

IEE 4010: Entrepreneurial Engineering III

Catalog Description: This course explores how traditional industrial engineering topics such as supply chain management, facility layout and location are relevant to entrepreneurial engineers. The course prepares students to effectively practice entrepreneurial engineering. *Prerequisite:* IEE 3010; 3 hours (3 – 0)

Textbook: *Dr Azim Houshyar Notes.*

Course Coordinator and Instructor: Dr. Azim Houshyar

Course Overview: Entrepreneurial Engineering III is a project-based capstone course. As your third course in Entrepreneurial Engineering and a capstone experience, the course is meant to serve an integrative role, bringing together all the pieces and parts of your undergraduate IEE education. This is a course on implementation. The central focus will be on a project, where you not only have to come up with an innovative concept or idea, but you have to meet the test of implementation. You will also be responsible for addressing implementation issues as they apply to a series of cases.

Course Learning Objectives: The course is designed to accomplish a number of objectives over the next fifteen weeks. In particular the following four topics will be discussed:

1. *Understanding the tools and techniques of designing and planning a new facility*
2. *Using mathematical models to find the optimum location of a facility in the supply chain*
3. *Gaining a better understanding of the logistics and supply chain management.*

Relationship of Course Objectives to Performance Criteria and Student Learning Outcomes:

Course Objectives	Performance Criteria ¹
Acquire competence in Entrepreneurial engineering.	L2. Develops financial analyses and business plans, market strategy, pricing strategy.
Understand the tools and techniques of designing and planning a new facility	C3. Develops appropriate design parameters (use, dimensions, economics, life cycle) considering identified constraints and criteria.
Gaining a better understanding of the logistics and supply chain management	J4. Assess the possibility of entering a global marketplace.

Evaluation: Your grade in this class will be based primarily on your demonstrated grasp of the material and ability to think entrepreneurially. If you ever have any question as to what this means in your assignments, ask the instructor immediately. The instructor also will expect you to challenge him throughout this class in deepening your understanding of the entrepreneurial process. There is almost nothing you cannot ask the instructor. Your final grade will be based on the following:

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| 1) Quiz (12%)/Assignments (8%)/Active Class Participation (5%) | 25% |
| 2) Term Project and Case Studies | 25% |
| 3) Midterm Assessment | 25% |
| 4) Final Assessment | 25% |

Grading Scale:	93 – 100	A	88 - 92	BA
	83 - 87	B	78 - 82	CB
	73 - 77	C	68 - 72	DC
	60 - 67	D	Below 60	E

Attendance Policy: Attendance is *mandatory*. The student will receive a score of zero for any assessment item not submitted because of absence. This includes the assignments, presentations, projects, tests, and the final exam. Extreme circumstances will be considered on an individual basis.

Academic Honesty Policy: (Same as the university's policy). 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.

Class Contribution: In this course, you learn more from one another than from any other single source. You will be expected to make a meaningful and substantive contribution to the learning experience of your fellow students. This means coming to class prepared, answering questions posed by the instructor, raising questions, sharing your professional experiences, voicing opinions, and so forth. *Attendance is not participation.* Your active participation in the class discussion is absolutely **ESSENTIAL**.

The course will involve a discussion format with extensive interaction between students and the instructor. The teaching style will mix core content with practical applications. Students will be challenged to grasp a concept or idea, relate it to other concepts, and then apply it in real-world entrepreneurial contexts.

Homework/Case studies/Project: Homework assignments and case studies are to be turned in at the beginning of lecture on the day they are due. Assignments will be announced in the class. *Late submissions will not be accepted! You will receive a score of zero for each assignment that you fail to turn in at the specified time.* If you use software to solve a problem you must submit sufficient documentation to illustrate your approach to the problem, along with the appropriate output to justify your results. (Note: Only one copy of the written report is necessary for each team). Every submission should be accompanied by an electronic submission (before 10:00 am) on the submission due date. Use *IEE 4010-Ch xx- Team X.docx* for your submission.

Assessment: The assessments will be administered during the lecture period on the days indicated in the schedule. You are responsible for the material up to the day of the assessment. Each assessment could consist of interim report on the project as well as questions and problems.

Term-Project: Facilities Planning and Logistics Group Project

The heart and soul of this course is the project. There will be a lot of coordination between this course and IEE 2010, IEE 3010 and IEE 4160. As such, you *may* choose the same team members that you have in IEE 4160. You are expected to use the knowledge gained in the course and IEE 4160 to design and develop the facility that can be used to produce the product of your choice. You may choose the same product that you designed in IEE 3010 (if there is enough complexity in the product to warrant the selection as per my approval, and you and your team feel comfortable with the selection); otherwise I will assign you one or two product(s) and you will be assumed to take ownership of those products. The selected product(s) then becomes the focal point of the semester project.

