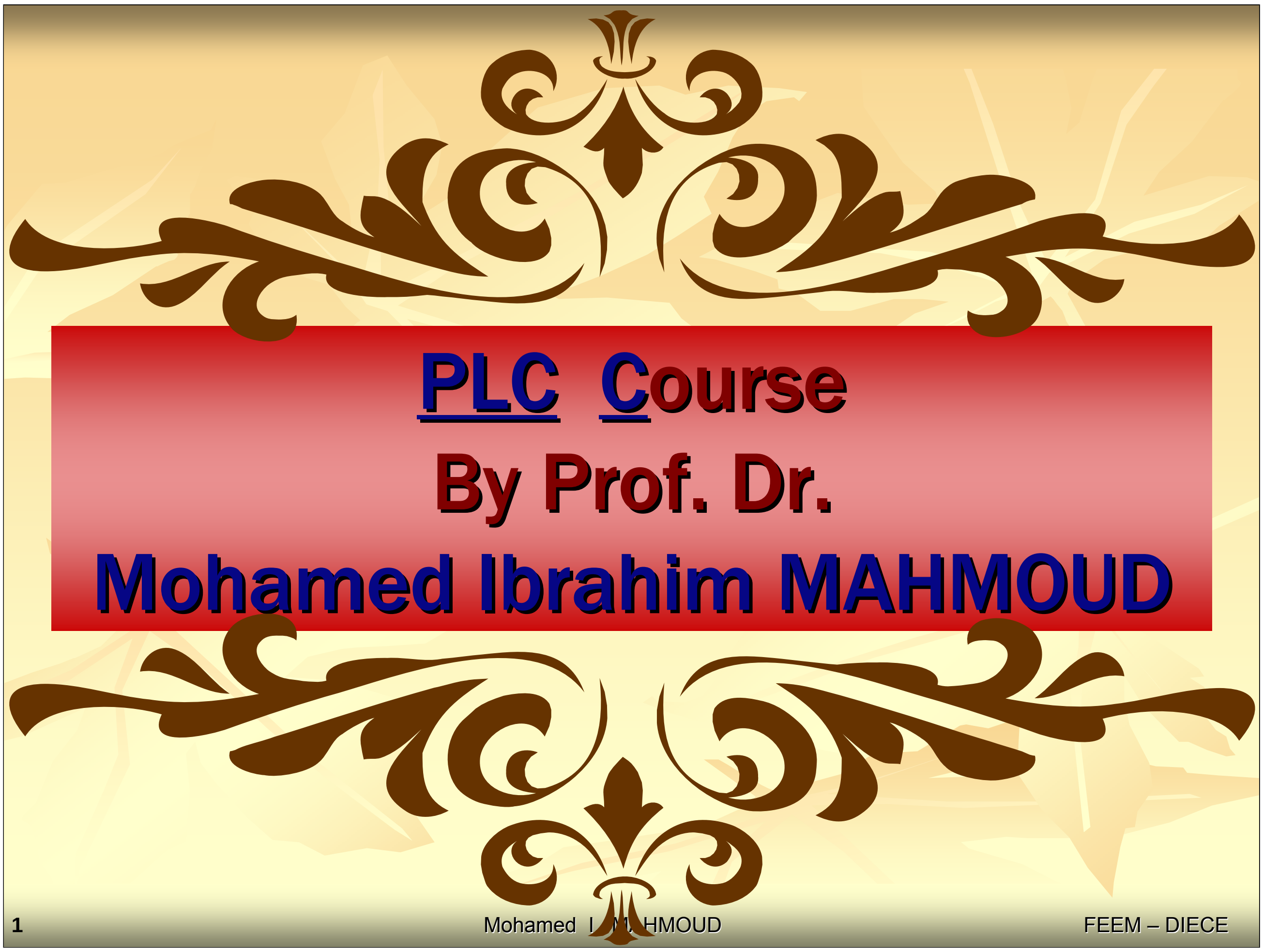
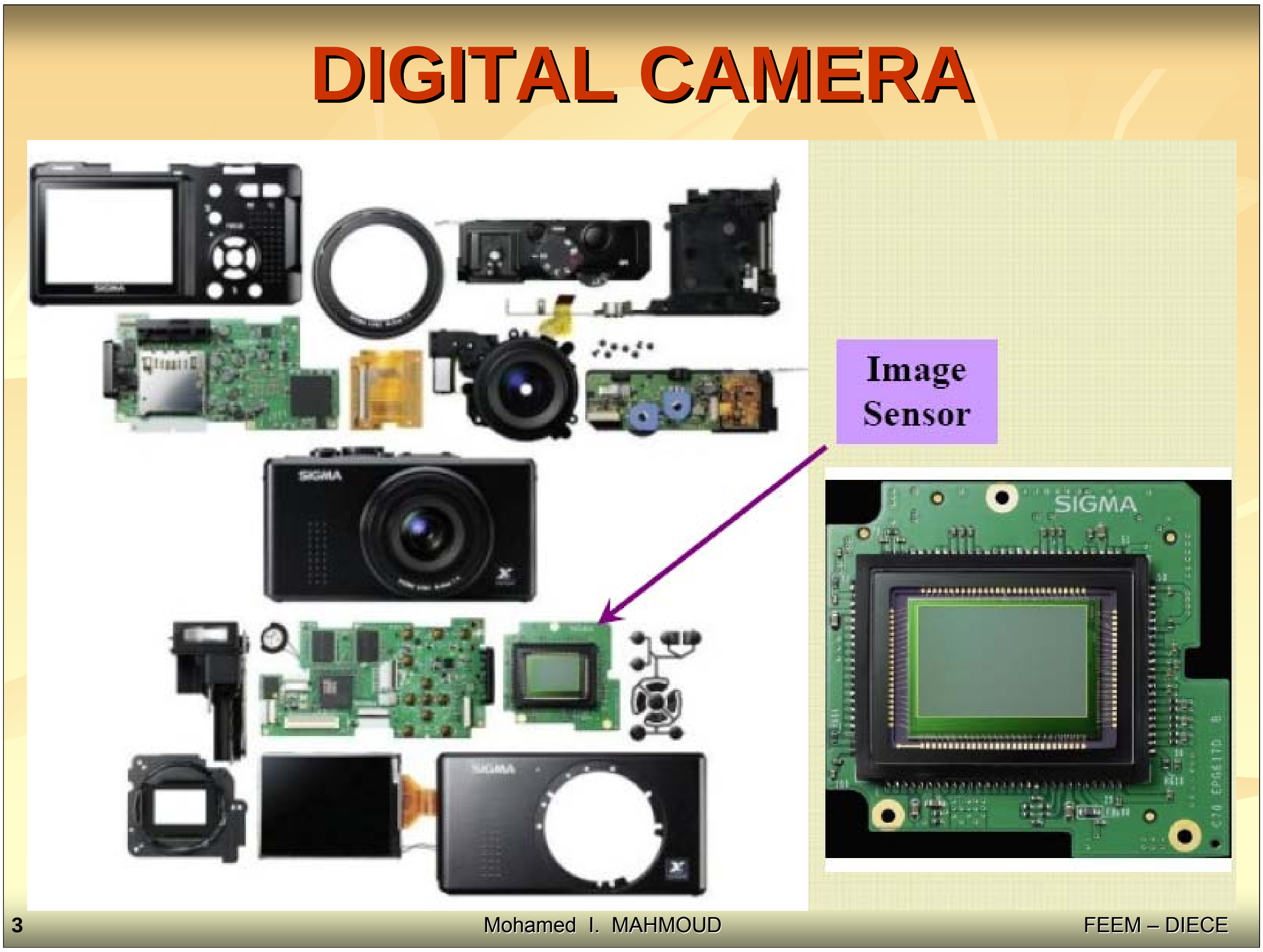


