Course Title: Decision Theory and Design Optimization   Course No.: AML 771
Date: 02 December 2006   Maximum Marks: 80   Duration: 2 Hrs
Note: Answer all the questions. Marks are indicated against each question.

Q. 1: List and discuss the methods for finding the global optimal solution of the optimization problems. [15]

Q. 2: Derive the necessary conditions for the minimum of the following functional:

$$I = \int_a^b F(f_1, \frac{df_1}{dx}, f_2, \frac{df_2}{dx}) \, dx$$

The values of f_1 and f_2 are known at $x = a$ and $x = b$.

Obtain the solution $(f_1(x), f_2(x))$ if $F(f_1, f_2) = \left(\frac{df_1}{dx}\right)^2 + \left(\frac{df_2}{dx}\right)^2 + 2f_1 f_2$ and $f_1(0)=0$,

$f_2(0)=0$, $f_1(\pi/2)=1$, $f_2(\pi/2)=-1$. [15]

Q. 3: Solve the problem using penalty function approach:

min $f(x_1, x_2) = x_1^2 + (10x_2 + 1)^2$

s. t. $-x_1 + x_2 \leq 0$ and x_1 is integer. You may take starting point as $(0, 0.0)$ [15]

Q. 4: Solve the quadratic programming problem using active set method:

min $f(x_1, x_2) = -x_1^2 - 2x_2^2 + 5 x_1 + 8x_2 + x_1 x_2$

subject to: $x_1 + 2x_2 \leq 10$, $0 \leq x_1 \leq 4$ and $0 \leq x_2 \leq 5$ [10]

Q. 5: Solve the following nonlinear programming problem:

min $f(x_1, x_2) = x_1^2 + x_2^2 - 6 x_1 - 8 x_2 + 10$

subject to: $4x_1^2 + x_2^2 \leq 16$, $3x_1 + 5x_2 \leq 15$ and $x_i \geq 0$

Choose starting point as $(1, 1)$. [15]

Q. 6: Derive the first-order necessary conditions for a general nonlinear programming problem. [5]

Q. 7: Find the minimum of $f_1(x_1, x_2) = x_1^2 + x_2^2$ and $f_2(x_1, x_2) = (x_1 - 2)^2 + x_2^2$

subject to $x_1 - x_2 \leq 1$. Draw the trade off curve. [5]