



IE 450 Industrial Facility Design 3(3, 1, 1) Second Semester 1439- 1440 H (2018/2019G)

Instructors: Prof. Abdulaziz M. Al-Tamimi Office: 2A 106/1
Prof. Emad Abouel Nasr Office: 2A 118

Course Description

The course aims to provide the knowledge and skills to design and evaluate an industrial facility capacity, space areas, and layout plan. It gives the design of subsystems of the plant such as material handling and storage system. Also, the course provides the techniques for computerized layout and location problem analysis.

Course Objectives

By the end of the course, each student should be able to:

- 1) Recognize the strategic planning concept for industrial facility and the design stages
- 2) Demonstrate ability of applying basic knowledge of design techniques in analyzing and design of facility
- 3) Analyze product data to estimate production volume and develop product specifications
- 4) Design manufacturing process and calculate factory the capacity (machines, material, and labors).
- 5) Construct the facility departments and calculate their areas
- 6) Analyze and design material handling and storage system
- 7) Design facility layout plan
- 8) Recognize the techniques and types of computerized layout
- 9) Analyze location problems and site selection

Course Learning Outcomes

Code #	NQF Learning Domains And Course Learning Outcomes	Course Teaching Strategies	Course Assessment Methods
1.0	Knowledge		
1.1	Identify and Recognize the concept of facility context, design phases, strategic planning @ 1.2	Lecture, Tutorial, group learning,	Assignments, group reports, Quizzes. Midterms
2.0	Cognitive Skills		
2.1	Analyze product data to estimate production volume, Design manufacturing process, and calculate factory capacity (machines, material, and labors), @2.1, 2.3	Lecture, Tutorial , group learning, project work	Assignments, group reports, Quizzes. Midterms
2.2	Develop facility departments areas and design, and layout <u>planning@2.3, 2.4</u>	Lecture, Tutorial, l group learning, project work	Assignments, group reports, Quizzes. Midterms Final exam
2.3	Analyze location problems and site selection@2.1, 2.4	Lecture, Tutorial, group learning, project work	Assignments, group reports, Quizzes. Midterms Final exam
3.0	Interpersonal Skills & Responsibility		
3.1	Evaluate facility design and layout plans demonstrating the ability to work effectively in a team @ 3.2	Project report, Participation of students in discussions	Presentation, report
4.0	Communication, Information Technology, Numerical		
4.1	Show ability to communicate and lifelong learning @4.1,4.2	Project report, Participation of students in discussions	Presentation, report

Required Text

1. Facility Planning, Tompkins, J & White J., John, Wiley & Sons.
2. Manufacturing Facility Design and material handling, F.E. Mayer, M.P. Stephen, Prentice Hall.

References

- 1- Manufacturing Facility: Location, Planning and Design, Sule, D.R.; PWS –Kent, latest edition.
- 2- Plant Layout and Material Handling, Apple, J.M., John Wiley & Sons, latest edition.
- 3- Systematic Planning of Industrial Facilities, Muther and Hales, latest edition.
- 4- Facility Layout and Location, Francis, White, Prentice Hall, latest edition.