Prof Dr.
Mohamed Ibrahim MAHMOUD

Departement of Industrial Electronics and Control Engineering

Faculty of Electronic Engineering at Menouf – Egypt


CUSTMER PRODUCTS
2
Mohamed I. MAHMOUD
FEEM – DIECE


DIGITAL CAMERA
Image Sensor
SIGMA
3
Mohamed I. MAHMOUD
FEEM – DIECE

HARD DISK

4 Mohamed I. MAHMOUD FEEM – DIECE

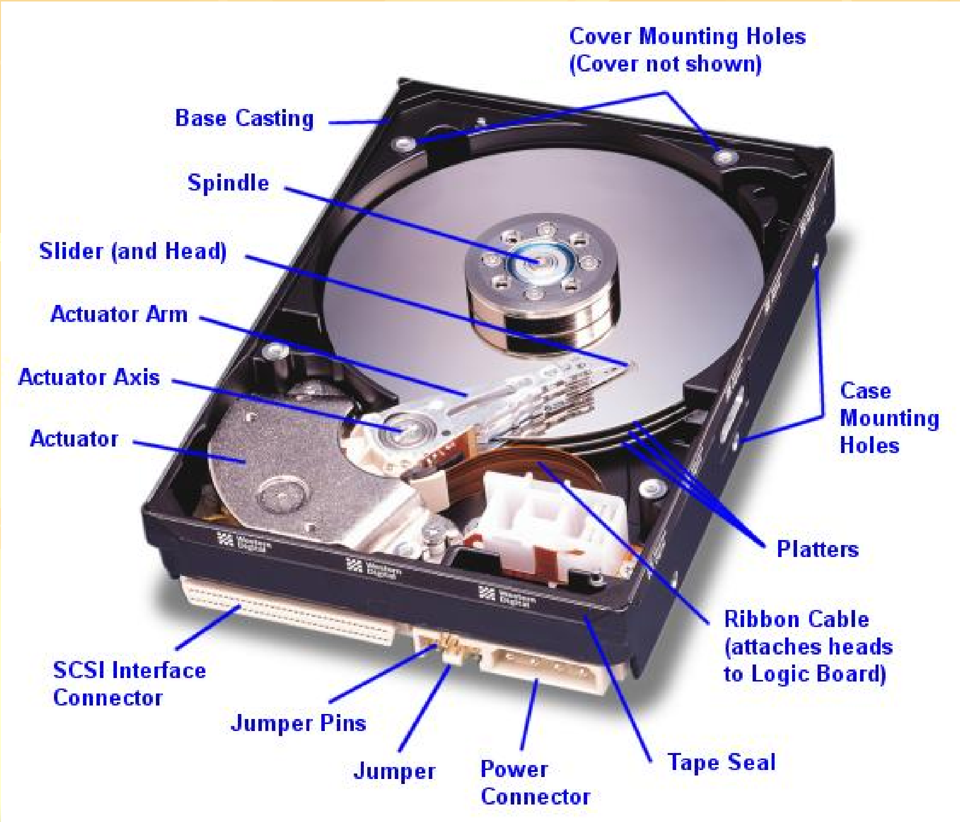
HARD DISK (Mechanical)

5 Mohamed I. MAHMOUD FEEM – DIECE

HARD DISK (Electronics)

6 Mohamed I. MAHMOUD FEEM – DIECE

HARD DISK DRIVE



7 Mohamed I. MAHMOUD FEEM – DIECE

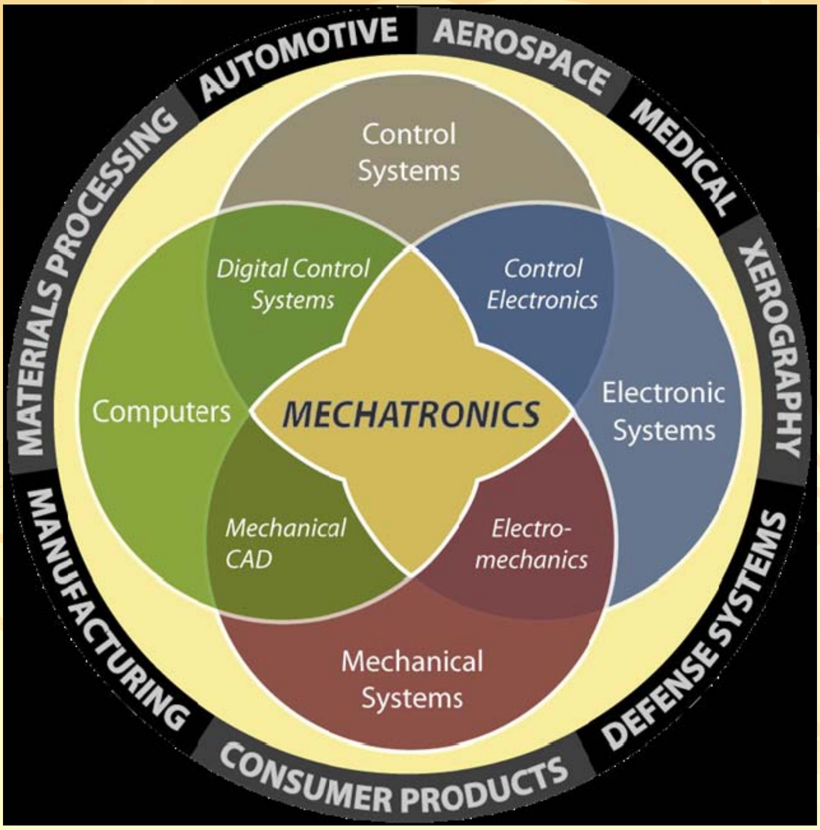
MECHATRONICS !?

