IE 301 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 having a high likelihood of containing fewer than 10 parts.
- The product should have potential for improvement (A good source of project ideas is to ask business people and user you know what products they would really like to have)
- The product should be evident of existence in the market and there is a need for it (You should have access to more than 3 potential lead users of the product; more than 10 would be better.
- The product should be an attractive opportunity for business; however may not high economic potential.
- The product should require no basic technological breakthroughs (requiring further invention) or any highly proprietary ideas for another context (dealing with sensitive information).

B) Project Grading

Evaluation	Marks
Continual evaluation (written & oral) (Presentation consistency & adequacy & discussion)	11
Report content (analysis)	11
Report writing skill (style, organizing & formation)	3
Total	**25**

C) Guidelines for project activities

Part (1) Product background and project Plan [500 marks]

1.1. Product description [150]

Provide a brief description of the product. This should include the following:

A) Introduction to product function, product importance and needs. **[30]**
B) Product use, variety and targeted customers. **[30]**
C) Product operating principles (scientific idea and technology idea). **[30]**
D) Similar brand name product and specifications. **[30]**
E) Standards related to the product and suggested product specifications. **[30]**

1.2. Existing Product design [250]

Carry product **dissection** for the selected product **using reverse engineering techniques, and** Find the following: [Hint, use lab equipment, tools, and instruments, and camera]

A) CAD drawing for assembly drawings, exploded drawing, and detailed drawing including all dimensions. **[150]**
B) Product decomposition data. This includes: **[100]**
- o BOM including functions and sub-function of the product components, material calculating, and any production requirements.
- o Product structure and assembly chart.
- o Identify the functions and sub-function of the product and its components.

1.3. Project product development plan [100]

Determine the main objectives and feasibility for development and how will be managed. You should carry the following:

A) Define and Prioritize opportunities and assessing development requirement **[25]**
B) Define product development vision, mission, mission statement **[25]**
C) Provide a mission statement for development. **[25]**
D) Provide a Project Plan: team formation and scheduling (Gantt chart) **[25]**

Part (2) Product Development Planning [500 marks]

2.1. Product Needs and Specifications [250]

A) Identifying the customer needs to provide the attribute required by customers. This done as follows: **[100]**

i. Using like/dislike method Gather data, **put a questionnaire**. It has to consist of 20 to 30 questions regarding your product and make gradation of the importance of the point by putting next to it weights from 1 to 5, 1 being not important at all and 5 being most important of all. For example, if you are doing the design of the desk, a possible question can be: Does the color of the desk matter? Yes No, if yes; how important is the color of the desk? 1 2 3 4 5 (These two statements are considered one question)
ii. **Collect answers** from a sample of customers (users, lead users, retailer/ sellers, and service departments.
iii. **Develop customer statements** from collected answers from customers (they may be more or less than the questions asked)
iv. **Develop customer needs** from customers statements(they may be more or less than the statements)
v. Using Kano approach, **Recognize the customer** needs type for satisfaction,
vi. Using affinity diagram method, **Identify needs classification** in terms of engineering characteristics: (1) Material (types and properties); (2) Feature (shape and form); (3) Function (capacity, speed,…); (5) Reliability and durability (product life); (6) Ergonomically (friendly use); (7) Maintainability (ease of maintenance); (8) aesthetic (appearance and look); (9) assembly steps (ease of assembly); (10) cost

B) **Identifying engineering characteristics & metrics (Target Specifications)**, based on the following:

i. **List engineering characteristics** which meet the needs to engineering terms of engineering characteristics classification given in A(vii). (i.e. one engineering may satisfy one or more needs)
ii. For each engineering characteristic, **Define specified unit** (qualitative or quantitative) **with corresponding value** (value type; equal x; less than y, between x-y ,or larger than x)
iii. **Identify benchmarking specifications**

C) **Developing quality function deployment (House of Quality)** and finding the probable engineering characteristics and product parts **[70]**

i. In the left, List customer needs and their importance in rows
ii. In the top, List engineering characteristics & metrics in columns and find the effect of each on the others and improvement status (Large is better (+) or less is better (-)
iii. In the middle, Develop relationship matrix (relation between needs and engineering metrics)
iv. In the right, List bench marks and their satisfactory rating to needs, then calculate weighted values for the rating
v. In bottom, Calculate the weighted values of engineering matrices satisfying needs
vi. Make table for target values for each engineering matric.

2.2. Product Function Analysis [250]

To understand the product, analyze the function(s) and sub function(s) of the product considering technical, user interface, and overall configuration issues. You should carry out the following:

A) Identify the main and support functions of the product and its components (cost if possible) **[50]**

i. List the function and sub-function of the product, sub-assembly and components using physical decomposition technique which carried out in section (1.2)

B) Identify and decompose the product function(s) to provide the product function diagram and attributes. Determine the methods can be used to satisfy product value. **[100]**

It is developed basically as follows:

The 1st step: Develop black box to represent product function with three types of inputs and outputs flows as shown in figure.

