**This problem statement is only for CS D students**

## Problem Statement

Develop a model to optimize the amount of material used for packaging multiple items into a single box without exceeding the box's weight capacity. This project can be used in logistics to minimize costs and environmental impact.

**Program Requirements:**

1. Optimize the problem.
2. Use Lagrange Multipliers.
3. Analyse the Problem
4. Provide analytical solution.
5. Graph the model by using Python.
6. Python solution is also required.

## Report Requirements

Students are required to submit a complete report of the project prepared in MS Word in their own words. A report is written in third person, i.e., use of I, We, Us, are not used to write the report. The contents of the report must include:

| Sr. No. | Deliverable | Marks |
|---|---|---|
| 1. | **Objectives and Introduction:** Objectives and introduction of the problem. In this section briefly introduce the problem and the methodology that will be adopted by you to solve the problem. | 5 |
| 2. | **Analytical Solution:** A step-by-step analytical solution (by-hand solution). Clearly state the assumptions and values that you use for the solution. | 20 |
| 3. | **Python Code:** Complete and well commented Python code. This section must include the explanation of the commands, functions, and toolboxes used. | 15 |
| 4. | **Python Solution and Results:** Step-by-step example demonstrating the Python solution. Clear retraceable steps should be listed to obtainthe presented solution.<br>Also, present detailed results and discussion in this section. Do not just paste the graphs or screenshot of the command window. Compare your by-hand and Python solutions, and present physical interpretation of your results and graphs. | 20 |
| 5. | **Flowchart:** Flowchart of the solution methodology or the program. | 5 |
| 6. | **Conclusions:** In this section, include conclusions related to this assignment. The conclusion section stands independently from the report and gives the reader a comprehensive idea of the project; thus, the conclusion section should briefly explain the problem, solution methodology, results, and analysis. The conclusion section is not very large and typically consists of 1-2 paragraphs. The conclusions section can also include bullet points. | 5 |
| 7. | **Contribution:** In this section clearly state the contribution of each group member. Generic statements such as 'each group member contributed equally' are not acceptable answers. In this section include difficulties that you faced during this assignment and how you overcame those difficulties. | 5 |

Each report element should be documented under a separate heading. Each page should be numbered. The report should be written in Calibri or Times New Roman typeface only. The size of the font should be 12. The size of first and second level of headings should be 14 bold, and 12 bold, respectively. The alignment of the report should be justified, while pictures and tables should be center aligned with relevant captions. The option to align the text left, right, center, and justify can be found under paragraph options on *Home* tab. Line and paragraph spacing should be set as 1.5. Optimally utilize the available space on each page, do not leave blank space on a page unnecessarily.

## Project Submission Guidelines

This project is an open-ended problem designed to demonstrate the application of differentiation in real life. The open-ended nature of the problem means that this problem can be solved in more than one way using various techniques and methodologies, some of these techniques have been covered in this course. You are free to adopt any technique and solution methodology to solve this problem. Solution techniques and methodologies that are not part of the course outline can also be used to solve the problem. However, you are required to take approval of such a solution technique before starting the project. You may have to do extensive research to completely solve the problem. If you have any confusion, you can discuss your query via email. Project guidelines are summarized below:

- This is a group project and carries 75 marks.
- A group can have a maximum of 3 students. One of the aims of this project is to enable students to work effectively in a team. **Therefore, this project cannot be done individually.** The project can be done in pairs.
- Plagiarized work (from internet or fellow students) will result in zero marks.
- Deadline for complete project submission on **google classroom** (one MS Word file and one pdf of the same Word file including all the codes and by-hand solutions) is **Wednesday 15 May 2024 before 11:59pm**. Do not submit your project in a .zip or

  .rar format. You can submit additional files such as .m files, however, the single PDF and MS Word file must also include all the information such as codes and figures.
- Name of your project report file must be as per following format: **ID1_ID2_ID3_MT1008_Project_Section**.
- Do not submit your project via email, it will not be considered.
- Late submissions will not be considered.