# ENGG*3070 Integrated Manufacturing Systems

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Fall 2022
Section(s): C01

School of Engineering
Credit Weight: 0.50
Version 1.00 - September 07, 2022

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# 1 Course Details

## 1.1 Calendar Description

Common production machines and manufacturing systems are dealt with, particularly automated systems, robotics, computer control and integration techniques, materials handling, inspection processes and process control. The course addresses societal and environmental issues related to manufacturing.

**Pre-Requisites:** ENGG*2120

## 1.2 Timetable

| **Lectures**: | | |
|---|---|---|
| Monday, Wednesday, Friday | 2:30 PM– 3:20 PM | LA, Room 204 |
| **Lab: See webadvisor** | | |

## 1.3 Final Exam

8:30AM - 10:30AM (Dec 05, 2022), Room TBA

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# 2 Instructional Support

## 2.1 Instructional Support Team

**Instructor:** Fantahun Defersha
**Email:** fdefersh@uoguelph.ca
**Telephone:** +1-519-824-4120 x56512
**Office:** THRN 2403
**Office Hours:** TBA

## 2.2 Teaching Assistants

**Teaching Assistant (GTA):** Amin Amouzadeh
**Email:** amouzada@uoguelph.ca

**Teaching Assistant (GTA):** Leonardo Gadelha Tumajan Costa de Melo
**Email:** lgadelha@uoguelph.ca

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# 3 Learning Resources

## 3.1 Required Resources

**Book (Textbook)**

Groover, M., Automation, Production Systems, and Computer Integrated Manufacturing, 5th edition, 2018, Pearson. (Textbook)

**Lecture and Notes (Notes)**

http://courselink.uoguelph.ca

Course material, news, announcements, and grades will be regularly posted on the ENGG*3070 CourseLink site. You are responsible for checking the site regularly. The lecture is the primary source of information for the course. Lecture notes will be made available to students on Courselink/D2L, but these are not intended to be stand-alone course materials. During lectures, the instructor will expand and explain the content of the notes and provide additional example problems. Discussion and Examples that may not be available from the posted lecture notes (or textbook) will also be presented during the lecture time to help you further understand the subject matter of the various topics. As such it is highly recommended that you attend the lectures. The best learning experience will be achieved if you attend lectures and labs regularly. Scientific studies have proven that a student's success rate is strongly related to his/her class attendance. Those who attend classes, tutorials, and labs have higher success rates than those who do not.

Miscellaneous Information: Other information related to recent research in Manufacturing Systems will be posted on CourseLink.

## 3.2 Recommended Resources

**Books (Textbook)**

Additional materials will be taken from the following recommended books to reinforce the

lecture and the lab.

1. Author: Ronald G. Askin and Charles R. Standridge; Title: : Modeling and Analysis of Manufacturing Systems; Publisher: Wiley; Year of Publication:1993; Edition 1st; ISBN 0-471-51418-7:
2. Author: Edward A. Silver, Daid F. Pyke, and Rein Peteson; Title: Inventory Management and Production Planning and Scheduling; Publisher: Wiley; Year of Publication: 1998; Edition: 1st; ISBN: 0-471-11947-4
3. Author: Kelton, W., Randall, S., and Nancy S.; Title: Simulation with Arena; Publisher: McGraw-Hill; Year of Publication: 2009; ISBN: 978-0073376288

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# 4 Learning Outcomes

## 4.1 Course Learning Outcomes

By the end of this course, you should be able to:

1. Identify the basic components of integrated manufacturing systems
2. Understand the fundamental of automation and control technologies in manufacturing
3. Develop simple Ladder Logic programming.
4. Know the techniques how different components (machine tools, material handling, robots, inspection, storage) of a manufacturing system can be integrated
5. Understand the role of material handling systems(e.g. conveyors, automated guided vehicles), material storage and retrieval systems, automatic identification and data capture in integrated manufacturing systems
6. Understand the design criteria of single station manufacturer cells, assembly lines, cellular manufacturing, flexible manufacturing systems.
7. Apply optimization techniques in the design and analysis of assembly and transfer lines, cellular manufacturing, automated guided vehicle and facility layout.
8. Understand the fundamental of manufacturing support systems such as process planning, production planning and control, just-in-time and lean production.
9. Master the basic techniques of production and inventory control.
10. Develop simulation models for manufacturing systems.

