

IME 414: MATERIAL HANDLING AND FACILITIES DESIGN
IME 434: MATERIAL HANDLING AND FACILITIES DESIGN LAB

Fall 2000

MW 8:00 - 8:50 p.m.
T 10:00 a.m. – 1:00 p.m.

Catalog Description: This course (IME 414), with the lab (IME 434), 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.
Prerequisites: IME 205, IME 310, IME 316, IME 416 or taken concurrently.

Textbook:

1. Sule, D.R., Manufacturing Facilities: Location, Planning, and Design, (Boston: PWS Publishing Co., 1994, Second Edition).
2. Bafna, K.M., IME 434 Lab Manual, Fall 2000.

References: A list of references and periodicals is attached.

**Instructor/
Coordinator:**

Name: Dr. Kailash M. Bafna, Professor
Office: 2015 Kohrman Hall
Phone: (616) 387-3732
Email: kailash.bafna @ wmich.edu
Office Hours: MW 9:00 – 11:00 a.m., T 9:00 – 10:00 a.m.

Long Term Behaviors:

In the future, students completing this course can:

1. Be used to coordinate the location and design of a complex new facility of any kind.
2. Be used to find solutions to any problems resulting from the movement of materials, people, and information in manufacturing and service related facilities.
3. Be used to improve the efficiency of any manufacturing or service system.

Prerequisites by Topics:

1. Work methods design and flow charts (IME 205).
2. Income statements, depreciation, taxes, time value of money, cash flow analysis, and rate of return (IME 310).
3. Methodology for preparing a good technical report (IME 316).
4. Forecasting and scheduling procedures (IME 416).
5. A working knowledge of WORD, EXCEL, and AUTOCAD software.

Course Objectives¹:

At the end of the semester, the student should:

1. Become very familiar in the use of all the tools and techniques needed to plan, analyze, and design new or modify existing manufacturing and service facilities (a, c, e, k).
2. Be able to use current methodology to evaluate and design material handling and storage systems (a, c, e, k).
3. Be able to use quantitative procedures for locating single and multiple facilities (e).
4. Become familiar with the procedures to plan and conduct a market analysis (b, j).
5. Be able to conduct a financial analysis for a newly designed/modified facility for economic justification (b).
6. Be able to prepare a written project report for a newly designed/modified facility (f, g).

¹ Letters in parentheses at the end of each objective refer to the ABET 2000 Engineering criteria.

Lecture Schedule:

| <u>DATE</u> | <u>TOPIC</u> | <u>CHAPTER</u> |
|-------------|---|----------------|
| 8-29 | Introduction to Course | |
| 8-30 | Product Development | 2 |
| 9- 4 | NO CLASSES--LABOR DAY | |
| 9- 5 | Product Development | 2 |
| 9- 6 | Manufacturing Processes | 3 |
| 9-11 | Manufacturing Processes | 3 |
| 9-12 | <i>Instructions for Lab # 1</i> | |
| 9-13 | Production Charts and Systems | 5 |
| 9-18 | Production Charts and Systems | 5 |
| 9-19 | Selection of Machines and Labor | 6 |
| 9-20 | Selection of Machines and Labor | 6 |
| 9-25 | Selection of Machines and Labor | 6 |
| 9-26 | <i>Instructions for Lab # 2</i> | |
| 9-27 | Support Facilities and Space Requirements | 7 |
| 10- 2 | Support Facilities and Space Requirements | 7 |
| 10- 3 | EXAMINATION # I | 2-6 |
| 10- 4 | Plant and Office Layout | 12 |
| 10- 9 | Plant and Office Layout | 12 |
| 10-10 | <i>Instructions for Lab # 3</i> | |
| 10-11 | Material Handling Principles | 8 |
| 10-16 | Material Handling Principles | 8 |
| 10-17 | Material Handling principles | 8 |
| 10-18 | Material Handling Equipment Selection | 9 |
| 10-23 | Material Handling Equipment Selection | 9 |
| 10-24 | <i>Instructions for Lab # 4, Financial Analysis</i> | 15 |
| 10-25 | Packaging, Storage and Warehousing | 10, 11 |
| 10-30 | Storage and Warehousing | 11 |
| 10-31 | <i>Instructions for Lab # 5</i> | |
| 11- 1 | Storage and Warehousing | 11 |
| 11-6 | Computer Aided Plant Layout | 13 |
| 11-7 | EXAMINATION # II | 7-12 |
| 11-8 | Plant Site Selection | 15 |
| 11-13 | Basic Facility Location | 17 |
| 11-14 | Work on Lab # 5 | |
| 11-15 | Basic Facility Location | 17 |