Grading

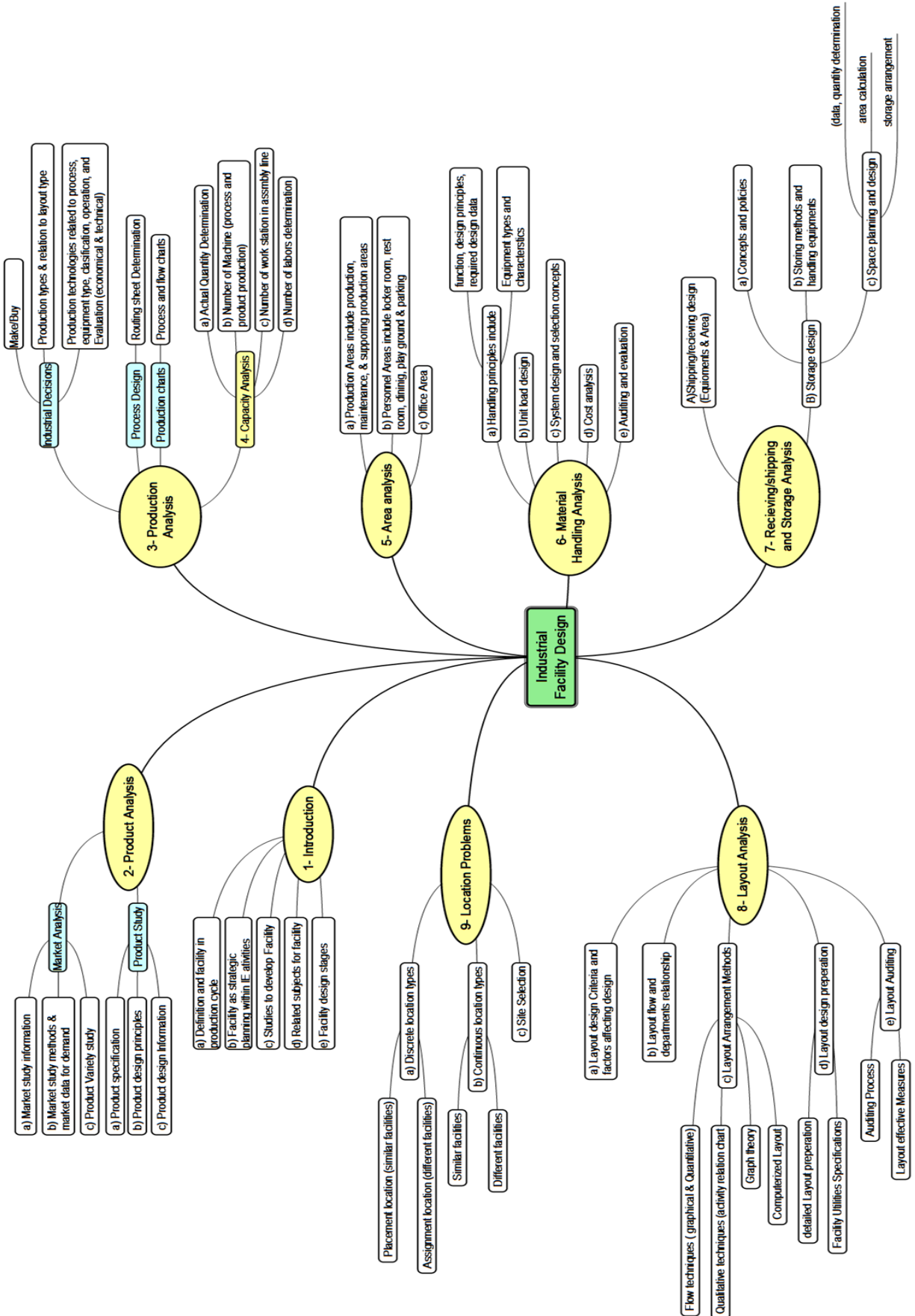
	Assessment task (e.g. essay, test, group project, examination, speech, oral presentation, etc.)	Week Due	Proportion of Total Assessment
1	Midterm	10th week Saturday at 10:00AM	15%
3	Design Project Report and Presentation	(Continual evaluation every 3 weeks and final assessment in 15th week)	15%
4	Two Quizzes	Weeks 5 and 14 (Saturday at 10:00AM)	15%
5	Industrial visit reports	15th week	10%
6	Participations & Homework	During semester	5%
7	Final Exam	As scheduled by the registrar	40%

Remarks

- ❖ **Student fails to attend at least 75%, will be barred from final exam. No excuses will be accepted by me. Any official excuses should be given within two weeks.**
- ❖ **Please attend class within the first 3 min of the beginning of the class. Student attends later, will not be allowed to enter the class.**

Topics to be covered and schedule

Week	Topic	Text Book	Exercise	project	Quiz/Exam	Plant visit
1)	Introduction to course;	Notes, CH 1 Tompkins		Project Selection		
2)	Product Analysis	Notes, CH 2 Tompkins	1			
3)	Production Analysis	CH3 Tompkins	2			
4)	Capacity Analysis	CH 4, 5 Tompkins; Notes	3			
5)			EV1	Quiz 1 (1,2,3)		
6)	Space Determination	CH 6 Tompkins	4			
7)	Material handling	CH 9 Tompkins; Notes	5, 6			
8)						
9)	Storage Analysis	CH 6,9,12 Tompkins; Note	7	EV2		
10)	Layout Analysis	CH 4,7,13,14 Tompkins, Notes	8		Midterm 1 (4-9)	
11)						V
12)	Location Analysis	CH 12 Tompkins; Note	9	EV3		
13)						
14)	Revision				Quiz 2 (10-13)	
Project submission		Project Evaluation				



IE 301 Guidelines for Semester work activities

A) Industrial Visit Reports [10 marks]

When you visit a factory, it is required to study the components related to industrial activities that take place during the production cycle Production Cycle as shown in figure (1) to produce goods and technical services.

