



## SYLLABUS

### 1 Course Information

Introduction to Smart Manufacturing and the Fundamental Concepts of Future Factories; Industrial Internet of Things; Digital Twin; Data Analytics; and Virtual Commissioning.

**Prerequisite(s):** None  
**Corequisite(s):** EMCH 377  
**Credit Hours:** 3  
**Meeting Time:** MF 15:55 pm – 17:10 pm  
**Meeting Location:** Web; Blackboard Collaborate Ultra Synchronous

### 2 Course Instructor

Name **Dr. Ramy Harik**  
Office Location **McNAIR Aerospace Center Suite 120**  
Office Hours **Virtual – MS Teams**  
Contact Information **harik@cec.sc.edu**  
Other Emails/posts will be replied to within 48 hours

### 3 Textbook and Additional References

No textbook will be required. Several readings from papers and industrial documentation will be provided, sample of these references:

- Kaishu Xia, Christopher Sacco, Max Kirkpatrick, Clint Saidy, Lam Nguyen, Anil Kircaliali and Ramy Harik, "A Digital Twin to Train Deep Reinforcement Learning Agent for Smart Manufacturing Plants: Environment, Interfaces and Intelligence," Journal of Manufacturing Systems, 2020.
- Juergen Lenz, Eric MacDonald, Ramy Harik and Thorsten Wuest, "Optimizing Smart Manufacturing Systems by Extending the Smart Products Paradigm to the Beginning of Life," Journal of Manufacturing Systems, vol. 57, pp. 274-286, October 2020.

### 4 Course Topics

1. Automation
2. Industrial robots
3. Materials handling and facilities planning
4. Production systems
5. Ergonomics
6. Cybermanufacturing
7. Data Analytics
8. Digital Twin & Realities
9. Industrial internet of things

## 5 Course Outcomes

1. Students will demonstrate an understanding of the principles of smart manufacturing processes and future factories.
2. Students will perform data analytics to optimize manufacturing.
3. Students will create a digital twin facilitating the integration of artificial intelligence and machine learning for future factories.

## 6 Lecture schedule

The course will adopt a standard weekly cycle with one topic per week. Each week contains two modules and one assignment.

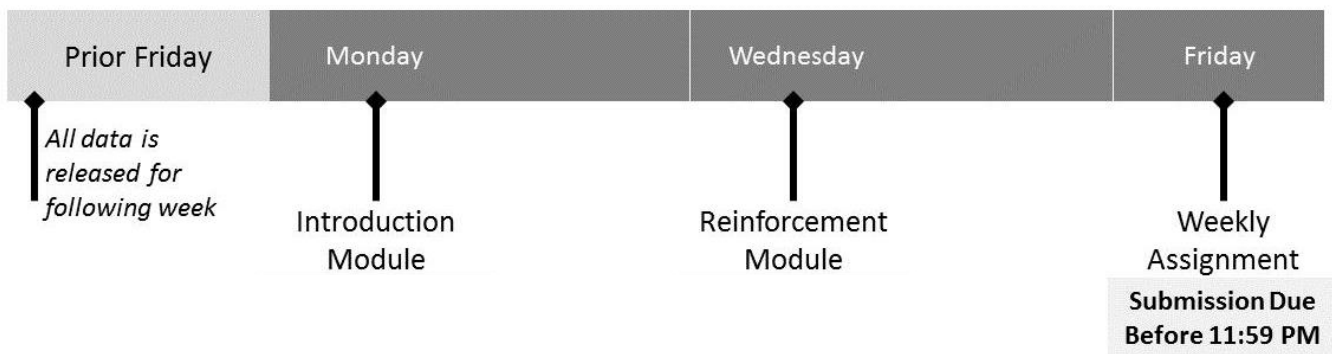
*(All materials relevant to Week X are released the Friday prior, as such students wishing to work on their assignments over the weekend can do so).*

### Sample Week X

- Module 1: Topic Introduction
- Module 2: Topic Reinforcement
- Assignment submission

All modules adopt the same approach: Watch, Execute, Submit, Practice.