Prof. Dr.
Mohamed Ibrahim MAHMOUD

Menoufiya University
Faculty of Electronic Engineering
at Menouf – Egypt

Department of Industrial Electronics and Control Engineering

MECHATRONICS



9 Mohamed I. MAHMOUD FEEM – DIECE

Write your notes

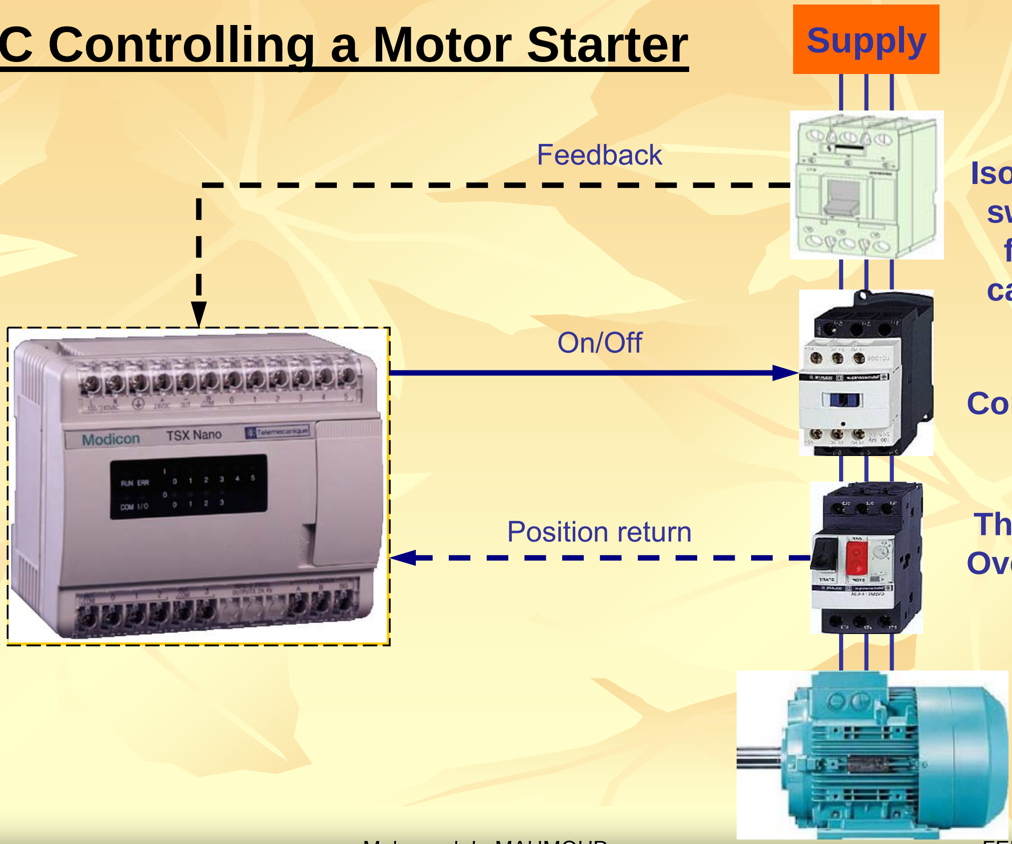
Automation And Control

A A C

Write your notes

PLC In An Automation

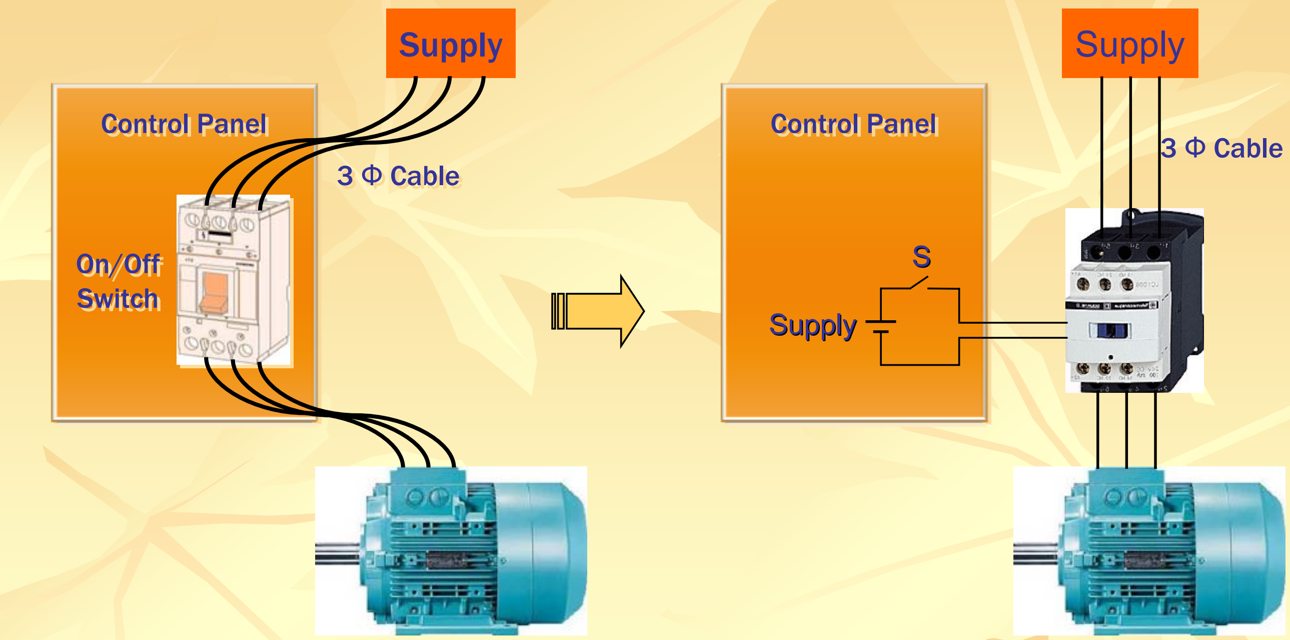
PLC Controlling a Motor Starter



11 Mohamed I. MAHMOUD FEEM – DIECE

Write your notes

Why Using Relay Control



The circuit has three advantages

