Dr. Mohamed Husien Eid

Mathematics Department
Faculty of Engineering – Shoubra
Benha University

Student **Program(courses)** **Engineer**
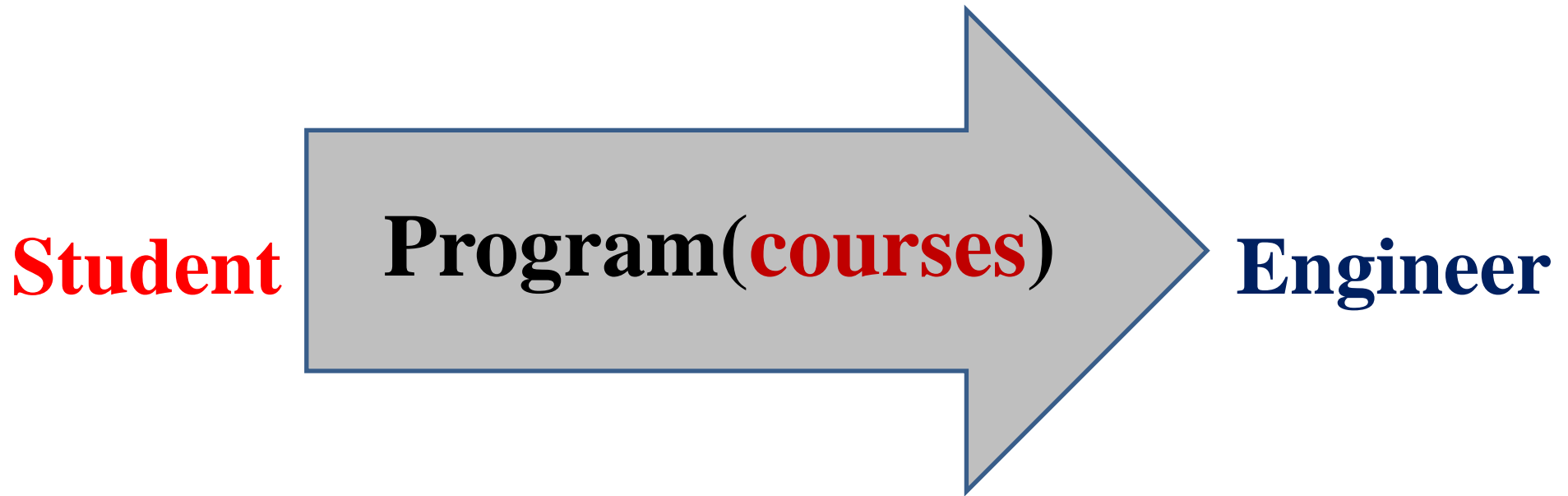
Scientific Approach: **المنهج العلمى**

To create new   يبدع

Invent	يخترع
Innovate	يبتكر
Discover	يكتشف
Clarify	يوضح
Specify	يصف
Refine	يهزب / ينقح
Develop	يطور

Intended Learning Outcomes (ILO's)

1. **Knowledge and Understanding**

2. **Intellectual Skills**

3. **Professional and Practical Skills**

4. **General Skills**

Course Aims : 1-A

- **Provide the students principals of Differential and Integral Calculus and Linear Algebra and their applications in engineering.**

- **Apply mathematical techniques for modeling, solving and analyzing real problems.**

Contents

Part I : Calculus

- Functions of single variable

- Limits and continuity

- Derivative

- Applications of derivative

- Integrals

Part II : Algebra

- Matrices

- Linear Systems

- Complex Numbers

- Binomial Theorem and Finite Series

- Mathematical Induction

- Theory of Equations

<u>Weighting of assessments</u>

- Final-semester examination   100   Marks
- Mid-semester examination   30   Marks
- Quizzes   10   Marks
- Class activities   10   Marks

- **Total   150 Marks**

<u>List of References</u>

<u>1- Course Notes</u>

"Lectures In Mathematics ", Algebra, Mohamed H. Eid, Benha University.

