper Motors (http://www.robotshop.com/ca/productinfo.aspx?pc=RB-Soy-01&lang=en-US)
(3) Cytron 3-40V, 2A Unipolar/Bipolar Stepper Motor Controllers (http://www.robotshop.com/ca/productinfo.aspx?pc=RB-Cyt-23&lang=en-US)
(2)Texas Instruments LM741 Operational Amplifiers (http://www.ti.com/lit/ds/symlink/lm741.pdf)
(2) Omron Electronic Components D2F-L Hinge Lever Micro Switch (http://canada.newark.com/omron-electronic-components/d2f-l/micro-switch-hinge-lever-spdt-3a/dp/36K7258?Ntt=36K7258)
(1) 4" Stroke 150 lb Force Linear Actuator (http://www.robotshop.com/productinfo.aspx?pc=RB-Fra-14&lang=en-US)
(1) Texas Instruments OPT101P Photo Diode and Trans impedance Amplifier (http://canada.newark.com/texas-instruments/opt101p/ic-transimpedance-amplifier-2mhz/dp/75C5222?Ntt=75C5222)
(1) Hamlin Hall Effect Magnetic Sensor (http://canada.newark.com/hamlin/55100-3h-02-a/hall-effect-magnetic-sensor/dp/50H8225?Ntt=50H8225)

Important Notes:

1) Using 3D printing even as a part of your design is **not** allowed. Students need to learn to do all the necessary machining by their hands. This is also to ensure fairness to the whole class.

2) You are allowed to only use the items in the kit that will be provided to you. In addition, each group can purchase **ONLY one** extra **sensor/actuator which is worth up to $20** from their own pocket, if needed. The need for this sensor/actuator MUST be clearly stated and justified in the final report. Note that the original receipt must be attached to the final report (no photo copies is accepted). This is to ensure fairness to all the groups. **Note that using the extra that costs more than $20 will result in 25% deduction of your mark**. The importance of this project is to familiarize and prepare you to work with a limited budget, which is the case in real-life projects.

Fabrication and Safety

Modification and assembly of materials may be carried out in the student machine shop. Students will be allowed to access the machine on a *first-come first-served* basis. Moreover, the final competition will be held in week 11 to encourage students to access the machine shop early in the term to complete the course requirements and avoid the "rush" of weeks 10-11 when other teams require access to the shop during the same time period to complete their respective term projects.

For student and machine safety, power tools available to students will be restricted and **Does NOT** include use of the milling machines or lathes.

Machine shop and safety:
Each group is allowed to use **up to $50** worth of material from the machine shop. It is therefore important to be very careful when selecting the material that you use for your project.

Important note: Students are allowed to use the machine shop on a *first-come first-served* basis. Students must have got training to have access to the machines they want to use.

Please note that equipment in the shop pose potential dangers for both operators and those in the vicinity. While reasonable efforts have been made to ensure and educate students about safe operation, caution must be exercised when working in the shop. For safety, students are required to adhere to all rules and regulations pertaining and posted in the shop. If there are any concerns regarding safety or suggestions to improve safety, please bring them to the Professor's or TA's attention as soon as possible.

- Both **hard and soft** copies are required for submission. **There is no late policies** for the **final** project report. Reports should be submitted to the TA and are due by 5:30 pm on April 5.

Remarking: You only have **three days** to ask for remark after the final report is returned. Beyond that, no adjustment will be made.

Report Deliverables

Final Design Report (Due Date: **April 5**)
The purpose of this report is to communicate the progress leading up to your group's resulting design. It will detail your design specifications, explaining calculations and analyses that ensure that your final design meets specifications. It should also include all microcontroller program code and a description of the logic you used to separate and sort the nuts. Any further testing, simulation, and results should be detailed and discussed. In addition, this report will also include changes to budgetary and scheduling plans. While the report should be comprehensive and include all the necessary information, it should not exceed **10 pages**. Appendices and codes are not counted toward the 10 page limit.