1- Provides safety for the operator

2- Reduce coast by reducing high power cable length

3- Reducing power losses

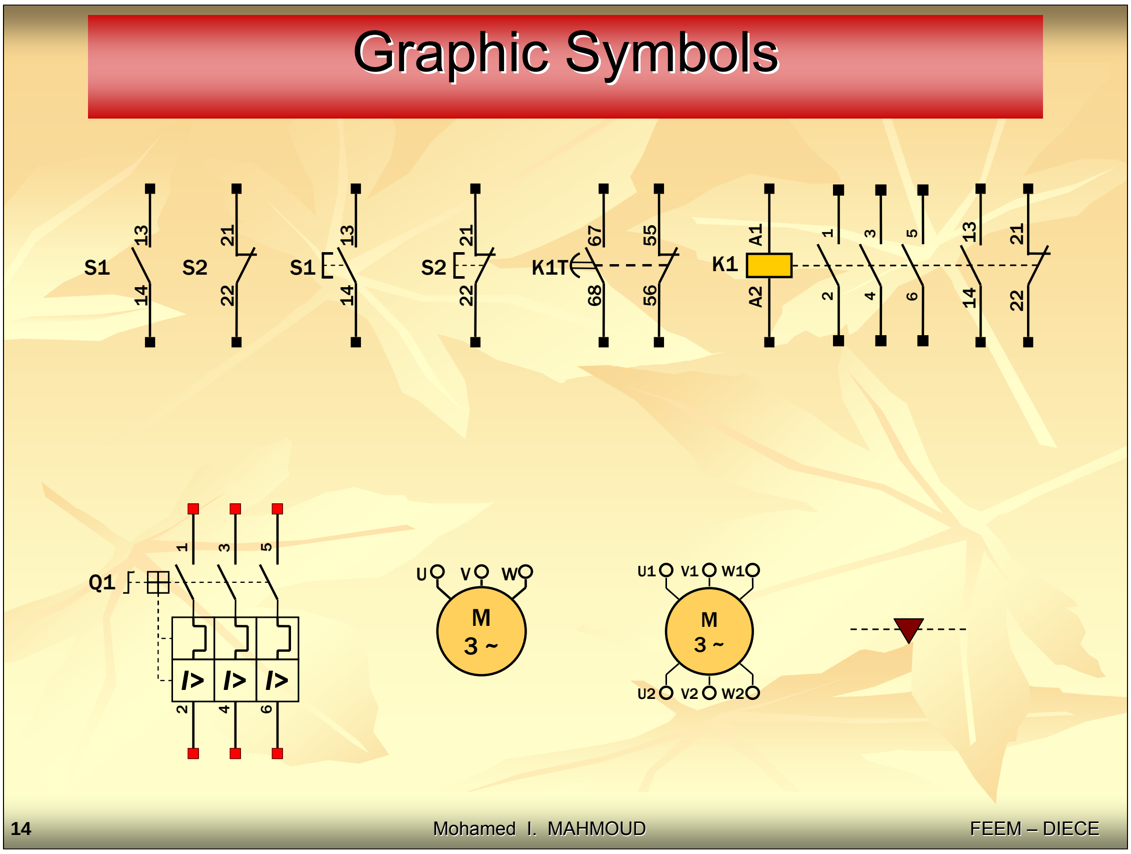
12 Mohamed I. MAHMOUD FEEM – DIECE

Write your notes

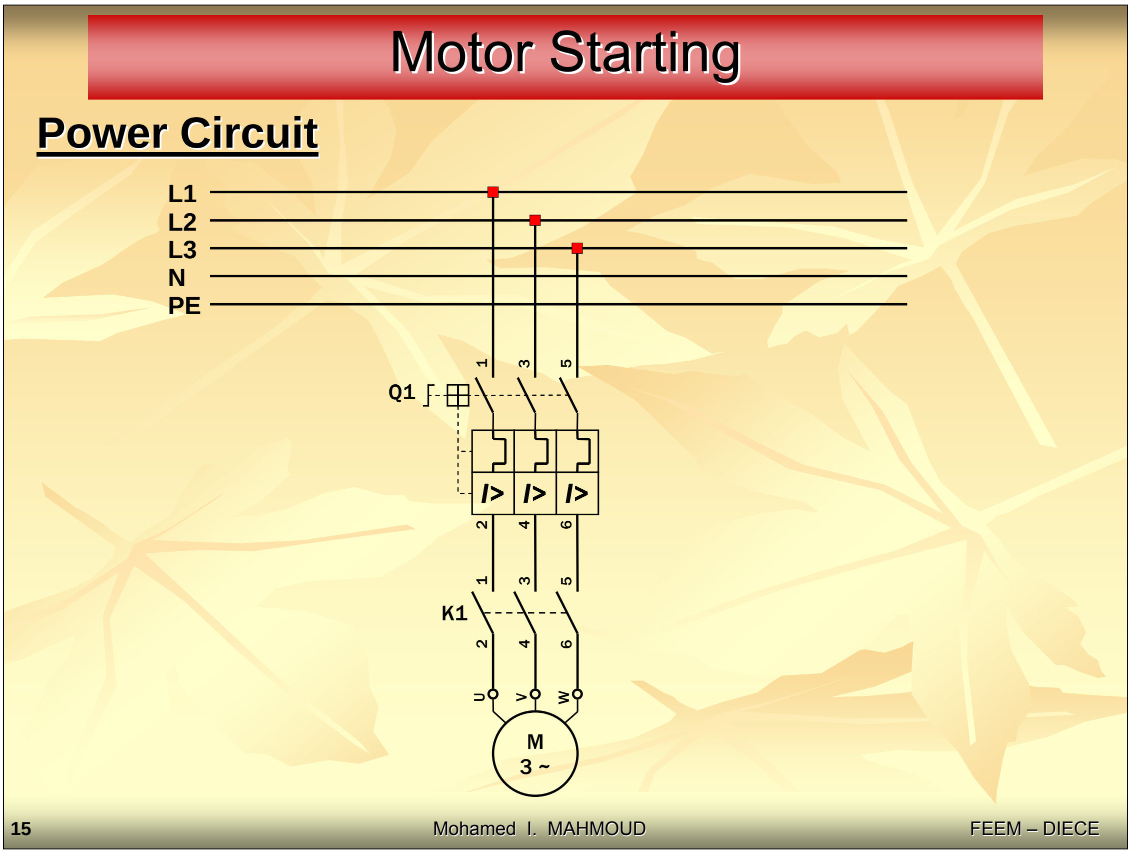
Relay Logic Controller

R L C

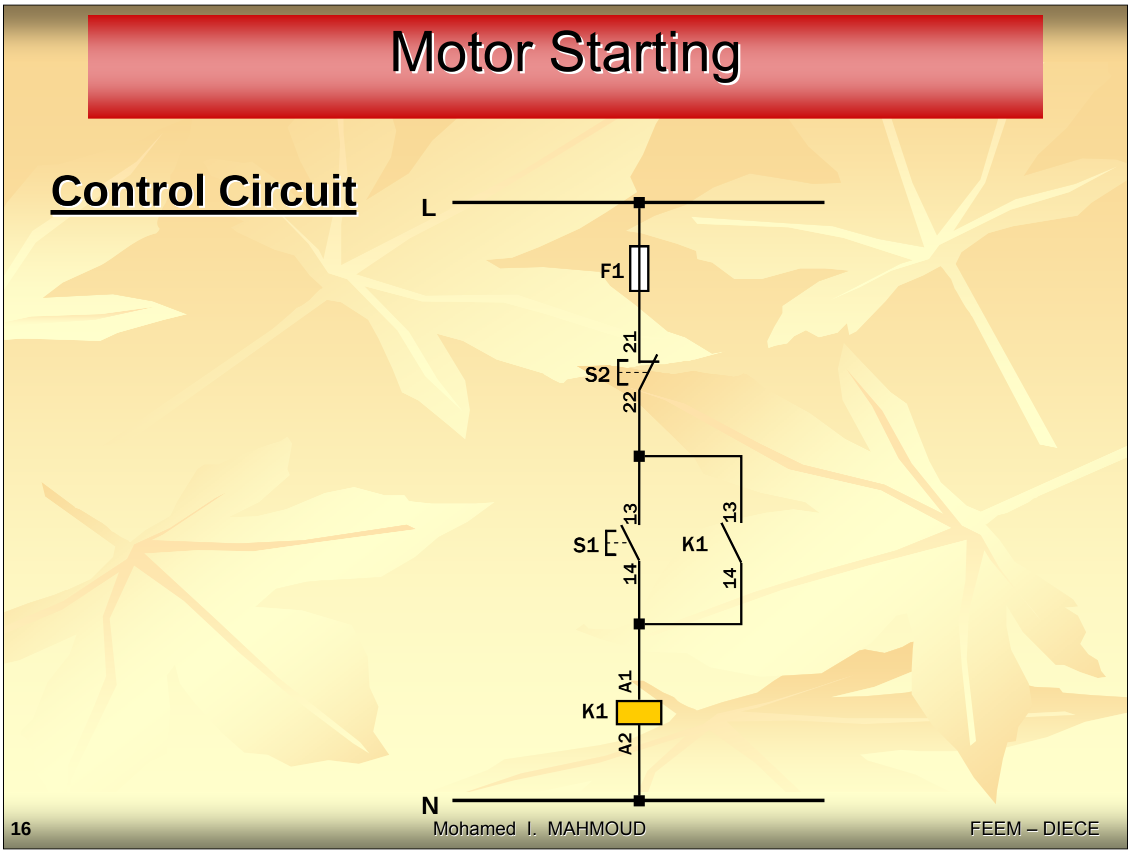
Write your notes



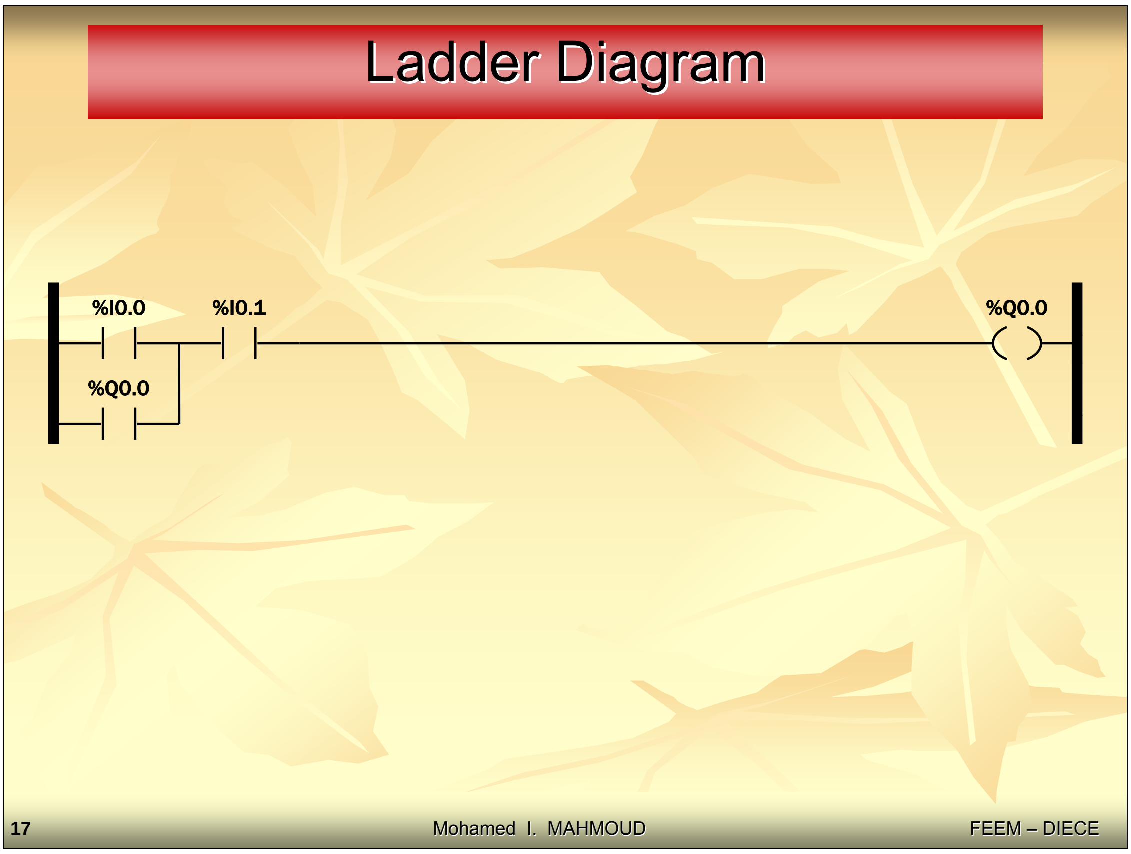
Write Your Notes



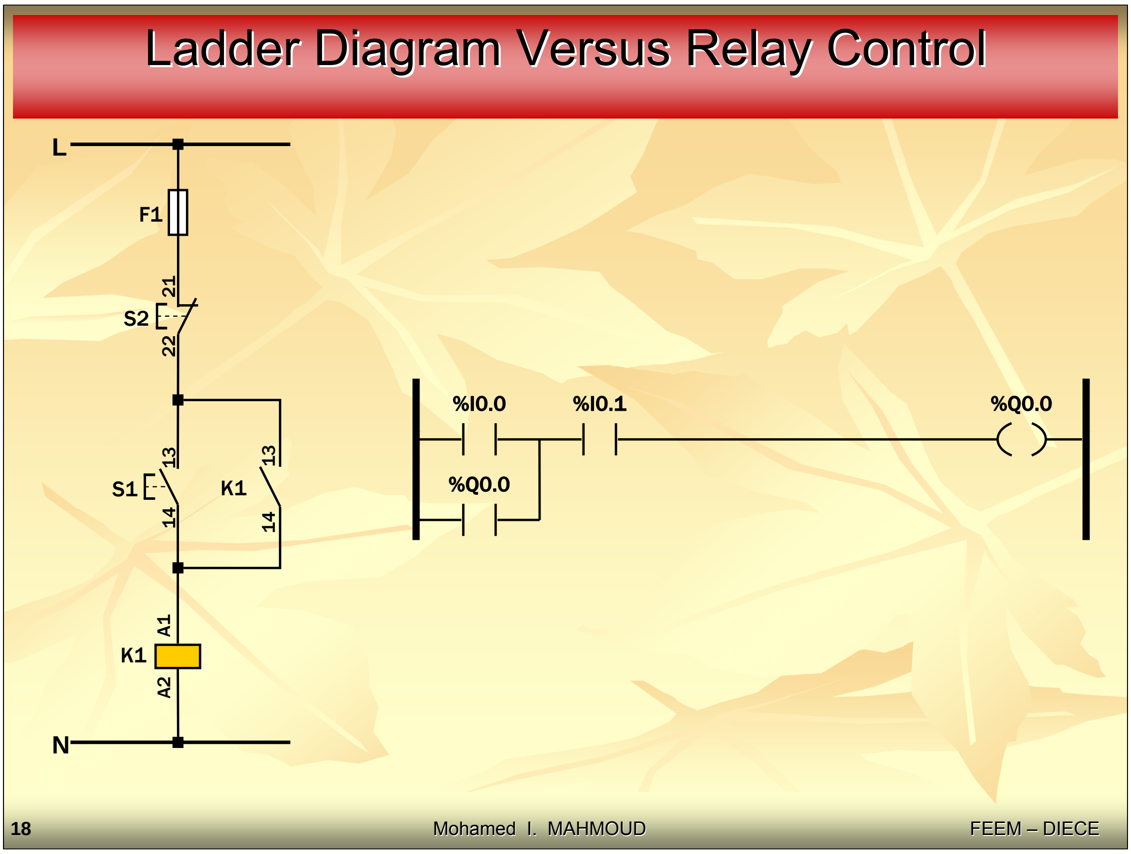
Write Your Notes



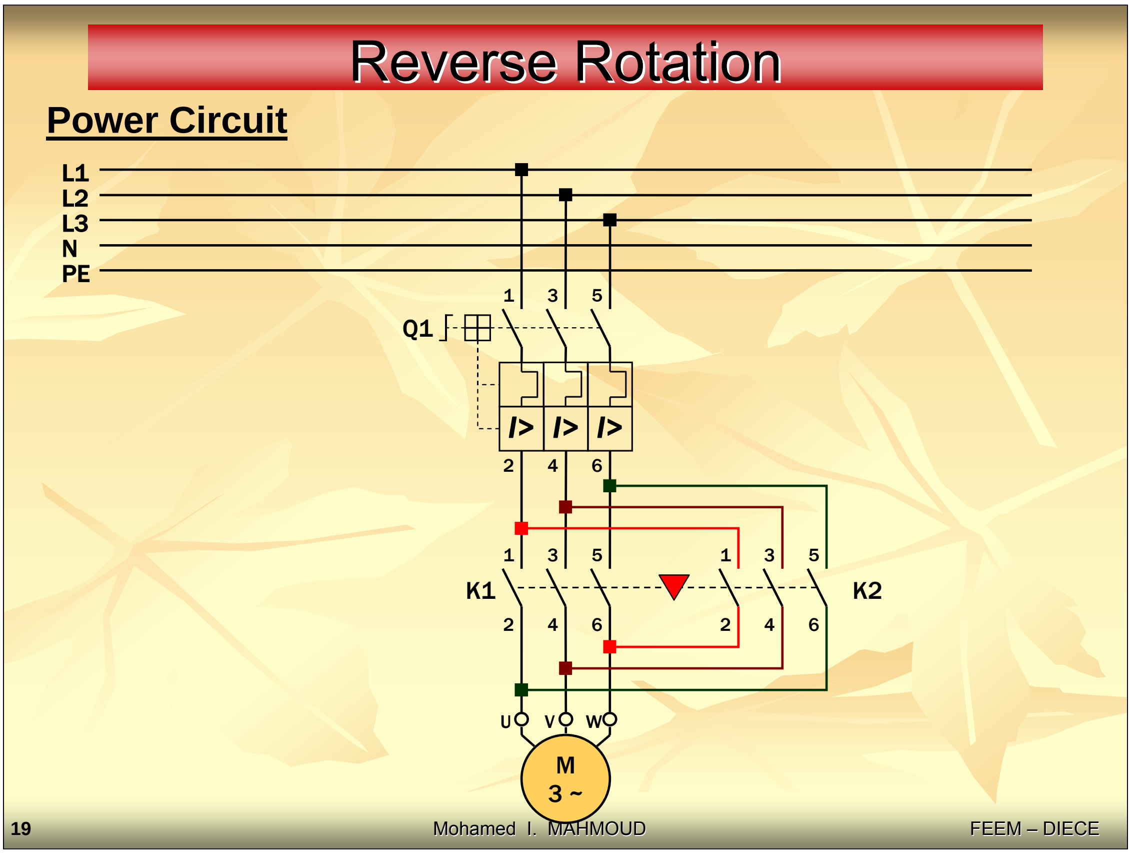
Write Your Notes



Write Your Notes



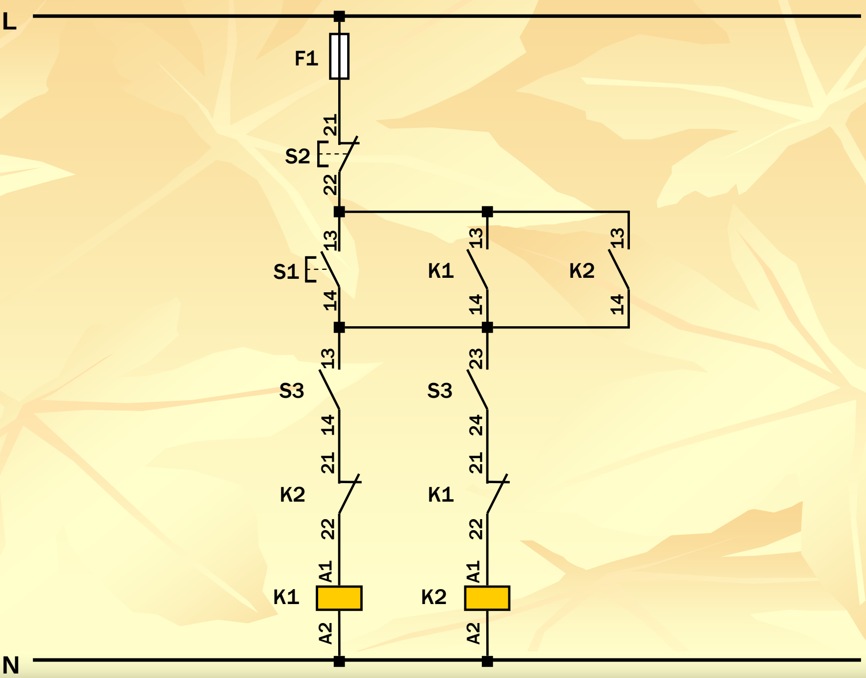