## 4.2 Engineers Canada - Graduate Attributes (2018)

Successfully completing this course will contribute to the following:

| # | Outcome | Learning Outcome |
|---|---|---|
| 1 | Knowledge Base | 2, 4, 7, 9 |
| 1.4 | Recall, describe and apply program-specific engineering principles and concepts | 2, 4, 7, 9 |
| 2 | Problem Analysis | 4, 5, 6, 10 |
| 2.3 | Construct a conceptual framework and select an appropriate solution approach | 4, 5, 6, 10 |
| 4 | Design | 6 |
| 4.1 | Describe design process used to develop design solution | 6 |
| 5 | Use of Engineering Tools | 3, 10 |
| 5.2 | Demonstrate proficiency in the application of selected engineering tools | 3, 10 |

# 5 Teaching and Learning Activities

## 5.1 Lecture Schedule

| Lecture | Lecture Topics | References | Learning Objectives |
|---|---|---|---|
| 1, 2 | **Introduction**<br>• Automation in Production Systems<br>• Manual Labor in Production Systems<br>• Types Manufacturing Operations and Production Facilities<br>• Basic Elements of Automation<br>• Level of Automation<br>• Components of Manufacturing Systems<br>• Classification Scheme for Manufacturing Systems | Chapters 1, 2, 3, 4, 13 | 1 |
| 3, 4 | **Introduction to Discrete Event Systems Simulation** | Other resources, | 1, 5 |

| | | | |
|---|---|---|---|
| | • Fundamentals of Simulation<br>• Time Advance Event Scheduling Algorithm | lecture note | |
| 5, 6 | **Discrete Control Using Programmable Logic Controller**<br><br>• Discrete Process Control<br>• Ladder Logic Diagrams<br>• Programmable Logic Controller | Chapter 9 | 2, 3 |
| 7, 8 | **Materials Transportation and Storage Systems**<br><br>• Overview of Materials Handling and Storage<br>• Analysis of Material Transportation Systems<br>• Analysis of Storage Systems | Chapters 10-11 | 1, 5 |
| 9 | **Single Station Manufacturing Cells**<br><br>• Single Station Manned Cells<br>• Single Station Automated Cells<br>• Application of Single Station Cells | Chapter 14 | 1, 5 |
| 10-14 | **Manual and Automated Production and Assembly Lines**<br><br>• Fundamental of Manual Assembly Lines<br>• Analysis of Single Model Assembly Lines<br>• Line Balancing Algorithms<br>• Mixed Model Assembly Lines<br>• Fundamentals of Automated Production and Assembly Lines<br>• Applications of Automated Production and Assembly Lines | Chapters 15-17 | 2, 3, 4 |

| | | | |
|---|---|---|---|
| | • Analysis of Transfer Lines and Assembly Systems | | |
| 15-17 | **Cellular Manufacturing System**<br>• Part families<br>• Part Classification and Coding<br>• Production Flow Analysis<br>• Cellular Manufacturing<br>• Application of Group Technology<br>• Quantitative Analysis in Group Technology | Chapter 18, Other resources, lecture note | 2, 3, 4 |
| 18-20 | **Flexible Manufacturing Systems**<br>• FMS Components<br>• FMS Applications and Benefits<br>• FMS Planning and Implementation Issues<br>• Quantitative Analysis of Flexible Manufacturing Systems | Chapter 19, Other resources, lecture note | 2, 3, 4 |
| 21-36 | **Manufacturing Support Systems**<br>• Inventory control<br>• Flow Shop Sequencing<br>• Job Shop Sequencing | Lecture and other resources | 2, 3 |

## 5.2 Labs

| **Topic** | **Week of:** |
|---|---|
| Simulation (Basic Processes and Advanced Processes) | Sept 21 |
| Simulation (Basic Processes and Advanced Processes) | Sept 26 |
| Simulations (Advanced Processes and Intermediate | Oct 03 |

| | |
|---|---|
| Modelling) | |
| Simulations (Advanced Processes and Intermediate Modelling) | Oct 17 |
| Additional Simulation Modeling | Oct 24 |
| Additional Simulation Modeling | Oct 31 |
| CIM - PLC Demonstraion | Nov 07 |
| CIM - Integration Demonstration | Nov 14 |

# 6 Assessments

## 6.1 Marking Schemes & Distributions

| Name | Scheme A (%) |
|---|---|
| Assignment | 15 |
| Labs | 15 |
| Quizzes | 20 |
| Mid-Term Exam | 20 |
| Final Exam | 30 |
| Total | 100 |

## 6.2 Assessment Details

**Assignments (15%)**
**Learning Outcome:** 1, 2, 3, 7, 9

- Assignment 1, Oct. 03 (Dropbox)
- Assignment 2, Oct. 24 (Dropbox)
- Assignment 3, Nov. 14 (Dropbox)
- Assignment 4, Nov. 28 (Dropbox)

**Labs (15%)**
**Learning Outcome:** 3, 4, 6, 7, 7
The lab is asynchronous and involves simulation modeling using ARENA and optimization using LINGO.