<u>2- Text Books</u>

"The Theory of Matrices", 2nd Edition, P.Lancaster and M.Tismenetsky, Academic Press, London, New York, 1985.
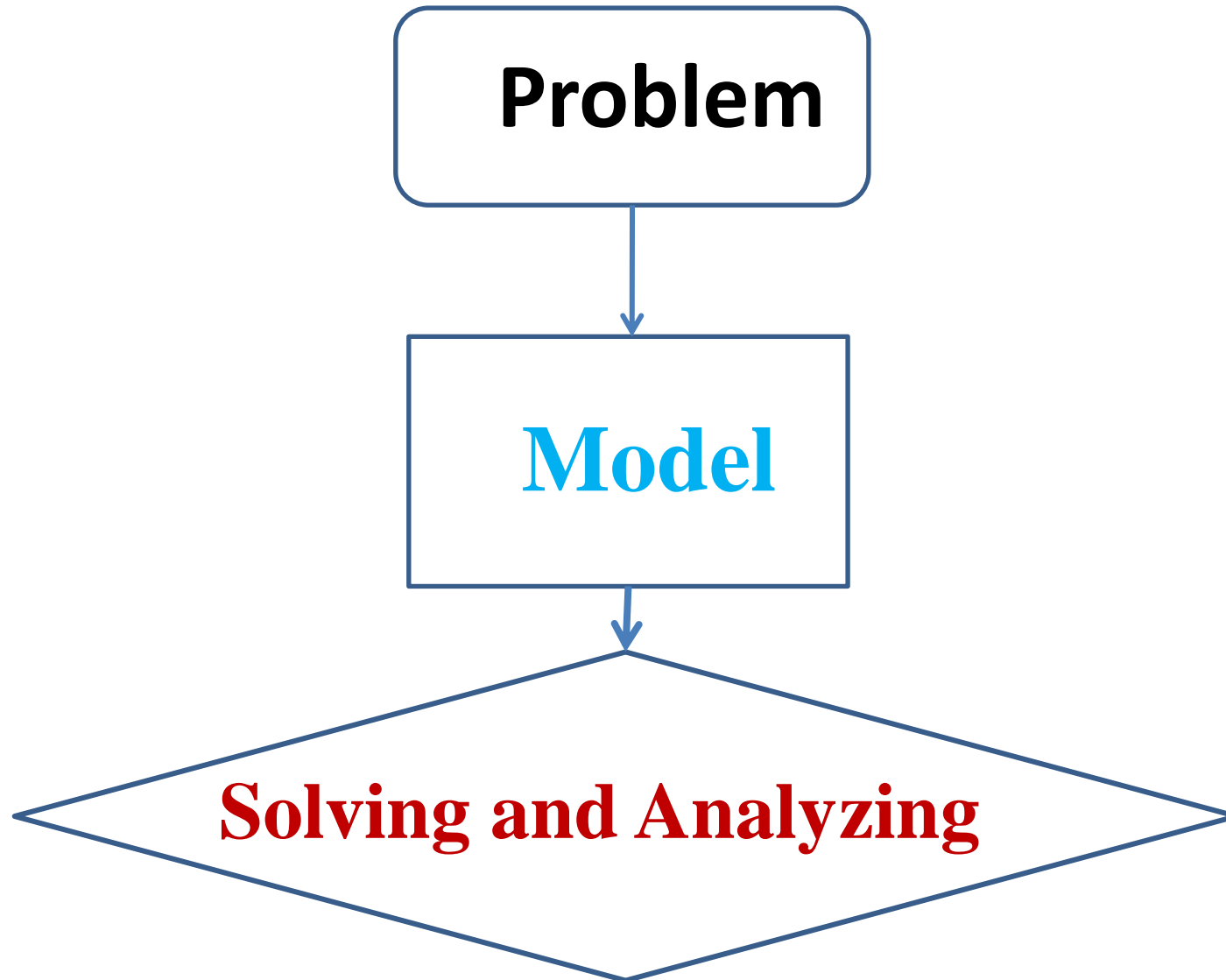
Sciences

Natural

Social (humane)

Mathematics

Mathematics is the science of modeling and treatment problems and phenomena via explicit criteria

Mathematics

Example1: Rate

An amount of sugar (100 gm) in solution is decomposed in a chemical reaction into other substance through the presence of acids, and the rate at which the reaction takes place is proportional to the mass of sugar still unchanged.