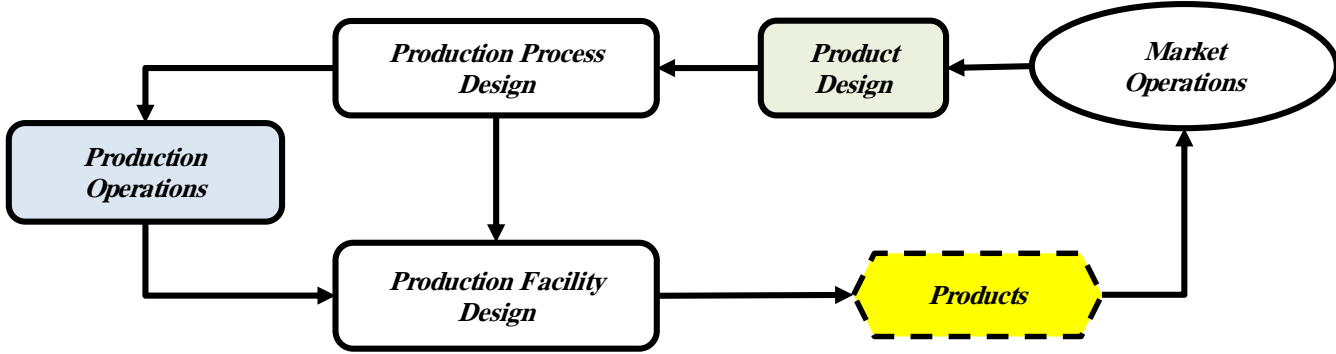


Figure (1) Production Cycle

Then a report should include the following: ثم إعداد تقريراً يشمل المحتويات التالية:

1-General Information (5P)

- Brief history and location (1 p)
- Factory management and organization structure (you should **discuss briefly** the management structure and the relation between the departments) (3 p)
- Labors specializations and wage system (1 p)

2-Product Information (8P)

- Product types, items (3 p)
- Raw materials and materials of the product (3 p)
- Market share and product pricing (2 p)

3-Factory Operation (12P)

- Product design, specifications, and standards (8 p)
- Production plans, schedule, and control (i.e. production rate) (2 p)
- Operation and organizing of store and warehouse (2p)

4-Production Methods (25P)

- Production mode and industrial characteristics (specialization, simplification, standardization, flexibility, and integration, etc.) (2 p)
- Production operations (processes, assemblies, handling, inspection, etc.). Simple **process outline chart** is required. (7p)
- Production equipment (types, level of automation, manning requirement, etc.) (4 p)
- Material handling equipment (types, level of automation, etc.) (4 p)
- Quality operations and equipment (method of inspection, equipment, control, etc.) (4 p)
- Storing system equipment (types, pallets, racks, etc.) (4 p)

5-Factory Design And Layout (30P)

- Factory layout **showing the production flow** (10 p)
- Production, services and management Department's areas and locations. (10 p)
- Factory design characteristics and specifications showing Building utilities and factory services (height, lighting, accesses, aisles, waste disposal, construction, ventilation, security, electricity, etc.) (10 p)

6-Related facilities in the factory (8P)

- Maintenance operation and facilities (2 p)
- Safety system and environmental control (2 p)
- Waste management and facilities (2 p)
- Any other supporting facilities (2 p)

7-Factory Evaluation (8P)

- Evaluation of factory design such as (1) layout – (2) flow – (3) material handling – (4) building quality – (5) equipment – (6) safety and environment (6p)
- Evaluation of industrial characteristics (specialization, simplification, standardization, flexibility, and integration, etc.) (2p)

8-Conclusion (4P)

Concluding remark and observation about:

- the factory design and its characteristics
- General remarks on the product variety, flow of production, work density, safety, waste disposal, etc.

