

# Industrial Engineering

Mech 495

**Instructor: F. Sassani**

Term: 1, Session: 2010-2011

Class time: Mon, Wed, Fri. 1-1:50 pm.

Location: CEME 1202

*This course is an introduction to the principles and techniques used by Industrial Engineers to control and operate manufacturing and service systems. A complete study of Industrial Engineering (IE) would require four years of university training. Industrial Engineering is an ideal bridge between Mechanical and some other Engineering disciplines, and the field Management. In this course you will become familiar with some of the most important IE concepts, and you will gain adequate knowledge of where and what to look for if you need to know more.*

## **TOPICS COVERED**

We hope to cover most of the following topics depending on class progress:

**Introduction.** *General introduction to the course and IE.*

**Organizational Structure.** *Various modes of operation, fundamental guidelines; and communication.*

**Manufacturing Systems.** *Job-shop, batch and mass production. Line, functional and group technology (cellular) layout. Respective merits and demerits. Practical systems and re-organization.*

**Manufacturing Processes/Process Planning.** *Selection of processes in production. Quality, quantity and cost considerations.*

**Classification and Coding.** *Group technology, part family formation methods, types of classification and their benefits. Opitz and MultiClass systems.*

**Scheduling (sequencing) of operations.** *Single, two and three-machine N-job sequencing problems. General solution (Branch and Bound), sequencing effectiveness criteria. Simulation method.*

**Forecasting.** *Various methods of trend forecasting including moving average, linear and non-linear regression, and exponential smoothing.*

**Statistical Quality Control.** *Quality control for variables, quality control for attributes (defectives and defects), acceptance sampling.*

**System Reliability.** Useful life of system components, reliability of parallel and series systems. More complex systems and application of state and path enumeration methods; and sensitivity analysis.

**Plant Location.** Optimum placement of new facilities. Mathematical solutions to rectilinear, Euclidean, gravity and MiniMax problems.

**Manufacturing Automation.** A review of the elements of manufacturing automation, flexible manufacturing and computer integrated manufacturing.

## Course Information

**Assignments:** Several assignments will be given. The assignments must be handed in for marking. Use of scientific software is not really needed, though is possible for some assignments.

Marking scheme:	Assignments constitute about	20%
	Mid-term Examination about	30%
	and Final Examination about	50% of the reported grade.
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	Total	100%

In order to pass the course the grade obtained in the final examination must be at least 50%. I would like you to be thinking between “obtaining first and second class standing” rather than ever thinking between “passing and failing”!

**Textbook:** There is no textbook requirement. But in any case, a list of relevant reference texts is provided.

**Notes:** Notes **should be taken during the lectures** from the board. A good deal of written material will be made available through the course VISTA website.

**A friendly reminder:** Please be advised that the course material available through the website is meant to **complement the actual lectures** during which much of the course content is presented, explained and discussed. Having these notes available to you online **should not** imply that the lectures could be skipped. So I hope to see you in the class on a regular basis.

## HISTORICAL BACKGROUND

"Industrial Engineering", as a discipline dealing with operation of a collection of production units, has its roots in the era of "Industrial Revolution". There were eight events known as the "the Great Inventions" that took place during the Industrial Revolution, six British, one French and one American. They were:

- Hargreave's Spinning Jenny
- Arkwright's Water Frame
- Crompton's Mule
- Cartwright's Power loom
- Watt's Steam Engine
- Berthollete's Chlorine Bleaching
- Maudslay's Screw Cutting Machine
- Inter-changeable Manufacture

*In fact, these events started the industrial revolution that led to the setting up of factories that changed the world. As more factories were built the natural trend to compete, improve quality and increase profits brought about a science that we now know it as Industrial Engineering.*

*Industrial Engineering combines the following disciplines:*

- Engineering Science and Technology
- Social Sciences
- Economic Sciences
- Physical Sciences
- Mathematical Sciences
- and often others

## **PRODUCTIVITY/PROFITABILITY**

*An industrial engineer will attempt to make an organization more efficient, and he/she may deal with topics like productivity and profitability. Let's just briefly compare the two and see what we learn.*

*Profitability = Revenue from sales - Cost of input (\$)*

*Productivity = Ratio of output/input (\$/number of people)  
or (units/time)*

*"Normally" a productive firm is also profitable one.*

*However, because profits are sales oriented, an organization may be very efficient in the use of resources, but market conditions may not allow it to sell its products at high enough prices to earn a net profit. Additionally, the cost of input raw material may have a similar effect.*

*Therefore, not only we deal with internal forces we also have to consider the external effects ranging from material availability and cost to union matters.*

## ***DUTIES OF AN INDUSTRIAL ENGINEER***

*Industrial engineers determine, eliminate, enhance or implement as appropriate the following:*

- *Waste and deficiencies*
- *Better means of control*
- *Cost effective analysis*
- *Expansion of business*
- *Improved technology*
- *More efficient operations*
- *Greater use of plant facilities*
- *Implementing new organizational structure*
- *Safety and human aspects*
- *and more...*
  - *Equipment layout*
  - *Personnel assignment*
  - *and more again....*

## ***USEFUL TEXTS***

Here are some useful texts in management, production and Industrial Engineering.

1. *"Industrial Engineering Methods and Controls", Donald R. Herzog, Reston Publishing Co, Inc, 1985.*
2. *"Principles of Industrial Engineering", Charles Buxton Going, McGraw-Hill Book Company, 2008.*
3. *"Introduction to Industrial and Systems Engineering", W.C. Turner, J.H. Mize and K.E. Case, Prentice-Hall Publishing, Inc, 1987.*
4. *"Industrial Engineering and Operations Research", D. Miller and J.W. Schmidt, Wiley & Sons Inc, 1984.*
5. *"Integrated Production Control Systems": Management, Analysis, Design, 2nd edition, D.D. Bedworth and J.E. Bailey, Wiley & Sons Inc, 1987.*
6. *"Analysis and Control of Production Systems", E.A. Elsayed and T.O. Boucher, Prentice-Hall, Inc, 1985.*
7. *"Quality Engineering in Production Systems", G. Taguchi, E.A. Elsayed and T. Hsiang, McGraw-Hill Book Company, 1989.*
8. *" Fundamentals of Modern Manufacturing ", M. P. Groover, 3rd Edition. Wiley, 2007.*
9. *"Operations Management: decision making in the operations function", 2nd edition, R.G. Schroeder, McGraw-Hill Book Company, 1985.*
10. *"Flexible Manufacturing Cells and Systems", W.W. Luggen, Prentice-Hall, Inc, 1991.*
11. *" Industrial Management ", James R. Evans, and William M. Lindsay, 5th Edition. South-Western College Publication, 2002.*