Write the mathematical model.

Find the time at which all amount is decomposed

تتحلل كمية من السكر (100 جم) في محلول في تفاعل كيميائي إلى مادة أخرى من خلال وجود الأحماض،

و معدل التغير يتناسب مع كتلة السكر المتبقية.

The original amount of sugar is 100 gm.

Assume that **x** is the amount of sugar converted at time t.

Then 100 – x is the amount still unchanged

Then $\dfrac{dx}{dt} = k(100 - x)$, K is constant, k =1

Then $\dfrac{dx}{x - 100} = -dt$ <u>Diff. equation</u>

Then $\ln(x - 100) = -t + c$

Then $x - 100 = e^{-t+c} = C.e^{-t}$

The decomposition starts when $t = x = 0$

Then $0 - 100 = C.e^0 = C$

Then $\textcolor{red}{x = 100 - 100e^{-t} = 100(1 - e^{-t})}$

is the mathematical relation.

(Increasing relation)

From $x(t) = 100(1 - e^{-t})$

t / minute	x / gm
1	63.2
2	86.5
4	98.2
5	99.99

All amount of sugar is converted when

x = 100 gm, t approaches infinity

Example 2 : Mixing Solution

A tank contains 100 liters a brine solution containing 20 kg of salt. At time t = 0, fresh water is poured into the tank at rate 4 liters per minute while the well mixture leaves the tank at the same rate.

Determine the amount of salt in the tank at any time t.

خزان يحتوي على 100 لتر محلول ملحي يحتوي على 20 كجم من الملح. في الزمن t = 0، يتم سكب المياه العذبة في الخزان بمعدل 4 لتر في الدقيقة بينما الخليط المخفف يخرج بنفس المعدل.

If S is the amount of salt in kg at any time

The concentration in kg in liter is S/100

Then $\dfrac{dS}{dt} = -4\dfrac{S}{100} = -0.04\,S$

Then $S(t) = e^{-0.04t+k} = m.e^{-0.04t}$

At $t = 0,\ S(0) = 20 = m.e^{0}.$ Then $m = 20$

Then $S(t) = 20e^{-0.04t}$

is the mathematical relation.

(Decreasing relation)

From $S(t) = 20e^{-0.04t}$

t / minute	S / Kg
0	20
1	19.22
2	18.46
10	13.4

The amount of salt in solution is 0 when t approaches infinity

Example 3

A metal bar at a temperature of 100^0 is placed in a room at a constant temp. 0^0.

After 20 minutes the temp. of the bar is 50^0

Find the time at which the temp. of the bar is 25^0

Find the temp. of the bar after 10 minutes.

Assume that u is the temp. of the bar at time t.

From Newton's law of cooling

$$\frac{du}{dt} = -k(\text{temp.of bar} - \text{temp.of its surrounding})$$

$$= -k(u - 0)$$

Then $\dfrac{du}{u} = -kdt$ Then $\ln u = -kt + c$

Then $u = e^{-kt+c} = e^c \cdot e^{-kt} = C \cdot e^{-kt}$

Since $u(0) = u(\text{time} = 0) = 100^0$

$$u(20) = u(\text{time} = 20) = 50^0$$

Then $100 = C \cdot e^0 = C$

$$50 = 100e^{-20k}, \text{ then } k = 0.035$$

The mathematical relation is:

$$\textcolor{red}{u(t) = 100e^{-0.035t}}$$

When the temp. of the bar is 25^0

Then $25 = 100e^{-0.035t}$, $\textcolor{red}{\text{then } t = 39.6 \text{ min}}$

After 10 minutes, the temp. of the bar is:

