ME 209 NUMERICAL METHODS
2nd EXAM QUESTIONS

Name Surname:
Student No:

26.12.2023
Duration: 90 min

1. (35p) The following data give the viscosity at several different temperatures:

T (°C)	5	20	30	50	55
μ (mPa.s)	80	15	9	6	5.5

   a) Find the corresponding viscosity μ at $T = 40\ °C$ with linear interpolation.
   b) Find the corresponding viscosity μ at $T = 40\ °C$ with quadratic interpolation.

2. (30p) Fit a straight line to the x and y values in the given table:

x	1	2	3	4	5	6	7
y	0.5	2.5	2.0	4.0	3.5	6.0	5.5

3. (35p) A jet fighter's position on an aircraft carrier's runway was timed during landing:

t (s)	0	0.5	1.0	1.5	2.0	2.5	3.0
x (m)	153	185	208	249	261	271	273

   where x is the distance from the end of the carrier. Determine the value of
   a) velocity (dx/dt), and
   b) acceleration (dv/dt) at time $t=1.5$ s using numerical differentiation.

SOME OF THE IMPORTANT FORMULATIONS

$$f_2(x) = b_0 + b_1(x - x_0) + b_2(x - x_0)(x - x_1)$$

$$b_0 = f(x_0) \qquad b_1 = \frac{f(x_1) - f(x_0)}{x_1 - x_0} \qquad b_2 = \frac{\dfrac{f(x_2) - f(x_1)}{x_2 - x_1} - \dfrac{f(x_1) - f(x_0)}{x_1 - x_0}}{x_2 - x_0}$$

$$y = a_0 + a_1 x \qquad a_0 = \bar{y} - a_1 \bar{x} \qquad a_1 = \frac{n\Sigma x_i y_i - \Sigma x_i \Sigma y_i}{n\Sigma x_i^2 - (\Sigma x_i)^2}$$

$\bar{y}$ and $\bar{x}$ are the means of y and x, respectively.

$$\frac{df(x)}{d(x)} \approx \frac{-f(x + 2\Delta x) + 4f(x + \Delta x) - 3f(x)}{2\Delta x} \qquad \frac{d^2 f(x)}{dx^2} \approx \frac{f(x + 2\Delta x) - 2f(x + \Delta x) + f(x)}{(\Delta x)^2}$$

GOOD LUCK.

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