**Course Syllabus**

**EGR 590-606 Lean Manufacturing for Sustainability**

**Fall Semester**

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Online Office Hours by appointment

***Purpose of Course***: The course will cover generic and specific lean manufacturing concepts and tools focused on sustainability. All these basic concepts will be employed to discuss industry strategy and global competitiveness. People responsible for continuously improving operational performance must develop systems that are fast, flexible, focused and friendly for their companies, customers and production associates. The course will provide the student with an introduction to lean manufacturing describing the background behind its development and how evaluations and assessments of production systems are performed. Lean manufacturing tools and techniques will be described and, in some cases, demonstrated in simulation exercises. Issues relating to employee involvement, improvement teams, training and culture will be presented. Planning for lean process implementation and the necessity of sustain improvements will be discussed. Finally, sustainability concept will be discussed and integrated with Lean Manufacturing.

***Conduct of Course***: this class will be conducted on-line only. Grading will be based upon performance on assigned exams and homework.

***Prerequisites***: Senior or graduate standing in industrial engineering or a related discipline and consent of instructor. The course is open to graduate students, advanced undergraduates and practicing engineers who wish to learn more about lean principles and practice. No prior background in lean production will be assumed.

***Course Specific Objectives***:

1. You will learn a brief history of manufacturing approaches employed and the background and philosophy of lean production. You will also learn the concept of waste and that the quest for truly lean production is a journey and not a destination.
2. The need for strategy, alignment with other corporate or plant objectives, and preparation for lean manufacturing will be presented.
3. You will learn some evaluation techniques that one can use in preparation for and use in lean manufacturing activities.
4. You will learn a set of approaches used in implementing lean manufacturing in production operations. While these tools are often useful, they are not an end on themselves and they are not necessarily the essence of lean manufacturing either.
5. Concepts as workplace organization, pull production, cellular arrangement and layout improvement, visual management, quick change, mistake reduction, employee involvement, need for employee creativity and motivation for lean implementation will be discussed and examples will be given.
6. Methods for promoting success in implementing lean transformations will be discussed.
7. The importance of sustainability in this competitive world and how Lean manufacturing is aligned with it

***Course Topics***:

1. What is lean production? – Introduction, background, and lean thinking.
2. Importance of philosophy, strategy, culture, alignment, focus and systems view. Discussion of Toyota Production System.
3. Lean production preparation – System assessment, process, and value-stream mapping – Sources of waste.
4. Lean production processes, approaches, and techniques.
5. Employee involvement – Teams – Training – Supporting and encouraging involvement – Involving people in the change process -- communication -- Importance of culture.
6. Startup of lean processes and examples of applications.
7. Sustaining improvement and change, auditing, follow-up actions.
8. Sustainability / Industrial Ecology

Two lectures per week will focus on theoretical and practical presentation of lean manufacturing concepts and processes as well as its implementation.

Topic 1: Understanding Manufacturing

Topic 2: Supply Chain Concepts and Principles

Topic 3: Lean Manufacturing description

Topic 4: Lean Supply Chain / Lean Six Sigma

Topic 5: Lean Tools – Workplace 5S’s / Standardization / Visual Management

Topic 6: Lean Tools – Kaizen

Topic 7: Lean Tools – Just in time

Topic 8: Lean Tools – Hoshin Planning

Topic 9: Lean Tools –Quick Change (SMED) and Productive Maintenance

Topic 10: Lean Tools – Value Stream Mapping

Topic 11: Lean Tools – Employee Involvement, Teams, Conflict, Empowerment

Topic 12: Lean Tools – Simulations

Topic 13: Sustainability / Industrial Ecology / Green Manufacturing

Topic 14: Lean Sustainability

***Textbooks***:

As textbooks for the course students may wish to choose to use one or both of the following two books yet they are not required:

* *The Toyota Way Fieldbook, Jeffrey Liker and David Meier, McGraw-Hill, 2006.*
* *Lean Production Simplified, Pascal Dennis, Productivity Press, 2007.*

***Other References:***

* *Lean Thinking,* James Womack and Daniel Jones, Free Press, Revised Edition, 2003.
* *The Machine That Changed The World,* James Womack, Daniel Jones, and Daniel Roos, Rawson Associates, 1990.
* *The Toyota Way,* Jeffrey Liker, McGraw-Hill, 2004.
* *Value Stream Management,* Don Topping, Tom Luyster, and Tom Shuker, Productivity Press, 2002.