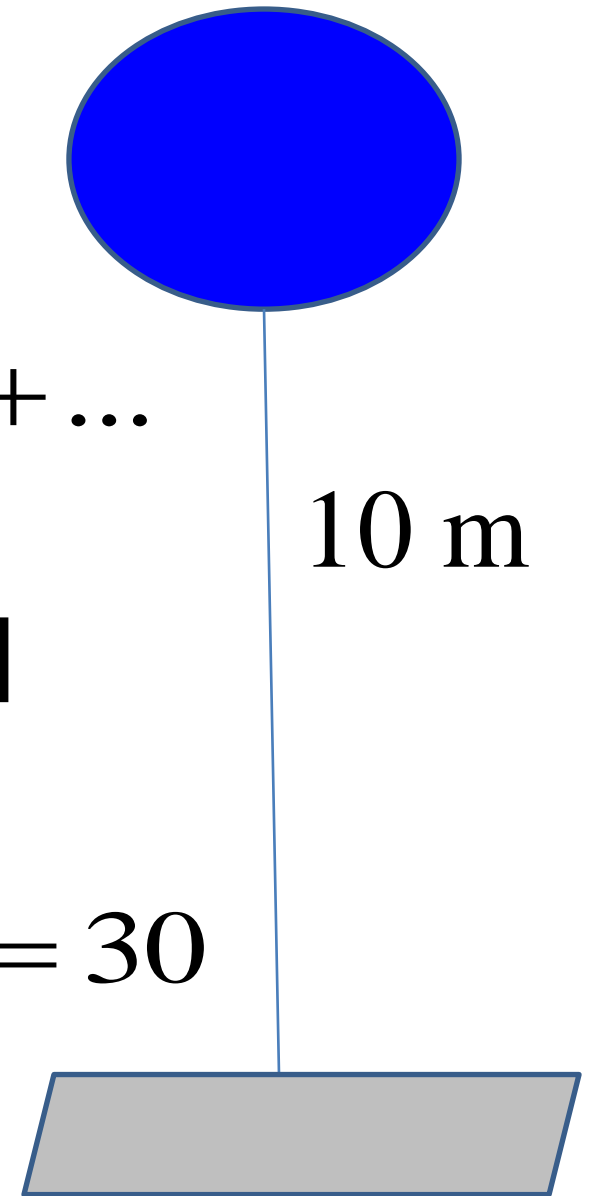$$\textcolor{blue}{u(10) = 100e^{-0.035(10)} = 70.5^0 \text{ F}}$$

Example 4: Series

كرة مطاطية سقطت من ارتفاع 10متر. و ارتطمت بالارض ثم ارتفعت 5 متر. و ظلت على هذه الحركة (كل ارتفاع نصف السابق) حتى السكون على الارض. أوجد الطول الكلى لهذه الذبذبات من لحظة السقوط حتى السكون.

$$S = 10 + 10 \cdot \frac{1}{2} \cdot 2 + 10 \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot 2 + \ldots$$

$$= 10 + 10[1 + \frac{1}{2} + \frac{1}{2} \cdot \frac{1}{2} + \ldots]$$

$$= 10 + 10 \frac{1}{1 - 0.5} = 10 + 20 = 30$$

10 m

Example 5: Assignment Problem   Matrix

In a factory three machines. Each one can manufacture three products.

The cost of the products by the first 5, 7, 9 pounds, respectively.

The cost of products by the second 14, 10, 12 pounds.

The cost of the products by the third, 15, 13, 16 pounds.

Find the minimum cost of production by assigning a machine to manufacture one product.

فى مصنع ثلاث ماكينات. تسطيع كل واحدة تصنيع ثلاث منتجات.

تكاليف المنتجات بواسطة الأولى 5 و 7 و 9 جنيهات على الترتيب.

تكاليف المنتجات بواسطة الثانية 14 و 10 و 12 جنيها.

