Name : ....

Roll No. : ....

Invigilator's Signature : ....

CS/M.Tech(IEM)/SEM-1/IEM-101/2009-10

2009

QUANTITATIVE METHODS & SIMULATION TECHNOLOGY

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Answer any *five* questions. 5 × 14 = 70

1. Describe KKT necessary and sufficient conditions of optimality. State two results of global optimality in a non-linear programming problem.

2. Using CPM, find the critical path and least cost schedule for a construction project based on the following inputs.
(Given : Indirect cost per day is Rs. 175/-)

3. Write down Bellman's optimality principle for a dynamic programming problem altogether, there are 10 cities. Starting from 1st city, the person had to reach the last city in only four stages so that the total distance will be minimum (a kind of shortest path problem). The distances between the cities are given in matrix form whose element's unit is in km.

   Write down the first two stages towards recursive solution. Can you guess about the existence of multiple solutions in this problem ? Explain.

4. Write short notes on the following :

   a) Goal and deviation variables

   b) Convexity and pseudoconvexity

   c) Early start and late finish

   d) Local maxima and global maxima.

5. Describe methods of drawing random numbers for simulation using exponential and normal distribution. What is the utility of uniform distribution in simulation ?

6. A furniture company makes two products, tables and chairs, which may be processed through assembly and finishing departments. Assembly has 60 hours available per week and finishing can handle up to 48 hours in finishing. Manufacturing a table requires 4 hours in assembly and 2 hours in finishing. Each chair requires 2 hours in assembly and 4 hours in finishing. Profit is Rs. 80 per table and Rs. 60 in chair.

   a) Formulate an LP model to solve above problem

   b) If the profit goal is 1400 what should they produce

   c) If the furniture company wants to meet the profit goal 1000 and to produce a table goal 10, formulate the problem.

7. Consider the following problem :

   Minimize $(x_1 - 3)^2 + (x_2 - 2)^2$

   Subject to $g_1(x) : x_1^2 + x_2^2 \leq 5$

   $g_2(x) : x_1 + 2x_2 \leq 4$

   $g_3(x) : -x_1 \leq 0$

   $g_4(x) : -x_2 \leq 0.$

   Verify that Fritz John conditions are true at the optimal point (2, 1).

8. a) Using conventional symbols of System Dynamics Software, write the equations based on the influence diagram and the flow diagram under a condition of positive feed back loop with one level and one rate variable. The value of the initial level of 20 and the constant of proportionality as 0·2 is to be considered.

   b) Illustrate with a diagram, for the above problem, the nature of simulation results for both level and rate over a 10 period time horizon.

   c) Elucidate the nature of industrial and managerial systems under the system dynamics framework.

5 + 5 + 4