1) As $x_1 \leq x_2$
For monotonically increasing $f(x_1)$ and $f(x_2)$
$f(x_1) \leq f(x_2)$

1.
2. Self-Explanatory
3. Self-Explanatory

4

4. $f(x) = 4x^3 - 18x^2 + 27x - 10$
Then, $f'(x) = 12x^2 - 36x + 27$
$f''(x) = 24x - 36$
To get the point of inflection,
$f''(x) = 0 \Rightarrow 24x - 36 = 0$
or, $x = 1.5$

4.

5. Self-Explanatory

6. $f(x) = x^3 - 12x$
Then, $f'(x) = 3x^2 - 12$
For getting the critical points $3x^2 - 12 = 0$
or, $x = \pm 2$
Now, $f''(x) = 6x$
$f''(2) > 0 \quad f''(-2) < 0$
Hence, the local minima and maxima are at
$x = 2$ and $x = -2$ respectively.

6.

$f(x) = x^3 - 9x^2 - 48x + 52$

$f'(x) = 3x^2 - 18x - 48$

Then, the critical point(s) may be found out by

$f'(x) = 0$

$\Rightarrow 3x^2 - 18x - 48 = 0$

or, $x = -2, 8$

$f''(x) = 6x - 18$

Then, $f''(-2) = -12 - 18 = -30 < 0$

$f''(8) = 30 > 0$

Thus $x = 8$ corresponds to a local minima and $x = -2$ corresponds to a local maxima.

7.

8. $f(x) = 12x^4 - 32x^3 + 24x^2 - 10$

Then, $f'(x) = 48x^3 - 96x^2 + 48x$

$f''(x) = 144x^2 - 192x + 48$

To get the point of inflection,

$f''(x) = 0 \Rightarrow 144x^2 - 192 + 48 = 0$

or, $(x-1)(x-\frac{1}{3}) = 0$

or, $x = 1, \frac{1}{3}$

	$-\infty < x < \frac{1}{3}$	$x = \frac{1}{3}$	$\frac{1}{3} < x < 1$	$x = 1$	$1 < x < \infty$
Sign of $f''(x)$	+	0	−	0	+
Behavior	Concave Upwards	Inflection	Concave Downwards	Inflection	Concave Upwards

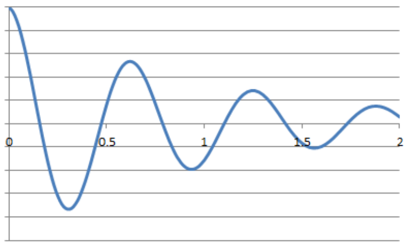
8.

Assignment for Non-linear programming problem

week-1

Introduction to NLP

1. For two point x_1 and x_2 , where $x_1 \leq x_2$, $f(x_1)$ and $f(x_2)$ would be monotonically increasing if
   a) $f(x_1) \leq f(x_2)$
   b) $f(x_1) < f(x_2)$
   c) $f(x_1) > f(x_2)$
   d) $f(x_1) \geq f(x_2)$



2. The function is unimodal in
   a) [0,1]
   b) [0.5,1]
   c) [1,1.5]
   d) [1,2]
3. Solve the optimization problem by graphical method

$$\begin{aligned} Min \quad & 3x + 2y \\ s.t. \quad & 9(x-2)^2 + 2x - y \leq 5 \\ & y \leq 5 \\ & x, y \geq 0 \end{aligned}$$

   a) 4.61
   b) 5.90
   c) 3.89
   d) 4.99

4. Find the point of inflection

$$f(x) = 4x^3 - 18x^2 + 27x - 10$$

   a) x=2
   b) x=2.3
   c) x=1.7
   d) x=1.5

5. Solve the optimization problem by graphical method

$$\begin{aligned} Max \quad & 2x + 3y \\ s.t. \quad & x^2 + y^2 \leq 5 \\ & x + y \geq 2 \\ & x, y \geq 0 \end{aligned}$$

a) 16.99
b) 10.23
c) 8.06
d) 13.33

6. Identify local minima and local maxima of $f(x) = x^3 - 12x$ over the region$-3 \leq x \leq 3$.?
a) $x = 0, x = 0$
b) $x = 2, x = -2$
c) $x = 3, x = -3$
d) $x = 1, x = -1$

7. Find the value of x for which the local minima in the interval [1,2]

$$f(x) = \cos(14.5x - 0.3) + x(x + 0.2) + 1.01$$

a) 1.8
b) 1.3
c) 1.5
d) 1.1

8. Find the point of inflections

$$f(x) = 12x^4 - 32x^3 + 24x^2 - 10$$

a) 1 and 0.33
b) 2 and 1.33
c) -1 and -1.33
d) 0 and -0.33

Answer

1. a,
2. c,
3. a
4. d
5. c
6. b
7. d
8. a