The project involves taking your own product and:

- 1. Designing a facility that can be used to economically manufacture your product in a commercial, non-profit or public context.*
- 2. Locating the optimum location of the facility as related to the supply chain.*
- 3. Writing a Detailed Business Plan for the project.*

Criteria Used for Grading the Semester Project: Below is a set of criteria for assessing the extent to which you successfully implemented a business idea or concept that is your own creation.

- 1. Forecast the demand for the product, based on your market share in the next 3, 5 and 10 years.*
- 2. Calculate the number of machinery and equipment, the resources, and the space needed to produce the product now and ten years from now.*
- 3. Identify the optimum layout of the facility and plans for expansion to accommodate future demand.*
- 4. Identify the types of material handling systems needed to handle all aspects of material movement in, within, and out of the facility*
- 5. Locate the optimum site to house the facility*
- 6. Categorize the cost of building this facility, and identify a potential funding agency that may be interested in raising a substantial sum of outside capital.*
- 7. Write a comprehensive business plan.*

To assist you with the semester project (which requires a lot of time to be completed), you will be asked to submit three interim reports, each focusing on a segment of the overall project. The grading on each report is based on the quality of your analysis and the completeness of your report. You will receive a grade that shows your rank as compared to the best report submitted by the class. In addition, ***if your report is found not to be acceptable, then you WILL be required to rewrite the report, before proceeding to the next phase.***

Oral and Written Presentations: Students will present their final projects orally during the previously announced sessions. These will be formal PowerPoint presentations lasting 10 minutes each, followed by Q&A. Students will also submit a final written report summarizing their projects and the related implementation issues. This write up should be a formal plan, and must have a section summarizing how things were actually implemented. Personal reflections on the project must also be included in the final report. More detail description of the Semester Project, Due Dates and Expectations is in the attached document.

Topics and Schedule

Please note that the topic schedule is a guide only; sometimes we will spend a little longer on one topic and a little less on another. The test and final exam times will occur on the dates listed, however, content of the tests may be altered based on the material covered prior to test time.

We will try to follow the schedule listed below:

Week 1	Introduction to Facilities Planning and Design	Chapter 1
Week 2	Product and Equipment Analysis	Chapter 2
Week 3	Product and Equipment Analysis (<i>continued</i>)	Chapter 2
Week 4	Process and Material Flow Analysis	Chapter 3 * Will be collected for ABET (L3)
Week 5	Personnel Space Requirements	Chapter 4 * Will be collected for ABET (L3)
Week 6	Material Handling	Chapter 5 * Will be collected for ABET (L3)
Week 7	Traditional Approaches to facilities Layout	Chapter 6 * Will be collected for ABET (L3)
Week 8	Computerized and Software Layout Problems	Chapter 7
Week 9	First Test	* Will be collected for ABET (J4)
Week 10	Storage & Warehousing	Chapter 8
Week 11	Group Technology Algorithms	Chapter 9
Week 12	Basic Models for the Location Problems	Chapter 10
Week 13	Basic Models for the Location Problems (Continued)	Chapter 10
Week 14	Team Presentation on the Term Project “Facilities Layout and Location”	
Week 15	Final Test	

IEE 4010: Semester Project Requirement Guidelines

Students are teamed-up in-groups of three. By the time you enroll in IEE 4010, you are expected to have identified a product (*the one you prototyped in IEE 3010*). In this course, you may decide to design a facility that can be used to manufacture that product, or the instructor may give you one or two product(s) of his choosing. The semester project will consist of three interim reports.

First Report (Supporting Drawings and Forecasting Demand):

This report consists of two parts:

1. In the **1st Part of 1st Report** you are expected to list all the components of the product (*i.e., part list and bill of material*), decide whether to build or procure each component, and construct the component drawings (*exploded view*). Next, you should construct the **route sheet**, **operation process chart**, **assembly chart** and any other supporting chart that will help you lay out your facility as efficiently as possible. At a minimum the this report should include:
 - A clear and concise definition of the product, its main functions, and specification
 - A comprehensive **Bill of Material** and **Part List** stating *part #, part name, drawing #, material, size*, and the *quantities used per final product*.
 - A Complete list of **Purchased Parts** along with a clear justification for each purchase decision.
 - As many **Route Sheets** as needed, stating *operation #, operation description, machine type, tooling and supplies, setup time*, and *operational time*.
 - A comprehensive list of the **Equipment** needed to perform the needed operations, identifying the *manufacturer*, the *price*, and the technical specification of the machine (*size, useful life, production rate, scrap rate, manpower needed*, etc).
 - An **Operation Process Chart**, identifying all the *operations, assemblies* and *inspection* performed to manufacture the product.
 - An **Assembly Chart**, identifying all the *assemblies* and *inspection* performed to manufacture the product.
 - Any other supporting material needed by the process engineer to get a clear picture of the how to manufacture the product.
2. In the **2nd Part of 1st Report** you should use a comprehensive approach to **forecast the demand** for your product (locally, nationally, internationally, weekly, monthly, and yearly). At a minimum this report should include:
 - A clear and concise list of all your *assumptions* and *justifications*.
 - A complete list of all the *raw data* that you used to make your forecast, and the *source of the data*.
 - A *graphical representation* of the data.
 - A complete list of *forecasting methods* used and the *corresponding accuracies*.
 - A clear justification for the *preferred forecast method*, and your *best five year forecast*.
 - A clear and concise risk analysis used to study the *impact of variations in demand* on your business, and your approach to handling such variations.

