Last Name **Name** **student ID (matricola)**

n = _____ (student ID No. /// *N. matricola, per intero oppure cifre finali*)

Section 1: LINEAR PROGRAMMING

A Company produces **bowls and mugs**.
The labor and raw material requirements, and the selling prices for these products are given in Table 1.

	RESOURCE REQUIREMENTS		
PRODUCT	*Labor (hr/unit)*	*Clay (lb/unit)*	*Revenue ($/unit)*
Bowl	1	4	40
Mug	2	3	50

There are 40 hours of labor and 120 pounds of clay available each day

The company wants to determine how many units of each product to produce per day to maximize its total income.

Questions

1.I. Formulate and write the LP math model of this problem

1.II. Solve it by using the most convenient tool in Matlab and describe **step by step** the obtainment of the **optimum**

1.III. Determine the optimal value of the **objective function**

1.IV. Determine the optimal values, if any, of the **decision variables**

1.V. At the **optimum**, provide comments on special or unexpected features, if any, e.g., regarding the role of the **decision variables**

Section 2: EMPIRICAL MODELS

In measuring vapor pressure, the following data were stored in the file
Sect.2_3.3.1.Pv.txt

Questions

First, carefully look at data and then use Matlab® tools:

2.1.determine one **interpolation model** that you consider reasonably valid

2.2.determine one **regression model** that you consider reasonably valid

2.3.compare meaning and results of the **interpolation model** vs. the **regression model**

In the case of the **regression model:**

2.4.is the regression model adopted by you a LINEAR or NON-LINEAR one?

2.5.calculate and discuss the **residuals**

2.6.plot the **residuals** as a **bar chart** of their distribution

2.7.using the predictions of the regression model adopted by you, plot the **Equivalent Graph (or Parity Line)**

2.8.using the regression model adopted by you, calculate the **Extrapolated point** at a new abscissa of $\left(\frac{n-0.05}{n+0.05} \cdot 100\right)$

2.9.using the regression model adopted by you, calculate the **Accuracy Factor**

Section 3: FINITE DIFFERENCE METHODS for PDE

Solve the following parabolic PDE $\frac{\partial u(x,t)}{\partial t} = \Delta \frac{\partial^2 u(x,t)}{\partial x^2} + ku(x,t)$

with

$\Delta = \left(\frac{n-0.05}{n+0.05} \cdot 5\right)$

$k = 0$

$L = 10$

$t_{final} = 1$

IC: $t = 0$ $u(x,0) = x$

BC: $A \cdot u(x,t)\big|_{x=0} + B\frac{\partial u(x,t)}{\partial x}\Big|_{x=0} = n^{1/2}$

$D \cdot u(x,t)\big|_{x=L} + E\frac{\partial u(x,t)}{\partial x}\Big|_{x=L} = \sqrt{\frac{t}{n+1}}$

A=D=n

B=E=0

where n = _____ (student ID No. /// *N. matricola, per intero oppure cifre finali*)

Questions

3.1.which type are the **Boundary Conditions**?

3.2.adopt the **explicit method**

3.3.using **MUC**, show (and discuss) the issue of "*physical incongruence*" of the **explicit method** by generating the necessary graphical views from **MUC** and attaching them here

3.4.What is the role of Delta_x? How much is Delta_x ?

3.5.What is the role of Delta_t? How much is Delta_t ?

Section 4: MATHEMATICAL MODELING

4.1 Classification of a model

Look at the below model:

$$\dot{y}_1 = (1 - \frac{y_2}{\mu_2})y_1$$
$$\dot{y}_2 = -(1 - \frac{y_1}{\mu_1})y_2$$

a) Which math model is this?

b) Provide all possible classifications for it

c) How many and what are the **parameters**?

d) Are the **parameters** positive or negative?

Section 5: TIME SERIES

With ref. to the **time series** data in the file

sect.5.1_calo peso 1.txt

for which some data have been "lost" and are missing in the series:

Questions

Calculate using Matlab

a) **standard deviation** of data

Then, using the script *moving.m* or another Matlab tool

b) propose a significant value of the **span** M for a **moving average**

c) obtain a new **filtered time series** from the original data by adopting the above **moving average** calculation

d) plot the new **filtered time series** against the original data and comment it

e) identify the **outliers** in the original **time series,** exclude them by proposing a reasonable criterion to this end