

CEL737 Optimization Techniques in Water Resources

Postgraduate Course, Water Resources Engineering, Dept. of Civil Engineering, IIT Delhi
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Major Test
1st Semester, 2008-2009

Full Marks: 50

Time: 2 hrs.

Answer all questions

- [1.] (a) Formulate an optimization problem for the design a cylindrical water storage tank to temporarily store water with a detention time of 4 hrs. The design of the tank should be aimed to minimize the cost involved in manufacturing it and should meet other design requirements. Enumerate various assumptions and restrictions made in the formulation. All notation used should be defined properly. (7)

- (b) Solve the following problem using Simplex algorithm: (7)

$$\text{Maximize } F = x_1 + 2x_2 + x_3$$

$$\text{ST } 2x_1 + x_2 - x_3 \leq 2$$

$$-2x_1 + x_2 - 5x_3 \geq -6$$

$$4x_1 + x_2 + x_3 \leq 6$$

$$x_i \geq 0; i = 1, 2, 3$$

- [2.] (a) What do you mean by following: (8)

(i) Saddle Point

(ii) Final value multistage decision problem

(iii) Integer Programming

(iv) Complementary slackness theory

- (b) Differentiate followings: (6)

(i) Return and transformation functions

(ii) Unimodal and multimodal functions

(iii) EPFM+HJ and EPFM+PCD

- [3.] (a) What do you mean by separability of objective function? State whether the following objective function is separable? (5)

$$f(x) = [R_1(x_1, s_2) + R_2(x_2, s_3)] [R_3(x_3, s_4) + R_4(x_4, s_5)]$$

- (b) Write down the sufficient conditions for a local minimum of n-dimensional unconstrained optimization problem. (4)

- [4.] (a) An unconstrained NLP Problem is defined as:

$$\text{Minimize } f(x) = x_1^2 + x_2^2 - 2x_1 + x_1x_2 + 1$$

Is the point $x = (x_1, x_2) = (4/3, -2/3)$ a local minimum? (6)

- (b) Write down the Kuhn-Tucker conditions for the following NLP Problem. (7)

$$\text{Minimize } f(x) = x_1^2 + x_2^2 - 2x_1 - 2x_2 + 2$$

ST

$$g_1(x) = -2x_1 - x_2 + 4 \leq 0$$

$$g_2(x) = -x_1 - 2x_2 + 4 \leq 0$$