### Module of the Week



## 7 Grading Policy

Graded work will consist of assignments and final exam.

The overall grade will be assigned as follows (grades will be rounded up):

90-100 A    85-89 B+    80-84 B    75-79 C+    70-74 C    60-69 D    < 60 F

**Requirements for undergraduate and graduate students:** Both undergraduate and graduate students will be exposed to the same topics. However, graduate students will be assigned additional and/or different questions in assignments and tests compared to undergraduate students.

	Undergraduates	Graduates
Assignments	80%	60%
Literature Study		20%
Final Exam	20%	20%

**Assignment:** Late assignments will not be accepted. Students are encouraged to work together but copying is not allowed.

**Literature Study:** A literature study on a Smart Manufacturing topic. [only for graduate students]

**Final Exam:** The final exam is scheduled (2.5 hours) and will be comprehensive of the course material covered during the semester. The exam will determine 20% of your final average. There will be no makeup of the final exam. Failure to attend the final exam results in the assignment of a zero for the final grade.

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## Attendance Policy

Attendance is taken with submissions at the end of every module. Students may skip 15% of submissions without penalties, after 15% the instructor may exact a letter grade.

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## Academic Integrity, Accommodating Disability and Diversity Policy

**Academic Integrity:** You are expected to practice the highest possible standards of academic integrity. Any deviation from this expectation will result in a minimum academic penalty of your failing the assignment and will result in additional disciplinary measures. This includes an improper citation of sources, using another student's work, and any other form of academic misrepresentation. University policies and procedures regarding academic integrity are defined in policy STAF 6.25, Academic Responsibility - The Honor Code (see <http://www.sc.edu/policies/ppm/staf625.pdf>). Prohibited behaviors include plagiarism, cheating, falsification, and complicity. All potential Honor Code violations will be reported to the Office of Academic Integrity, which has the authority to implement non-academic penalties as described in STAF 6.25. Academic penalties for Honor Code violations in this course range from a zero on the assignment to failure of the course.

**Accommodating Disability:** Reasonable accommodations are available for students with a documented disability. If you have a disability and may need accommodations to fully participate in this class, contact the Student Disability Resource Center: 777-6142, TDD 777-6744, emailsads@mailbox.sc.edu, or stop by LeConte College Room 112A. All accommodations must be approved through the Student Disability Resource Center.

**Diversity Policy:** In order to learn, we must be open to the views of people different than ourselves. In this time we share together over the semester, please honor the uniqueness of your fellow classmates and appreciate the opportunity we have to learn from one another. Please respect each others' opinions and refrain from personal attacks or demeaning comments of any kind. Finally, remember to keep confidential all issues of a personal or professional nature that are discussed in class.

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## Miscellaneous Information

**Online Learning Outcomes:** All LOs are equivalent of those of a face-to-face (F2F) version of the course.

**Fair Policy:** All readings/materials comply with copyright/fair use policies.

**Technology:** Course delivery will be conducted through Blackboard Collaborate Ultra/Microsoft Teams.

**Software Requirements:** This course might use open-source software for process model and simulations.

**Student Technical Requirements/Skills:** Familiarity with computer-aided modeling satisfied through EMCH 111.

**Interactions:**

- S2I: Blackboard announcements will be used with a combination of emails/Teams for further interactions.
- S2S: Emails and Teams
- S2C: All course materials will be posted on Blackboard

**11 Class Schedule**

<b>Week</b>	<b>Topic</b>	<b>Student-to-Instructor Contact Minutes</b>
Week 1	Introduction	150
Week 2	Automation	150
Week 3	Industrial Robotics	150
Week 4	Materials Handling	150
Week 5	Facility Planning	150
Week 6	Production systems	150
Week 7	Production systems	150
Week 8	Ergonomics	150
Week 9	Cybermanufacturing	150
Week 10	Data Analytics	150
Week 11	Data Analytics	150
Week 12	Digital Twin	150
Week 13	All Realities	150
Week 14	Final Exam Preparations	150
	Total Student-to-Instructor contact minutes	2100

*\*This syllabus is subject to change throughout the semester as necessary*