

**IME 4040: PLANT LAYOUT AND  
MATERIAL HANDLING**

Spring 2011 (CRN: 13716/717))

MWF 8:30 – 9:20 a.m. (D-206)  
T 11:30 - 2:20 p.m. (C-226)

**Catalog Description:** This course is designed to give the students a comprehensive understanding of the issues involved in the design of an industrial production system. It will cover the problems in plant location, product analysis, process design, equipment selection, materials handling, and plant layout. NOT FOR ENGINEERING CREDIT. Prerequisites: IME 3050, IME 3260, and senior standing.

**Textbook:**

- Stephens, Matthew P. and Meyers, Fred E., Manufacturing Facilities Design and Material Handling, (Upper Saddle River: Pearson Education, Inc., 2010, Fourth Edition).
- Bafna, K.M., IME 4040 Lab Manual, Spring 2011.

**References:** A list of references and periodicals is given at the end of this syllabus.

**Instructor/  
Coordinator:** *Name:* Dr. Kailash M. Bafna, Professor  
*Office:* E-212 Parkview Campus  
*Phone:* (269) 276-3355  
*Email:* [kailash.bafna@wmich.edu](mailto:kailash.bafna@wmich.edu) (send **all** emails here)  
*WebCT Access:* <https://elearn.wmich.edu>  
*Office Hours:* MW 9:30-10:20 am., T 10:30-11:20 am.

**Long Term Behaviors:**

In the future, students completing this course can:

- Coordinate the design of a complex new facility of any kind.
- Find solutions to problems resulting from the movement of materials, people, and information in manufacturing and service-related facilities.
- Improve the efficiency of manufacturing or service systems.

**Prerequisites by Topics:**

- Work methods design and flow charts (IME 3050).
- Forecasting and scheduling procedures (IME 3260).

**Course Objectives:**

<u>Course Objectives</u>	<u>Performance Criteria</u> <sup>1</sup>	<u>ABET/TAC Outcomes</u> <sup>2</sup>
1. Plan, analyze, and design to improve manufacturing and service facilities	F1 Defines technical problems, compares alternative options, and designs a solution	f
2. Learn and apply techniques to evaluate and design material handling and storage systems	C3 Uses decision making tools to analyze or improve a process or system	c
3. Conduct a financial analysis to justify a newly designed/modified facility	A2 Demonstrates the use of one or more tools (CAD, Word, Excel, PowerPoint, CAE) in presentation, analysis, research of a design	a*
4. Work with a team to design a new facility	E5 Through group projects, learn valuable skills beyond learning course content	e*

5. Be able to communicate information through a variety of techniques	G2 Conveys technical information effectively in graphical form (posters, PPT, histograms, FEA outputs)	g*
---	--	----

<sup>1</sup>**Performance Criteria:** IME performance criteria may be found at <http://www.wmich.edu/ime>

<sup>2</sup>**ABET/TAC Outcomes:** Outcomes may be found at <http://www.abet.org/>

\*Tracked in course notebook

**Lecture Schedule:**

<u>WEEK OF:</u>	<u>TOPIC</u>	<u>CHAPTER</u>
1-10	Introduction to Facilities Design	1
	Sources of Information for Facilities Design	2
1-17	<b>MLK Day Convocation &amp; Activities (No Classes on Monday, 1-17)</b>	
	Sources of Information for Facilities Design	2
	Use of Time Study	3
	Process Design	4
1-24	<i>Instructions for Lab # 1</i>	<i>Lab. Manual</i>
	Process Design	4
	Flow Analysis Techniques	5
1-31	Flow Analysis Techniques	5
	Workstation Design and Space Requirements	7
2- 7	<i>Lab #1 due, Instructions for Lab #2</i>	<i>Lab. Manual</i>
	Workstation Design and Space Requirements	7
	Auxiliary Services Requirement Space	8
2-14	Auxiliary Services Requirement Space	8
	<b>EXAMINATION # I (2-15)</b>	<b>1-5</b>
	Activity Relationship Analysis	6
2-21	<i>Lab #2 due, Instructions for Lab # 3</i>	<i>Lab. Manual</i>
	Employee Services Space Requirements	9
	<b>SPIRIT DAY (No Classes on Friday, 2-25)</b>	
2-28 to 3-4	<b>SPRING BREAK (No Classes)</b>	
3- 7	Office Layout Techniques and Space Requirements	12
3-14	<i>Lab #3 due, Instructions for Lab # 4</i>	<i>Lab. Manual</i>
	Financial Analysis	Notes
	Area Allocation	13
3-21	<i>Lab #4 due, Instructions for Lab #5</i>	<i>Lab. Manual</i>
	Area Allocation	13