Lab Reports Will Be Submitted Via Dropbox

**Quizzes (20%)**

- Quiz-1 Sep 30 (In-Class)
- Quiz-2 Oct 14 (In-Class)
- Quiz-3 Nov 11 (In-Class)
- Quiz-4 Nov 25 (In-Class)

**Midterm Exam (20%)**
**Date:** Fri, Oct 28, (in Class)
**Learning Outcome:** 1, 2, 3, 4

**Final Exam (30%)**
**Date:** Mon, Dec 5, 8:30 AM - , 10:30 AM, TBD
**Learning Outcome:** 1, 2, 6, 7, 8, 9

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# 7 Course Statements

## 7.1 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

**Missed lab, quiz, and midterm**: : If you miss a lab, quiz, or midterm due to grounds for granting academic consideration or religious accommodation, the weight of the missed evaluation will be distributed and added to the weight of the final exam.

**Lab Work**: You must attend and complete all laboratories with no makeup for missed labs. If you are to miss a laboratory due to grounds for granting academic consideration, or if you are

to miss a lab for religious accommodation, arrangements must be made with the teaching assistant apriori.

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

# 8 School of Engineering Statements

## 8.1 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 but these are not intended to be stand-alone course notes. Some written lecture notes will be presented only in class. 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 labs.

## 8.2 Students' Learning Responsibilities

Students are expected to take advantage of the learning opportunities provided during lectures and lab sessions. 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.

## 8.3 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.

# 9 University Statements

## 9.1 Email Communication

As per university regulations, all students are required to check their e-mail account regularly: e-mail is the official route of communication between the University and its students.

## 9.2 When You Cannot Meet a Course Requirement

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. The grounds for Academic Consideration are detailed in the Undergraduate and Graduate Calendars.

Undergraduate Calendar - Academic Consideration and Appeals

https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

Graduate Calendar - Grounds for Academic Consideration
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml

Associate Diploma Calendar - Academic Consideration, Appeals and Petitions
https://www.uoguelph.ca/registrar/calendars/diploma/current/index.shtml

## 9.3 Drop Date

Students will have until the last day of classes to drop courses without academic penalty. The deadline to drop two-semester courses will be the last day of classes in the second semester. This applies to all students (undergraduate, graduate and diploma) except for Doctor of Veterinary Medicine and Associate Diploma in Veterinary Technology (conventional and alternative delivery) students. The regulations and procedures for course registration are available in their respective Academic Calendars.

Undergraduate Calendar - Dropping Courses
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml

Graduate Calendar - Registration Changes
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/genreg-reg-regchg.shtml

Associate Diploma Calendar - Dropping Courses
https://www.uoguelph.ca/registrar/calendars/diploma/current/c08/c08-drop.shtml

## 9.4 Copies of Out-of-class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

## 9.5 Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required; however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to make a booking at least 14 days in advance, and no later than November 1 (fall), March 1 (winter) or July 1 (summer). Similarly, new or changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time.

For Guelph students, information can be found on the SAS website
https://www.uoguelph.ca/sas

For Ridgetown students, information can be found on the Ridgetown SAS website
https://www.ridgetownc.com/services/accessibilityservices.cfm

## 9.6 Academic Integrity

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 encourages academic integrity. 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 or faculty advisor.

Undergraduate Calendar - Academic Misconduct
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml

Graduate Calendar - Academic Misconduct
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml

## 9.7 Recording of Materials

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

## 9.8 Resources

The Academic Calendars are the source of information about the University of Guelph’s procedures, policies, and regulations that apply to undergraduate, graduate, and diploma programs.

Academic Calendars
https://www.uoguelph.ca/academics/calendars

## 9.9 Disclaimer

Please note that the ongoing COVID-19 pandemic may necessitate a revision of the format of course offerings, changes in classroom protocols, and academic schedules. Any such changes will be announced via CourseLink and/or class email.

This includes on-campus scheduling during the semester, mid-terms and final examination schedules. All University-wide decisions will be posted on the COVID-19 website (https://news.uoguelph.ca/2019-novel-coronavirus-information/) and circulated by email.

## 9.10 Illness

Medical notes will not normally be required for singular instances of academic consideration, although students may be required to provide supporting documentation for multiple missed assessments or when involving a large part of a course (e.g.. final exam or major assignment).

## 9.11 Covid-19 Safety Protocols

For information on current safety protocols, follow these links:

- https://news.uoguelph.ca/return-to-campuses/how-u-of-g-is-preparing-for-your-safe-return/
- https://news.uoguelph.ca/return-to-campuses/spaces/#ClassroomSpaces

Please note, these guidelines may be updated as required in response to evolving University, Public Health or government directives.

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