Project marking
The project demonstration will be marked out of **40**. The mark breakdown depends on the following categories: (1) design (**20%)**, (2) performance (**12%**), and (3) speed of sorting (**8%**).

Design (20%)
The first category is broken down into 4 subcategories as outlined in the table below

Table 3: Design category Marks Weighting

Subcategory	Weight
Relevance to Mechatronics Design	7

Conformance to Dimensions specifications	4
Footprint of the Mechanism	6
Quality of Design – machining	3

Relevance to Mechatronics Design: your design will fall in one of three categories; (a) mechatronics, (b) mechanical, or (c) manual. A mechatronics design utilizes sensors to correctly sort all the nuts fed in random order. A mechanical design **MAY NOT** utilize sensors to sort the nuts and can only use actuators and machined channels (e.g. pinball machine) to accurately sort the nuts. ENGG*3490 main emphasis is one mechatronics design and hence a mechanical based design will be only awarded 3/5 in the "Relevance to Mechatronics Design" subcategory. Finally, a manual design that utilizes neither the microcontroller nor the sensors and actuators provided in the kit will be awarded 2/5 in this category.

Conformance to Dimensions specifications: groups should design their sorting mechanism to conform to the dimensions specified in page 10. Maximum tolerances of 8% for every dimension specified will be allowed with no penalty. The centre points of all four coffee mugs can be organized in a horizontal line or arch as long as the spacing dimensions mug-to-mug and mugs-to-platform are preserved. If you elect to organize the coffee mugs centers along an arch, the spacing dimensions will be as shown in the Figure below. Failure to produce a design that satisfies the above requirements will result in 2 marks deduction in this subcategory.

O is the center of your mechanism

$OA = OB = OC = OD = 23cm$

$\alpha = 28^\circ$

$\beta = 50^\circ$

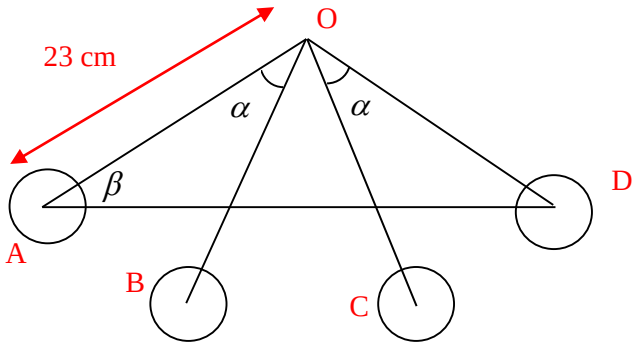

Fig. 2: Layout of the packaging stations

Quality of Design – machining: Your final sorting mechanism should be the product of systematic application of a well thought out design process that meets the project requirements. Your final design should reflect this fact and hence poorly machined parts or subsections of the mechanism that are products of "last minute" tweaking to ensure the objective is met will not be looked at favorably during the final evaluation. Your design should demonstrate that considerable time has been allocated to the implementation of the predefined design process. Also, your final product should reflect the fact that time was spent in the machine shop to ensure the integrated sorting mechanism is robust and was not put together in a rush to meet the

competition deadline. Poorly-machined or integrated parts in your final design may result in 1-2 marks deduction in this subcategory.

Performance (12%)

This category relates to efficiency of the sorting mechanism. At the end of sorting, each mug should have 3 nuts that belong to this container category. For every container, an inspection will be performed at the end of sorting to count the number of nuts and their types. For every nut that does not belong to a specific container a total of 1 mark will be deducted. For example if a sorting mechanism places 3 correct nuts in container 1 (3 steel small), 2 correct in container 2 (2 brass medium and 1 brass large), 2 correct in container 3 (2 brass large and 1 nylon large), and 2 correct in container 4 (2 nylon large and 1 brass medium); a total of 3 marks will be deducted and the groups' grade in this category will be 9/12. An empty container results in 3 marks deduction for this container. Also, at the end of sorting for every container having 2 or 4 nuts (of any combination) will result in 1 mark deduction. Every container having 1 nut or 5 nuts as opposed to 3 will result in 2 marks deduction. If the sorting of all 12 nuts is done correctly, a full mark of 12/12 is guaranteed in this category.