3-28	Facilities Design—The Layout <b>EXAMINATION # II (3-29)</b>	<b>6-13</b>	14
4- 4	Material Handling		10
	Material Handling Equipment		11
4-11	Material Handling Equipment <i>Lab #5 due (4-13)</i>		11
4-18	Material Handling Equipment		11
4-28 (Thurs)	<b>COMPREHENSIVE FINAL EXAMINATION (8:00 a.m. – 10:00 a.m.)</b>		

### Laboratory Schedule:

#### Report 1: Product, Manufacturing, and Flow Analysis (due Monday, 2-7)

1. Parts list
2. Production routing sheets for each "make" part
3. Flow Process chart for each "make" part
4. Assembly chart for product
5. Operations chart
6. Package design
7. Unit load design
8. Material and parts requirement list

#### Report 2: Machine & Space Requirements (due Monday, 2-21)

1. Machine requirements:
  - a) Computations of machine requirements
  - b) Area and cost of production equipment
2. Receiving and shipping areas
3. Storage analysis
4. Organization chart
5. Plant services space requirements
6. Total space requirements

#### Report 3: Preliminary Layout (due Monday, 3-14)

1. From-To chart
2. Activity Relationship chart
3. Worksheet for activity relationship chart
4. Nodal Diagram
5. Initial departmental layout
6. Final departmental layout
7. Plot plan
8. Material handling system design
9. Material handling equipment list

#### Report 4: Financial Analysis (due Monday, 3-21)

1. Plant cost: land, building, and production equipment
2. Material cost
3. Personnel cost
4. Office equipment cost

5. Material handling equipment cost
6. Profit and loss statement

**Report 5: Final Project Report (due Wednesday, 4-13)**

The final report will contain all the material from the earlier reports. It will also contain a write up on the entire project and the detailed layouts drawn to scale for:

1. Final plant layout.
2. Production departments showing all equipment
3. Storage design: receiving, shipping, storage, and warehouse
4. Office areas showing all work stations
5. Service areas

**Laboratory Project Procedure:**

The instructor will divide the class into several groups. Each group will be given detailed information on a product, and they are to plan, design, and layout the manufacturing facilities to produce this product. The final report will include layouts of the manufacturing areas, service areas, and office areas, and a financial analysis for the company. Each group will submit a total of five reports (the contents of each report are shown above) on the due dates indicated. Normally, each member of a group will receive the group grade for the lab. However, if there is evidence of unequal participation in the lab by the members of a group (in terms of quality and quantity of work), the group grade will be divided up to reflect the individual levels of participation.

**Computer Usage:**

All five reports in the laboratory project are to be done using the computer. You will need a working knowledge of Word, Excel, and any CAD software (preferably AUTOCAD and VISIO). All forms to be completed and other computational software needed for each report can be downloaded from my WebCT site. All written text material must be in WORD or some other word processing software.

**Written Communication Requirements:**

All the reports required for the laboratory project have sections that need to be written. These sections will be graded for good writing skills and mechanics. In addition, the final report will be judged for good report preparation skills.

**Library Usage:**

A list of references and periodicals useful in this course is attached at the end of this syllabus. As you work on the laboratory project, you will find it extremely useful to refer to the appropriate sections in the books listed to get different perspectives for designing the same thing. A review of the current issues of the listed periodicals will give you an insight into the latest developments in the areas of materials handling and warehousing.

**Evaluation Distribution:**

<u>Laboratory:</u>		<u>Course:</u>	
Report 1	200 points	Examination # I	20%
Report 2	200 points	Examination # II	25%
Report 3	200 points	Examination # III	25%
Report 4	100 points	Laboratory Project	30%
Report 5	300 points		
<b>Total for Project</b>	<b>1000 points</b>	<b>TOTAL</b>	<b>100%</b>

**Grading Scale:**

The following grading scale will be used in my class:

**A** (91–100 ), **BA** (86–91 ), **B** (81 – 86), **CB** (76 – 81), **C** (71 – 76), **DC** (66 – 71), **D** (60 – 66), **E** (below 60).

Attendance at all examinations is mandatory and no make-up exams will be given. All examinations will be graded on a numerical scale. At the end of the semester, the grades will be added up for all the examinations and the lab (with the appropriate weights) and then converted to a letter scale to determine the final course grade. In order to receive a course grade of ‘C’ or better, the student must pass (a grade of D or higher) in all 3 examinations. A student will receive an ‘E’ in the course if they fail in all 3 exams.

