

## EET 110 – Assignment 1: Problem Formulation

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### Assignment Goals

The objective of this assignment is to develop the skill of mathematical modeling. For each of the following scenarios, identify the decision variables, objective function, and all relevant constraints to formulate a standard Linear Programming (LP) model.

## 1. Manufacturing Optimization

### Problem 1: Solar Panel Assembly

A renewable energy startup in Bengaluru is assembling two types of solar panels: the "Ganga-Mono" (high efficiency) and the "Yamuna-Poly" (standard). Each Ganga-Mono panel sold yields a profit of ₹ 5,000, while each Yamuna-Poly yields ₹ 3,000. Assembly requires two main resources: high-purity silicon and labor hours. A Ganga-Mono panel requires 5 kg of silicon and 4 hours of labor, whereas a Yamuna-Poly panel requires 3 kg of silicon and 2 hours of labor. For the next week, the factory has 1,500 kg of silicon and 1,200 labor hours available. Market research suggests that at most 200 Ganga-Mono panels can be sold due to their high price. Formulate a linear program to maximize the total weekly profit.

## 2. Logistics and Transportation

### Problem 2: Coal Logistics for Thermal Plants

The North Indian Power Grid needs to transport coal from two major mines—Dhanbad and Korba—to two thermal power stations—A and B. The Dhanbad mine has 400 tons of coal available, while Korba has 500 tons. Station A requires at least 300 tons to maintain operations, and Station B requires at least 450 tons. The cost of transporting one ton of coal from Dhanbad to Station A is ₹ 600, and to Station B is ₹ 800. From Korba, the transport cost is ₹ 700 per ton to Station A and ₹ 500 per ton to Station B. Formulate an optimization model to minimize the total transportation cost while meeting the fuel requirements of both power stations.

## 3. Power Systems and Environment

### Problem 3: Hybrid Green-Dispatch

A regional load center must meet a constant power demand of 800 MW using a combination of a Natural Gas plant and a Coal plant. The cost of generating 1 MW from the Coal plant is ₹ 4,500, and from the Gas plant is ₹ 6,000. However, the Coal plant is heavily polluting, emitting 0.9 tons of  $CO_2$  per MW, while the Gas plant emits only 0.4 tons per MW. The local environmental regulator has mandated that the total  $CO_2$  emissions from these two plants must not exceed 500 tons per hour. Additionally, due to technical constraints, the Coal plant cannot generate more than 600 MW, and the Gas plant must always maintain a minimum generation of 100 MW to stay synchronized with the grid. Formulate the model to minimize the total generation cost.