Speed (8%)

The third category depends on speed of sorting.

- For groups that scored 12/12 in performance, a full mark of 8/8 in speed will be awarded to the group that completes the "correct" sorting in the fastest time. The group that requires the longest time to correctly sort 12 nuts will receive a mark of 4/8 in this category. The mark for all other groups (that successfully completed category 2) will be spanned linearly between 8/8 and 4/8.
- All groups that fail to score 12/12 in performance will be placed in a separate poll for evaluation for speed. They will be ranked based on speed of sorting and their mark in this category will be calculated as (mark in performance/12)*(8)*($\frac{\text{speed of fastest group in the pool}}{\text{recorded speed of the group}}$).

5.4 Other Important Dates

Monday, January 11, 2016: First day of class
Monday, February 15 – Friday, February 19, 2016: Winter Break
Friday, March 11: drop date – 40th class

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6 LAB SAFETY

Safety is critically important to the School and is the responsibility of all members of the School: faculty, staff and students. As a student in a lab course you are responsible for taking all reasonable safety

precautions and following the lab safety rules specific to the lab you are working in. In addition, you are responsible for reporting all safety issues to the laboratory supervisor, GTA or faculty responsible.

If the laboratory rules are not followed, consequences will include removing student's access to the lab. If this results in lab work not being completed, the student will receive a grade of 0.

1. You should download and print a copy of the ENGG*3490 Lab Manual from Courselink. Be sure to carefully read the specific manual section before you go to perform each of the laboratory exercises.

2. Equipment in the shop pose potential dangers for both operators and those in the vicinity. While reasonable efforts have been made to ensure and educate students about safe operation, caution must be exercised when working in the shop. For safety, students are required to adhere to all rules and regulations pertaining and posted in the shop. If there are any concerns regarding safety or suggestions to improve safety, please bring them to the Professor's or TA's or the technicians attention as soon as possible. For student and machine safety, power tools available to students will be restricted and **Does NOT** include use of the milling machines or lathes.

3. You must do as instructed by the TA or the technician. If you are not sure about something ask them. Inform the TA or the technician immediately if you become aware of a potential hazard.

4. Food and beverages cannot be stored or consumed in this laboratory

5. Safety glasses are mandatory for all experiments. You will not be allowed to perform an experiment without them.

6. Proper footwear is mandatory for all the experiments. This means no open toed shoes or sandals.

7. The fire extinguisher, first aid kit, and phone are located at the front of the lab (THRN 2307). Dial ext. 52000 in case of emergencies.

8. All accidents should be reported to the demonstrator.

7 ACADEMIC MISCONDUCT

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community faculty, staff, and students to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in

any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member.

7.1 Resources

The Academic Misconduct Policy is detailed in the Undergraduate Calendar:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml

A tutorial on Academic Misconduct produced by the Learning Commons can be found at:
http://www.academicintegrity.uoguelph.ca/

Please also review the section on Academic Misconduct in your Engineering Program Guide.

The School of Engineering has adopted a Code of Ethics that can be found at:
http://www.uoguelph.ca/engineering/undergrad-counselling-ethics

8 ACCESSIBILITY

The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty and administrators. This relationship is based on respect of individual rights, the dignity of the individual and the University community's shared commitment to an open and supportive learning environment. Students requiring service or accommodation, whether due to an identified, ongoing disability for a short-term disability should contact the Centre for Students with Disabilities as soon as possible

For more information, contact CSD at 519-824-4120 ext. 56208 or email csd@uoguelph.ca or see the website: http://www.uoguelph.ca/csd/

9 RECORDING OF MATERIALS

Presentations which are made in relation to course work—including lectures—cannot be recorded or copied without the permission of the presenter, whether the instructor, classmate or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

10 RESOURCES

The Academic Calendars are the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs:
http://www.uoguelph.ca/registrar/calendars/index.cfm?index