**Performance Criteria<sup>2</sup>:**

- Objective 1. Know how to correctly apply the various tools and techniques used in the designing of manufacturing and service facilities [I, II, III, 1, 2, 3, 5].
- Objective 2. Become familiar with the various types of material handling and storage equipment and be able to evaluate and design material handling systems [III, 1, 3, 5].
- Objective 3. Be able to conduct a detailed financial justification for newly designed/modified facilities [II, 4].
- Objective 4. Be able to design a new facility and prepare a detailed project report [1, 2, 3, 4, 5].

<sup>2</sup>Numbers in brackets refer to the method of evaluation (Roman numerals refer to examination numbers and Arabic numerals refer to laboratory report numbers).

**Academic Honesty:**

You are responsible for making yourself aware of and understanding the policies and procedures in the Undergraduate and Graduate Catalogs that pertain to Academic Honesty. These policies include cheating, fabrication, falsification and forgery, multiple submission, plagiarism, complicity and computer misuse. [The policies can be found at <http://catalog.wmich.edu> under Academic Policies, Student Rights and Responsibilities.] If there is reason to believe you have been involved in academic dishonesty, you will be referred to the Office of Student Conduct. You will be given the opportunity to review the charge(s). If you believe you are not responsible, you will have the opportunity for a hearing. You should consult with your instructor if you are uncertain about an issue of academic honesty prior to the submission of an assignment or test.

## **IME 4040: PLANT LAYOUT AND MATERIAL HANDLING**

### **List of References and Periodicals**

#### **REFERENCES**

1. Allegri, Theodore. Materials Handling. Van Nostrand Reinhold, 1984.
- \*2. Apple, James. Materials Handling Systems Design. Ronald Press, 1972. [TS180.A66]
- \*3. Apple, James. Plant Layout & Material Handling. Krieger, 1991. [TS178 .A63 1991]
- \*4. Black, J. Temple The Design of the Factory with a Future. McGraw-Hill, 1991. [TS157.B57 1991]
5. Francis, McGinnis, and White. Facilities Layout and Location. Prentice Hall, 1992.
6. Hales, Lee. Computerized Facilities Planning. IIE, 1985.
- \*7. Heragu, Sunderesh, Facilities Design. PWS Publishing, 1997. [TS177.H47 1997]
- \*8. James and Alcorn. A Guide to Facilities Planning. Prentice Hall, 1991. [TS177.J36 1991]
- \*9. Konz, Stephan. Facility Design. Publishing Horizons, Inc., 1985. [TS177.K66 1985]
- \*10. Kulweic, Raymond. Materials Handling Handbook. American Society of Mechanical Engineers and the International Material Management Society. 1985. [TS180.M315 1985]
- \*11. Meyers, Fred. Plant Layout & Material Handling. Prentice Hall, 1993. [TS178.M48 1993]
- \*12. Moore, James M. Plant Layout & Design. McMillan, 1962. [TS155.M692]
- \*13. Muther, Richard. Practical Plant Layout. McGraw-Hill, 1955. [TS155.M7995]
- \*14. Muther, Richard and Haganas, Knut. Systematic Handling Analysis. Management and Industrial Research Publications, 1969. [TS180.M8]
15. Muther, Richard. Systematic Layout Planning. Cahners Books, 1974.
- \*16. Reed, Ruddell Jr. Plant Layout: factors, principles, and techniques. Richard Irwin, Inc., 1961. [TS155.R36]
- \*17. Sule, D.R., Manufacturing Facilities: Location, Planning, and Design. PWS Publishing Co., 1988. [TS177.S84 1988]
- \*18. Sule, D. R., Logistics of Facility Location & Allocation, Marcel Dekker, 2001. [HD58.S85 2001]
- \*19. Tompkins and Smith. The Warehouse Management Handbook. McGraw-Hill, 1988. [HF5485.W351988]
- \*20. Tompkins, White, et. al. Facilities Planning. Wiley, 2003. [TS177.F324 2003]
- \*21. Tompkins and Harmelink. The Distribution Management Handbook. McGraw-Hill, 1994 [HF5415.7.D572 1994]
- \*22. Tompkins, James A. Winning Manufacturing : The How-to Book of Successful Manufacturing. McGraw Hill, 1990. [TS155.T57 1990]
- \*23. Materials handling and storing. U.S. Dept. of Labor (Occupational Safety and Health Administration), 1998. [L35.2:M 41/2/998]

#### **PERIODICALS (Housed in Waldo Library)**

- \*1. Modern Materials Handling [TS149.M63]
- \*2. Material Handling Engineering [TS149.F45]
- \*3. Plant Engineering [TS155.A1 P53]

\* Available in Waldo Library [call number is shown in parenthesis]