Bengal Engineering and Science University, Shibpur

M. E. (Civil) Second Semester Examination, April 2013

Sub: Water Resources Planning and Management (CE-1014)

Time: Three Hours | Full Marks: 70

Answer any four from the following. Two marks are reserved for neatness.

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1. a) With neat sketch, define i) a convex function and ii) a concave function. (6+10 = 16)

   b) Find the minimum/maximum of the following functions:

   i) $f(x) = x_1^3 + x_2^3 - 3x_1 - 12x_2 + 20$ ii) $f(x) = x_1^2 + x_2^2 + 16x_1 + 16$

2. Solve the following

   i) Minimize $x_1^2 + x_2^2$
   Subject to $x_1 + x_2 = 8$

   ii) Minimize $x_1^2 + x_2^2 - 4x_1 - 4x_2 + 8$
   Subject to $x_1 + 2x_2 - 4 \leq 0$
   $2x_1 + x_2 \leq 5$

3. Two different varieties of rice are grown on a land of 400 ha. The cost of growing variety1 per hectare is Rs. 4 lakhs and that of variety2 is Rs. 2.5 lakhs. Gross benefits from these crops are Rs. 6 lakhs/ha and 3.5 lakhs/ha respectively. The available budget is Rs. 4 crores. Formulate the LPP and determine the optimal cropping pattern.

4. Consider the optimal monthly operation of a reservoir for water supply purpose. Minimum and maximum values of storage in this reservoir are 10 units and 40 units respectively, and release from the reservoir is to be restricted between 0 and 30 units. There is a constant monthly demand of 25 units from this reservoir. Assuming N periods of operation, derive the Dynamic Programming formulation of the optimization problem to minimize the cumulative loss incurred from the penalties due to deviation from the target demand. Use square of the deviation as the penalty function. Solve this problem for the following inflow sequence, for periods N and N-1, assuming N = 24.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Inflow	10	10	10	0	0	20	30	40	40	20	20	10

5. Discuss the four different Stochastic Dynamic Programming (SDP) models, based on independent inflow, correlated inflow and inclusion of the inflow as a state variable, in relation to single reservoir operation problem.

6. In a multi-reservoir water supply project, three reservoirs A, B and C are proposed to be constructed. Three different combinations are tried: i) A, B, C are in series; ii) A, B, and C are in parallel; and iii) A and B are in parallel, and C is in series with them. Assuming minimization of cumulative losses incurred from deviation of target demands as the objective function, derive the i) complete DP formulation of these three optimization problems, including constraints, system dynamics, performance function, backward recursive equation, discretization scheme and discretized recursive equation. Use S_{t+1} as the control variable. Draw neat sketch for each configuration.