تكاليف المنتجات بواسطة الثالثة 15 و 13 و 16 جنيها.

احسب أقل تكلفة للانتاج بتخصيص ماكينة لكل منتج.

Products

$$
\begin{array}{c}
\text{M1} \\
\text{M2} \\
\text{M3}
\end{array}
\begin{bmatrix}
5 & 7 & 9 \\
14 & 10 & 12 \\
15 & 13 & 16
\end{bmatrix}
$$

Minimum cost = 5 + 12 + 13 = 30

Example 6: Linear System

A chemical compound is available in three concentrations:

The first of concentration: 1 mg /bottle

The second of concentration: 2 mg /bottle

The third of concentration: 3 mg /bottle

If we wante to produce 14 bottles of concentration 2.5 mg / bottle by mixing whole several bottles of each type. Find all possible solutions.

Assume that :

x = number of bottles taken from the first
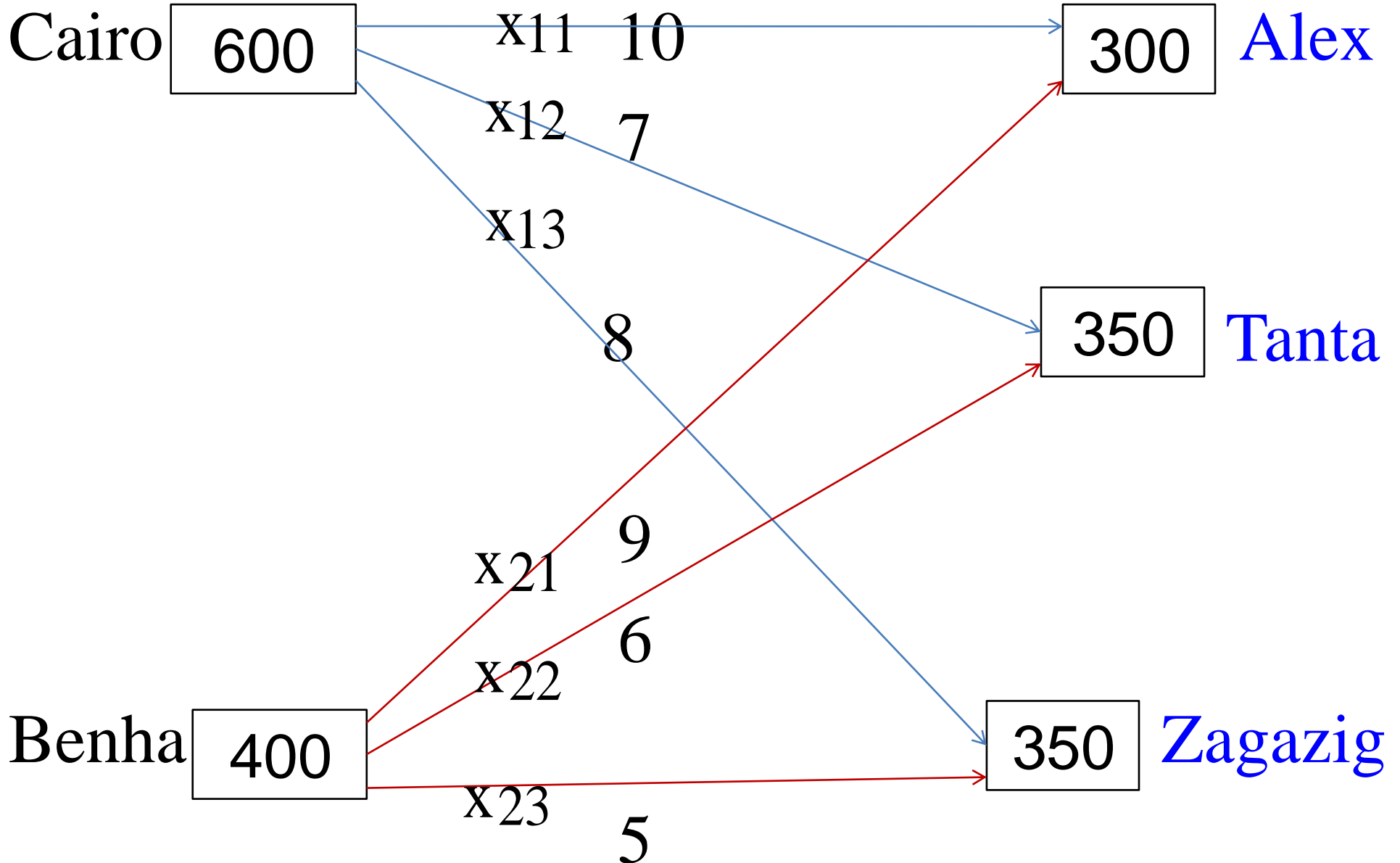
y = number of bottles taken from the second