1- معلومات عامة عن المصنع

- تاريخ وكيفية إنشاء المصنع وموقعه
- إدارة المصنع والهيكل التنظيمي والأقسام الموجودة (تسويق-مشتريات- مبيعات- إدارة إنتاج- صيانة-إدارة الجودة- وغيرها)
- العمالة وتخصصاتها ونظام الأجور والمكافآت

2- معلومات عن المنتج

- تصميم المنتجات وأنواعها والمواصفات الفنية والقياسية
- المواد المستخدمة الأولية ونصف مصنعة
- حجم السوق ودراستها وسعر المنتجات

3- معلومات عن تشغيل الإنتاج

- فترات التشغيل وكمية ومدلات الإنتاج
- أساليب التخطيط والرقابة على الإنتاج
- تنظيم المستودعات والتحكم في المخزون

4- معلومات عن وسائل الإنتاج

- نمط الإنتاج والتقنية المستخدمة
- أساليب تصميم العمل وعمليات الإنتاج (تحويلية- تجميعية- تحضيرية-معالجة- فحص-تعبئة)
- معدات عمليات الإنتاج المستخدمة والعدد والأدوات المستخدمة
- معدات المناولة المستخدمة للمواد والمعلومات والأفراد
- أساليب فحص المنتج ومكوناته وطرق رقابة الجودة ومعدات القياس
- أساليب ومعدات المخازن

5- معلومات عن مخطط المصنع

- مخطط المصنع ومسار الإنتاج في المصنع
- مواقع ومساحات أقسام الإنتاج والتخزين والمساندة كالجودة والصيانة وإدارة الإنتاج وغيرها
- مواقع ومساحات أقسام الإدارة التصميم والمالية والتسويق وغيرها
- مواصفات مخطط المصنع والمباني (خدمات المبنى من إضاءة ومرمرات والإنشاءات والتبوية والأمن والكهرباء والمخرج)

6- معلومات عن الأعمال المرتبطة بالمصنع

- أساليب ووسائل السلامة وحماية البيئة
- أساليب ووسائل الصيانة
- أساليب إدارة النفايات والخردة
- المبنى والخدمات والمنافع المستخدمة وأي تسهيلات أخرى

7- تقييم خصائص المصنع والنتائج المستخلصة

- خصائص تصميم المصنع مبنياً على عدة خصائص مثل (المخطط - المسار - مناولة المواد - جودة المبنى -)
- الخصائص الصناعية (التخصص- التبسيط- التوحيد والتوصيف القياسي- التكامل) للمعدات والمنتجات والإنتاج والإدارة

8- خاتمة

- ملاحظات عن تصميم المصنع وخصائصه
- ملاحظات عن المصنع (تنوع المنتجات- أساليب الإنتاج- تصنيف الجودة- حركة الإنتاج- المستودعات- كثافة العمل- حجم المصنع- التخلص من النفايات- أي ملاحظات عن الأعمال المرتبطة بالمصنع)

B) Project Guidelines

a) Guideline for project selection

- Compose a dynamic team who has diverse knowledge in (market targeting, technical and task analysis).
- Select a leader who can direct the team toward successful product development.
- Select a material good product (commodity) not a service.
- The product should be evident of existence in the market and there is a need for it.
- The product should be an attractive opportunity for business; however, may not high economic potential.
- The product could be produced and technologically applicable.

b) Project Grading

Evaluation	Unit 1	Unit 2	Unit 3	Final Marks	
Continual evaluation (written & oral)	100	250	350	700→	7
Report content (writing skill (style, organizing & formation)	130	320	550	1000→	10
			Total	1700→	17

c) Guidelines for project activities

Part (1) Product analysis [130 marks]

- 1.1. **Product description [20P]:** provide a brief description of the product. Include the following:
- A) The product function, product importance and needs. **[5]**
 - B) Product use, variety and targeted customers. **[5]**
 - C) Standards related to the product. **[10]**
- 1.2. **Market analysis [60P]:** determine quantity to be produced. You should carry the following:
- A) Collect history data for **[25]**:
 - a- Collect demand of targeted market (import and export; local producers)
 - b- collect data on product variety sales and its ratio V/G1V/G1
 - B) Find volume of production as follow **[35]**
 - a- forecast future demand, using forecast technique
 - b- calculate the market gap and market share
 - c- find yearly quantity to be produced, and investment opportunity
- 1.3. **Product data [50P]:**
- A) Develop product drawing and specification using reverse engineering for the selected product, find the following:
 - Part list. **[5]**
 - Part structure, provide the level of product parts and subassemblies **[5]**
 - Assembly chart, provide the assembly sequence of the parts **[10]**
 - Assembly drawings / exploded drawing. **[10]**
 - Detailed drawing including all dimensions, material calculating, and any production requirements. **[20]**