***Course Requirements***:

**Homework:**

Please look at the homework list for deadlines and details

**Examinations:**

There will be two exams and a set of homework as described next:

***Grading***:

First exam 35 %

Second exam 35 %

Homework 30 %

Total 100 %

**Grade scale:**

|  |  |
| --- | --- |
| **Grade range** | **Grade letter equivalent** |
| **98-100** | **A+** |
| **94-97** | **A** |
| **90-93** | **A-** |
| **87-89** | **B+** |
| **83-86** | **B** |
| **80-82** | **B-** |
| **77-79** | **C+** |
| **73-76** | **C** |
| **70-72** | **C-** |
| **67-68** | **D+** |
| **63-66** | **D** |
| **61-62** | **D-** |
| **60 and below** | **F** |

***Bachelor degree in Engineering is recommended for this class***

***Requirements for Credit-Only (S/U) Grading***

In order to earn a ‘S’ grade the students will be required to take all exams and complete all assignments with a grade of C- or above. Conversion from letter grade to credit only (S/U) grading is subject to University deadlines. Refer to the Registration and Records calendar for deadlines related to grading. For more details refer to

<http://www.ncsu.edu/policies/academic_affairs/courses_undergrad/REG02.20.15.php> .

***Requirements for Credit-Only (S/U) Grading***

In order to receive a grade of S, students are required to take all exams and quizzes, complete all assignments, and earn a grade of C- or better. Conversion from letter grading to credit only (S/U) grading is subject to university deadlines. Refer to the Registration and Records calendar for deadlines related to grading. For more details refer to

<http://www.ncsu.edu/policies/academic_affairs/courses_undergrad/REG02.20.15.phpp>

***Policies on Incomplete Grades***

If an extended deadline is not authorized by the instructor or department, an unfinished incomplete grade will automatically change to an F after either (a) the end of the next regular semester in which the student is enrolled (not including summer sessions), or (b) the end of 12 months if the student is not enrolled, whichever is shorter. Incompletes that change to F will count as an attempted course on transcripts. The burden of fulfilling an incomplete grade is the responsibility of the student. The university policy on incomplete grades is located at <http://www.ncsu.edu/policies/academic_affairs/grades_undergrad/REG02.50.3.php>

***Late Assignments***

Assignments will not be accepted after the established deadlines, unless subject to the excused absence policy.

***Makeup Work***

Assignments not turned in on a designated deadline because of an excused absence must be submitted within 48 hours of the deadline, unless other arrangements have been made with the instructor due to extenuating circumstances.

***Additional Excuses Policy***

None.

***E) ACADEMIC INTEGRITY***

Academic Integrity

Students are required to comply with the university policy on academic integrity found in the Code of Student Conduct found at <http://www.ncsu.edu/policies/student_services/student_discipline/POL11.35.1.php>

***Academic Honesty***

See <http://www.ncsu.edu/policies/student_services/student_discipline/POL11.35.1.php> for a detailed explanation of academic honesty.

***Honor Pledge***

Your signature on any test or assignment indicates "I have neither given nor received unauthorized aid on this test or assignment.”

***F) ELLECTRONICALLY-HOSTED COURSE COMPONENTS***

Students may be required to disclose personally identifiable information to other students in the course, via electronic tools like email or web-postings, where relevant to the course. Examples include online discussions of class topics, and posting of student coursework. All students are expected to respect the privacy of each other by not sharing or using such information outside the course.

Electronically-hosted Components: Powerpoint presentations, additional readings, videos, and other materials will be made available via Moodle.

***F) ACCOMODATIONS FOR DISABILITIES***

Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, student must register with the Disability Services Office (http://www.ncsu.edu/dso) located at 1900 Student Health Center, Campus Box 7509, 515-7653. For more information on NC State's policy on working with students with disabilities, please see the Academic Accommodations for Students with Disabilities Regulation at

<http://www.ncsu.edu/policies/academic_affairs/courses_undergrad/REG02.20.1.php> .

***G) NON-DISCRIMINATION POLICY***

NC State University provides equality of opportunity in education and employment for all students and employees. Accordingly, NC State affirms its commitment to maintain a work environment for all employees and an academic environment for all students that is free from all forms of discrimination. Discrimination based on race, color, religion, creed, sex, national origin, age, disability, veteran status, or sexual orientation is a violation of state and federal law and/or NC State University policy and will not be tolerated. Harassment of any person (either in the form of quid pro quo or creation of a hostile environment) based on race, color, religion, creed, sex, national origin, age, disability, veteran status, or sexual orientation also is a violation of state and federal law and/or NC State University policy and will not be tolerated. Retaliation against any person who complains about discrimination is also prohibited. NC State's policies and regulations covering discrimination, harassment, and retaliation may be accessed at <http://www.ncsu.edu/policies/campus_environ> or

<http://www.ncsu.edu/equal_op>. Any person who feels that he or she has been the subject of prohibited discrimination, harassment, or retaliation should contact the Office for Equal Opportunity (OEO) at 515-3148.