z = number of bottles taken from the third

Then   x + y + z = 14,

x + 2y + 3z = 14(2.5) = 35, x, y, z ≥ 0, integers

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} x \\ 7 - 2x \\ 7 + x \end{bmatrix} = \begin{bmatrix} 0 \\ 7 \\ 7 \end{bmatrix}, \begin{bmatrix} 1 \\ 5 \\ 8 \end{bmatrix}, \begin{bmatrix} 2 \\ 3 \\ 9 \end{bmatrix}, \begin{bmatrix} 4 \\ -1 \\ 11 \end{bmatrix}$$

Optimization Problem Linear Programming

Cairo | 600 | —x11— 10 → | 300 | Alex

x12 7

x13 8

| 350 | Tanta

x21 9

x22 6

Benha | 400 | x23 5 → | 350 | Zagazig

Mathematical Model

Minimize $f = 10x_{11} + 7x_{12} + 8x_{13} + 9x_{21} + 6x_{22} + 5x_{23}$

s.t

$$x_{11} + x_{12} + x_{13} = 600$$

$$x_{21} + x_{22} + x_{23} = 400$$

$$x_{11} + x_{21} = 300$$

$$x_{12} + x_{22} = 350$$

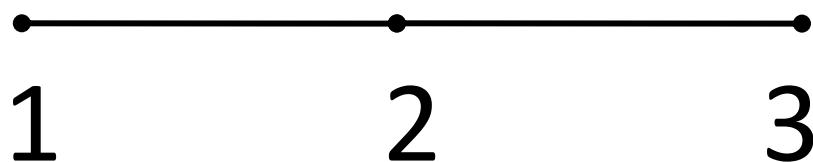$$x_{13} + x_{23} = 350$$

$$x_{11}, \ x_{12}, \ x_{13}, \ x_{21}, \ x_{22}, \ x_{23} \geq 0$$

Properties of Chemical Compounds

$$CH_2 \Longequal CH \text{———} CH_3$$

- The molecular graph:

```
  •————————————•————————————•
  1            2            3
```

- The matrix:

$$\begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}$$

Write a brief summary of this lecture and what you want from this course.

أَكتب نبذه مختصرة عن هذه المحاضرة و ما تريده من هذا المقرر.

For more information, visit the website

www.bu.edu.eg/staff/mohamedeed3

——————→ courses

Benha University

Home

النسخة العربية

My C.V.

About

Courses

Publications

Reports

Published books

Workshops / Conferences

Supervised PhD

Supervised MSc

You are in:Home

Dr. Mohamed Husien Mohamed Eid

Academic Position: Lecturer

Current Administrative Position:

Ex-Administrative Position:

Faculty: Engineering, Shoubra

Department: Mathematical & Physical Engineering

Edu-Mail: mohamed.eed@feng.bu.edu.eg

Alternative Email: M_H_Eid2014@hotmail.com

Mobile:

Scientific Name: M.H.Eid

Publications [Titles(11) **::** Papers(0) **::** Abstracts(11) **]**

Inlinks(0) :: Courses Files(261) | Total points :283

News

Thank You