The Final Exam will have 6-7 questions and the total marks will be 50.

It is a restricted open book exam. The permitted materials for the exam are:

- Calculators (including programmable)
- Drawing instruments
  i.e. Rulers, Set Squares and Compasses
- Two (2) revision sheet (A4 double-sided). They must be handwritten original notes.

Below are some sample questions.

Question 1:

Use *Lagrange Multiplier* method to solve the nonlinear programming problem:

Minimize $2x + y$
Subject to $x^2 + y^2 = 1$

Question 2:

In the Simplex Method for solving linear programming problem, when a corner point is found, how to decide whether it is the optimal solution or not? How to improve the solution if the corner point is not the optimal solution? Please explain the process and give reasons why it works.

Question 3:

A machine shop foreman wishes to schedule two types of parts, each of which have to undergo turning, milling, and grinding operations on three different machines. The time per lot for the two parts available, machine time, and profit margins are provided in the following table.

Part	Turning	Milling	Grinding	Profit $ per lot
Part 1	12 hrs/lot	8 hrs/lot	15 hrs/lot	120
Part 2	6 hrs/lot	6.5 hrs/lot	10 hrs/lot	90
Machine time available hrs	60 hrs	75 hrs	140 hrs	

Schedule the lots for maximization of profits.

- Formulate the problem as a linear programming problem.
- Solve this linear programming problem graphically.

Question 4:

It is required to find the **rectangular of the largest area** (in the positive quadrant) that can be transcribed within a given ellipse $\frac{x_1^2}{4} + x_2^2 \leq 1$ and satisfy a prescribed linear constraint $4x_1 + 3x_2 \leq 6$

- Formulate the problem as a nonlinear programming problem.
- Solve this nonlinear programming problem graphically.

Question 5:

Explain the main idea of BFGS algorithm for unconstrained nonlinear programming problems. Use the following example to compute the search direction in the first step of BFGS algorithm assuming the starting point is $x_1 = 4, x_2 = 3.$

Minimise $\frac{x_1^2}{4} + x_2^2 - 2x_2$

Question 6:

Explain the main idea of SQP algorithm for constrained nonlinear programming problems.

Question 7:

Explain the principle, advantages and limitations of Genetic algorithm for nonlinear optimisation.

Question 8:

Explain the key idea of golden section method for solving one dimensional nonlinear programming problem.

Question 9:

Explain the key idea of branch and bound algorithm.

Question 10:

Use FOC and SOC to solve the following unconstrained optimization problem

Minimize

$$(x_1 - 2)^2 + (x_1 - x_2)^2 + (x_1 - x_3)^2 + (x_2 - x_3)^2$$