| <u>DATE</u> | <u>TOPIC</u> | <u>CHAPTER</u> |
|-------------|--|----------------|
| 11-20 | Location with Fixed Costs | 18 |
| 11-21 | Location with Fixed Costs | 18 |
| 11-22 | Location with Fixed Costs | 18 |
| 11-27 | Continuous Facility Location | 19 |
| 11-28 | Continuous Facility Location | 19 |
| 11-29 | Course review | |
| 12- 4 (Mon) | COMPREHENSIVE EXAMINATION # III (8:00 – 10:00 a.m.) | |

Laboratory Schedule:

Report 1: Product, Manufacturing, and Flow Analysis (due Monday, 9-25)

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. Operation process chart
6. Material and parts requirement list
7. Package design
8. Unit load design

Report 2: Machine & Space Requirements (due Monday, 10-9)

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

Report 3: Preliminary Layout (due Monday, 10-23)

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, 10-30)

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 Monday, 11-20)

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

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.

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 | | |
| Total for Project | 1000 points | TOTAL | 100% |

Grading Scale:

The following grading scale will be used in my class:

A (91 – 100), **BA** (88 – 90), **B** (81 – 87), **CB** (78 – 80), **C** (71 – 77), **DC** (68 – 70), **D** (60 – 67), **E** (below 60).

Attendance at all exams 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.

Performance Criteria²:

- 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 [II, III, 3, 5].
- Objective 3. Calculate the location of single and multiple facilities using mathematical analysis techniques [III].
- Objective 4. Know the basic procedures for conducting a market analysis [I].
- Objective 5. Be able to conduct a detailed financial justification for newly designed/modified facilities [II, 4].
- Objective 6. Be able to prepare a detailed project report [1, 2, 3, 4, 5].

²Numbers in brackets refer to the method of evaluation as listed in the previous section (Roman numerals refer to examination numbers and Arabic numerals refer to laboratory report numbers).

IME 414: MATERIAL HANDLING AND FACILITIES DESIGN

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.
 - *3. Apple, James. Plant Layout & Material Handling. Krieger, 1991.
 4. Black. The Design of the Factory with a Future. McGraw-Hill, 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.
 8. James and Alcorn. A Guide to Facilities Planning. Prentice Hall, 1991.
 - *9. Konz, Stephan. Facility Design. Publishing Horizons, Inc., 1994.
 - *10. Meyers, Fred. Plant Layout & Material Handling. Prentice Hall, 1993.
 - *11. Moore, James M. Plant Layout & Design. McMillan, 1962.
 - *12. Muther, Richard. Practical Plant Layout. McGraw-Hill, 1955.
 - *13. Muther, Richard and Haganas, Knut. Systematic Handling Analysis. Management and Industrial Research Publications, 1969.
 14. Muther, Richard. Systematic Layout Planning. Cahners Books, 1974.
 - *15. Reed, Ruddell Jr. Plant Layout. Richard Irwin, Inc., 1961.
 - *16. Tompkins and Smith. The Warehouse Management Handbook. McGraw-Hill, 1988.
 - *17. Tompkins, White, et. al. Facilities Planning. Wiley, 1996.
- * Available in Waldo Library

PERIODICALS (Housed in Waldo Library)

1. Modern Materials Handling
2. Material Handling Engineering