Write Your Notes



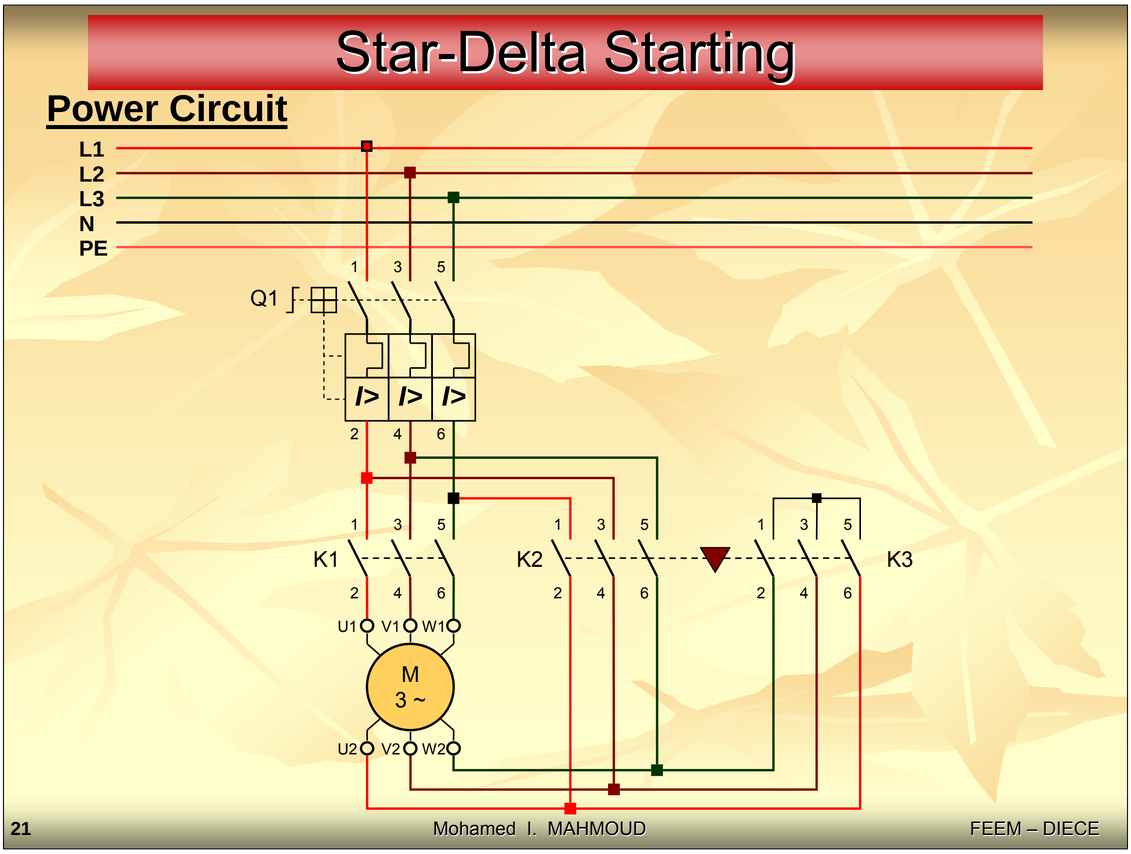
Write Your Notes

Reverse Rotation

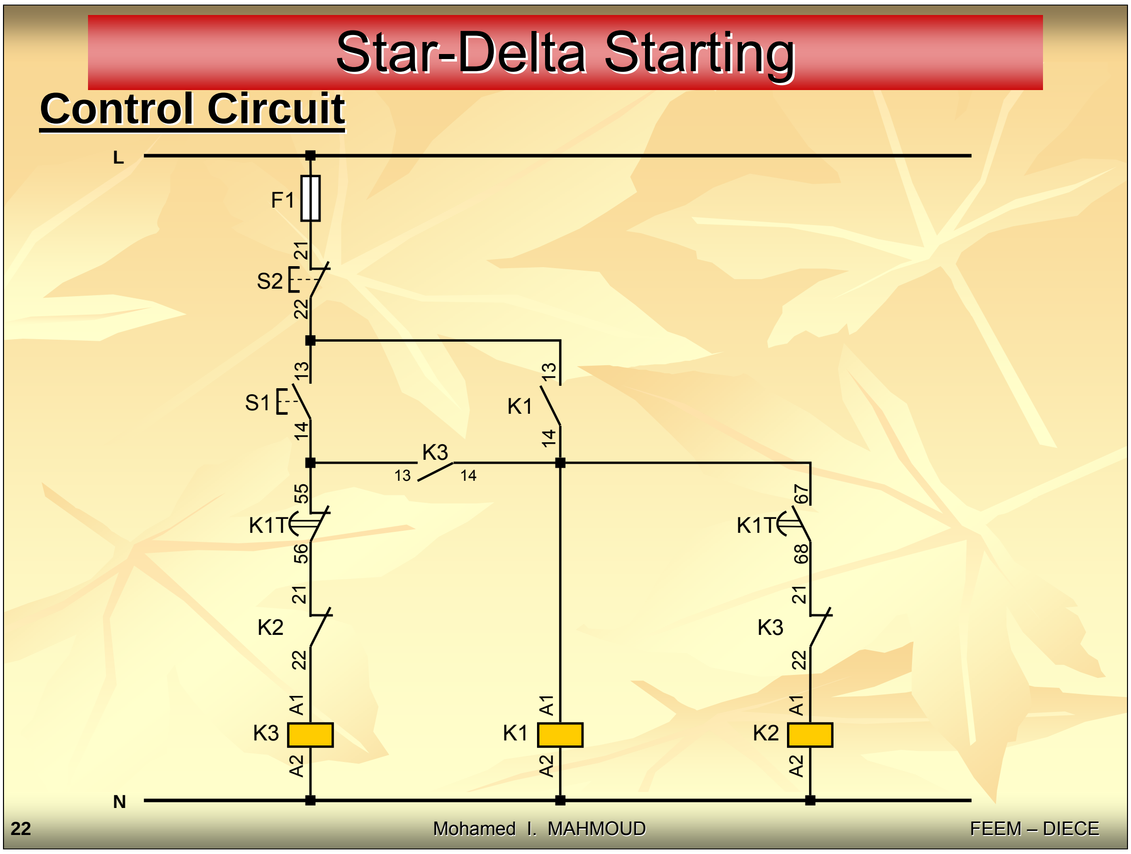
Control Circuit



Write Your Notes



Write Your Notes



Write Your Notes

Programming Languages
IEC 1131 – 3

Write your notes

SFC - GRAFCET

Graphic-based…. High level language used to program PLC automatically.

Allows users to define their program in a flowchart format.

Basis of IEC1131-3 (SFC) language standards.

24 Mohamed I. MAHMOUD FEEM – DIECE

Write your notes

IEC 1131

