University of South Carolina
College of Engineering and Computing
Department of Mechanical Engineering

EMCH 792
Smart Manufacturing

SYLLABUS

1 Course Information

Course Description
Advanced Concepts of Future Factories and Smart Manufacturing: Hardware Infrastructure, Future Factory Cyber Infrastructure, Industrial Internet of Things Machine to Machine Network, Machine Vision, Manufacturing Event Understanding and Future Factory Data Infrastructure.

Prerequisite(s): None
Corequisite(s): EMCH 792
Credit Hours: 3
Meeting Time: TT 17:00 pm – 18:15 pm
Meeting Location: Room: McNAIR Classroom Web; Blackboard Collaborate Ultra Synchronous

2 Course Intructor

Name	**Dr. Ramy Harik**
Office Location	**McNAIR Aerospace Center Suite 120**
Office Hours	**Virtual – MS Teams**
Email	**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:

- Anumbe, N.; Saidy, C.; Harik, R. A Primer on the Factories of the Future. Preprints 2022, 2022060134 (doi: 10.20944/preprints202206.0134.v1).
- 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 Transformation products
9. Digital Transformation tools and challenges
10. Industrial internet of things
11. Manufacturing Event Understanding

5 Course Outcomes

1. Students will demonstrate an understanding of the advanced concepts 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 also have interaction with the West Virginia University through the NSF Future Factories grant.

7 Grading Policy

Graded work will consist of assignments and two projects.
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 students and grading policy:
Assignments: Late assignments will not be accepted. Students are encouraged to work together but copying is not allowed.

Literature Study: A literature review study on a Smart Manufacturing topic.

Final Project: The final project is scheduled due the last week of the semester and will be comprehensive of the course material covered during the semester. The final project will determine 50% of your final average. Late submissions will not be accepted. Students will be expected to write and integrate machine learning and artificial intelligence algorithms towards solving a smart manufacturing challenge.

	Graduates
Literature Review	50%
Hands on Project	50%

8 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.

9 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, emailsasds@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.

10 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 Smart Manufacturing and Digital Transformation research areas.

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

Week	Topic	Student-to-Instructor Contact Minutes
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	Digital Transformation products	150
Week 12	Digital Transformation tools and challenges	150
Week 13	Industrial Internet of Things	150
Week 14	Manufacturing Event Understanding	150
	Total Student-to-Instructor contact minutes	2100

Generated By: **Ramy Harik** on 8/1/2022.

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