Second Report (Production-area Space and Total Space Calculation and Material Handling):

This report consists of two parts:

1. In the **1st Part of 2nd Report** you should calculate the required production space for your facility. To do so, you need to specify the required number of machinery and equipment, the required space per workstation, and the overall required space for the production area. At a minimum this report should include:
 - A clear statement of the **Operational Time** for the facility per day/week/month and year, and the corresponding justification.
 - An analysis of the **Number of Machines** needed based on their production rate and historical scrap rate. Justify your expansion plans for the next five years, and its impact on the number of equipment to be purchased at the startup time.
 - A clear analysis of the **Space** needed for each **Workstation**, along with the corresponding **Layout**. You must clearly list all the items that are needed for the workstation to perform properly, the corresponding space, and position in the layout of the workstation.
 - A decision on the **Type of Layout** used in your facility, and the rationale.
 - A detailed description of the optimization procedure used to find the **Best Layout** for the production area. Your layout must clearly show the overall dimensions, the location and sizes of the aisles, and the each workstation in relation to others.
2. In the **2nd Part of 2nd Report** you should identify all the non-production areas needed for the proper operation of the facility (the receiving area, the shipping area, the administration offices, tool room, tool crib, locker rooms, etc). Furthermore, you should investigate the most efficient material handling system needed to handle product movement throughout the facility (within the receiving area, production area, shipping area, and between these areas). At a minimum this report should include:
 - A complete list of all the **Non-production Areas** that you need in support of your production system.
 - You need to identify the number of required docks and the access roads to the facility.
 - A clear analysis of the **Space** needed for each of the areas, along with the corresponding **Layout**. You must clearly list all the items that are needed in that location, the corresponding space, and position in the layout of the area.
 - Basically, you **MUST** draw the layout of the non-production area, and using qualitative measuring, identify the relationships between these non-productive areas, then use computerized facility layout to generate several good layouts, and pick the best one.
 - Then you must add your personal objectives to improve upon the quality of the computer generated layout.
 - You may want to include your production area (already calculated in the previous report) as one department in relation to all non-productive areas of the facility.
 - Finally, you should investigate the most efficient material handling system needed to handle product movement throughout the facility (*within the receiving area, production area, shipping area, and between these areas*).

Third Report (Location Analysis and Final Report):

In this report you should put together the findings of the previous reports to produce a layout of the facility showing the position of each department in the facility. Furthermore, you should identify the **Best Location** of the facility based on subjective and objective analysis. In addition, you should perform a very detailed **Financial Analysis**, showing the total capital cost of building the facility, the cost per unit production, and the sales, price per unit, markup used in the analysis, and profit/loss for the first five years of production. At a minimum this report should include:

- An overall layout of the facility with the overlaying movement of material and personnel.
- A detailed qualitative and quantitative analysis of the **Best Location** to house your facility.
- A comprehensive **Financial Analysis** showing the performance your business in the first five years of operation.
- A detailed **Business Plan**, **Marketing Plan**, and **Pricing Plan** that is professional enough to be submitted to a financial source for funding propose.

The grade for each report is based on the complexity of the production system, the elegance and completeness of the analysis model, and the quality of the written report and oral presentation. If the team chooses to produce their own product, they are expected to adhere to this guideline. The production facility should involve:

1. A product with a minimum of 10 components using at least 10 different machines
2. A minimum of 5 different types of material handling systems
3. A minimum of 30 employees
4. A minimum of one locker room and an eating area
5. A minimum of 4 types of administrative office
6. A minimum of 2 docks for receiving/shipping area

Each team should submit five reports along with a disk-copy of the report and supporting material. The proposed due dates are selected so that you will not be overwhelmed with submitting a comprehensive report for the whole project at the end of semester. The nature of the reports and the corresponding due dates for these reports are as follows:

1. **Report 1: Supporting Drawings& Forecasting Demand**
2. **Report 2: Space Calculation for Production and non-production-area & Material handling**
3. **Report 3: Financial Analysis, Location Analysis and Final Report**
4. **Final PowerPoint Presentation**

Final PowerPoint Presentation: Each team will have 10 minutes to present their project to the class and answer questions and concerns. The presentation should include:

1. Description of the product
2. List of machines and material handlers
3. List of personnel and their responsibilities
4. List of different departments of the facility and corresponding space
5. Most efficient layout of the facility with overlaying material and personnel flow
6. Cost of building the facility
7. Site Analysis
8. Business Plan.

*** The final Report will be collected for ABET (C4)**