Part (2) Production analysis [320 marks]

- 2.1 **Introduction [40P]:** provide the decision to be taken for production. Include the following:
- A) **Make / buy decision:** give a list of the parts to be processed or bought indicating the reasons of this decision **[10]**
 - B) **Technology decision:** provide a list of equipment and their general specification selected for the factory. (Catalogues could be provided). This will be done while carrying out process design section (2.2). **[20]**
 - C) **Mode of production decision:** explain the type of production according to variety and quantity of production. **[10]**
- 2.2 **Process Analysis [90P]:** determine data of the processes sequence and time as follows:
- A) **Production routing sheets:** provide the process sequence to produce the parts. The table should provide general information about the part. Description, equipment, tooling, and times (process, load/unload, setup) and production time should be including in the table. **[50]**

- B) **Operation (outline process) chart:** provide collective chart from assembly and chart and routing sheet. [20]
- C) **Assembly activity table and precedence diagram:** this table provides the assembly process precedence and time. [20]
- 2.3 **Capacity analysis [90P]:** find the size of the facility and material requirement. Determine the following:
- A) **The actual quantities:** the quantities are obtained from volume of production and assuming defect policy, using the operation chart. {You should include all materials required to dispatch product to market}. [30]
 - B) **The raw material requirement:** Find **the shape and size of raw material required** to be delivered to the factory, using actual quantity. [20]
 - C) **The number of production/assembly work stations:** using the actual quantity and production time from routing sheets, the capacity of production is obtained. The actual production rate also can be evaluated. [20]
 - D) **The number of labors:** the required labors and assistants are calculated. [20]
- 2.4 **Material handling analysis [60P]:** find the required handling equipment. carry the following:
- A) **Suggest handling methodology:** explain briefly the method to determine the handling methods and unit load concepts. [10]
 - B) **Handling selection:** describe the handling equipment and unit load to be used. [20]
 - C) **Handling capacity:** calculate the number of containers and handling equipment. [30]
- 2.5 **Supporting production operations [20P]:** develop required supporting facilities as follows:
- A) **Quality facility:** give brief description of the equipment to test the quality and manpower needed. [4]
 - B) **Maintenance facility:** give brief description of the maintenance operation and the required facility to carry proper maintenance; workshops, spare part storage, and manpower. [4]
 - C) **Waste facility:** give brief description of the equipment to get rid of wastes and manpower needed. [4]
 - D) **Safety facility:** give brief description of the safety equipment and systems and manpower needed. [4]
 - E) **Other facility:** any other requirements (such as: computer network, Telephone, etc.) [4]
- 2.6 **Layout planning sheet [20P]:** This sheet represents flow process charts and include all data developed in previous sections

Part (3) Layout analysis [550 marks]

- 3.1 **Introduction [50P]:** provide the following:
- 3.1.1 Organization chart and describe the departments' duty and authority. [25]
 - 3.1.2 The relation between departments should be given with outlining the reason and justification for the relationship. [25]
- 3.2 **Space determination [200P]:** Departments' areas should be determined as follow:
- 3.2.1 Develop production departments' layout and Area. [70]
 - 3.2.2 Develop storage/warehouse & receiving/shipping departments' layout and Area. [70]
 - 3.2.3 Find office areas. [30]
 - 3.2.4 Find all other areas required to be included in the layout; such as quality, maintenance, parking, personnel, etc. [30]
- 3.3 **Arrangement analysis [80P]:** find initial arrangement between departments. carry the following:
- 3.3.1 Develop the relationship (from-To) matrix for flow and activities. [40]
 - 3.3.2 Develop arrangement between departments using the methods given [computer use is also encouraged] and check with outline process chart. [40]
- 3.4 **Layout design [120P]:** develop complete layout and specification. develop the following:
- 3.4.1 Detailed layout drawing. [60]
 - 3.4.2 general specifications requirement; such as height, utilities, accesses, etc. [60]
- 3.5 **Cost Analysis [100P]**
You may further carry out cost analysis determine the cost of product, rate of return, capital recovery, etc. This is to be done as separate chapter. Cost data such as of investment, overheads, materials, labors, maintenance etc. should be evaluated. Then pricing and economic benefits should be analyzed.