Next step: Divide the black box to several black boxes to create more description of product sub functions which are required to implement the product overall function

Process of Functional Decomposition:

a. Define the overall function that needs to be accomplished (Define the main function).
b. Decompose the function into sub-functions.
c. Document what (function), not how (form). [Form follows from function, so consider form after defining function].
d. Use standard notation when possible [Employ the standard notation for the type of system you are developing].
e. Establish logical flow [Place functions in a logical sequence, and employ well-defined logical functions].
f. Match inputs and outputs [Function must include all required transformations of energy, materials, or information].
g. Break the functions down as finely as possible.

C) Develop Technical/Task FAST to find the probable Fast and analyze the function. **[100]**

The steps necessary to construct the FAST diagram are as follows:

1) Prepare a list of all the functions by assembly or system using the verb and noun technique of identification of function.

2) Write each function on a small cards. Select a card with the function that you consider to be the basic function.

3) Determine logic questions for each function (**Why? and How?**) to establish the relation between the functions at higher and lower levels that are required to perform the highest-level basic function. When this has been properly done, each function in the entire series is illuminated by
   a. On the left, "Why it is done (Why is this function performed)?"; **and**
   b. On the right, "How it is done (How is this function accomplished)?"

4) Next the question **"When?"** is asked of each function, and it is diagramed in time sequence in relation to the other functions so that examination of the diagram vertically illuminates the matter of which functions are to be accomplished at the same time and the sequential relationships of all others

5) Continue FAST diagram until we arrive at a function that is an accepted interface function for the scope of the problem. the scope of the problem is defined and outlined on the FAST diagram by the scope lines (vertical broken lines).

6) The arrangement of these functions, as shown by the FAST diagram, establishes the critical path. The critical path identifies the functions that are the result of other functions to be performed.

Part (3) Product Concept development [500 marks]

3.1. Concept Generation [325]

Carry out the steps of concept generating ideas as follow:

3.1.1. Knowledge search for existing ideas (external and internal searches) [60]

- Identify concepts can be developed from gathered information from patents, literature, benchmarking (competitors) , etc. **[30]**
- Identify concepts can be adapted from knowledge of individual, group, etc. **[30]**

3.1.2. Finding alternatives and solutions (Exploring ideas) [200]

- Develop concept classification tree to identify promising sources to develop the product. **[75]**
  i. Classify several categories (Classes) for possible solutions.
  ii. For each category, classify various solution techniques (technologies and methods).
  iii. Build a tree for each category focusing on the most promising solutions.
- Develop concept combination table to provide systematic potential solutions using classification tree for all categories. **[75]**
- Find the morphological chart from the combination table focusing on the most promising combination. **[50]**

3.1.3. Revising the Solutions and alternatives of ideas [65 marks]:

- Identify opportunities for development/improvement by carrying revision of the above processes.

3.2. Concept selection [75 marks]:

Carry Concept screening and concept scoring using Pugh matrix finding:

- Selected criteria for rating (you should include cost, ease of manufacture and ease of use criteria beside other criteria), **[25]**
- Concepts rating and then ranking analysis. **[50]**

3.3. Concept testing [100 marks]:

Test the acceptance of the idea and it is meeting needs by carrying the following:

- Make and carry a survey based on the following: **[50]**
  i. Developing a survey which contains
     a. A way of communicating the product concept (sketches, CAD model, description showing specification and advantages)
     b. Method of measuring customer response by asking for his choice of concepts, his reaction to concepts, and his thinking for concept improvement.
     c. A way to measure customer purchase intent based on five response categories.
  ii. Choose sample population and market segments.
  iii. Choose a survey format (interview, electronic means, verbal…)
- Analyzing the survey and interpret result. Find purchase intent. Make a decision. **[50]**

Part (4) Product design [500 marks]

4.1. Final Product Design [200]

Provide final design details and specifications for the developed product. Product data includes the following:

A. CAD drawing for assembly drawings, exploded drawing, and detailed drawing including all dimensions.
B. BOM including functions and sub-function of the product components, material calculating, and any production requirements.
C. Product structure and assembly chart

4.2. Assess the developed product design [50]

A. Assess the design by rating importance with respect **ergonomic** (ease of use, ease of maintenance, user interaction, safety),
B. Assess the design by rating importance with respect **aesthetic** (product differentiation, team motivation, proud (ownership, fashion, or image) , and
C. Assess the design by rating performance of product **quality** (user interface quality. emotional appeal, ability to maintain and repair the product, appropriate of resources, product differentiation)

4.3. Develop DFM process [150]

Estimate costs and make decision for cost reduction using BOM and calculating the following:

a. Total unit variable cost = Σ manufactured and standard components variable cost. This determined from material cost, processing cost (processing time* [machine + labor] cost), assembly cost (assembly time* [machine if any+ labor] cost).
b. Total unit fixed cost = Σ manufactured components fixed cost. This determined from tooling and nonrecurring expenses (NRE) costs and tooling life.
c. Total unit direct cost = Total unit variable cost + Total unit fixed cost
d. Overhead charges for material, processing, assembly, and tooling
e. Total unit cost = Total unit direct cost + Overhead charges

4.4. Develop a prototyping plan [100]

Investigate the product capability to carry the function at appropriate cost considering prototyping technologies (3D CAD) and free fabrication.