- 1979 : The International Electrotechnical Commission assigned the research committee 65A to define a PLC standard.
- Objective : to meet the increasing complexity requirements of control and monitoring systems and the large number of PLCs which are incompatible with each other.
- Its contents :
  - IEC1131-1 : General information (1992).
  - IEC1131-2 : Specifications & equipment testing (1992).
  - **IEC1131-3 : Programming languages (1993)**
  - IEC1131-4 : Recommendation to the user.
  - IEC1131-5 : Message handling functions specifications.

25 Mohamed I. MAHMOUD FEEM – DIECE

Write your notes

IEC 1131-3

This standard describes

Two textual languages
- Instruction list IL
- structured Text ST

Two graphic languages
- Ladder Diagram LD
- Function Block FB

A graphic chart
- Sequential Fn. Chart SFC

Write your notes

Instruction List (IL)

- ⌘ Series of instructions, each one must start on a new line.
- ⌘ One instruction = operator + one or more operations separated by commas.
- ⌘ Function Blocks lunched using a special operator.

Label	Operation	Operand	Comment
Run:	LD	%IX1	(*pushbutton*)
	ANDN	%MX5	
	ST	%QX2	(*run*)

27 Mohamed I. MAHMOUD FEEM – DIECE

Write your notes

Structured Text (ST)

- Syntax similar to that of Pascal; enabling a description of complex algorithmic structure
- succession of statements for assigning variables, controlling functions and function blocks, using operators, repetition, conditional executions.
- Function blocks launched using a special operator.

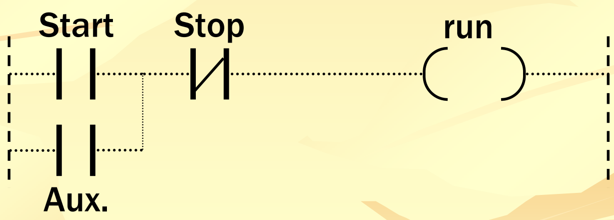
```
J:=1
WHILE J<=100 & X1<>X2 DO
J:=J+2
END_WHILE
```

28 Mohamed I. MAHMOUD FEEM – DIECE

Write your notes

Ladder Diagram (LD)

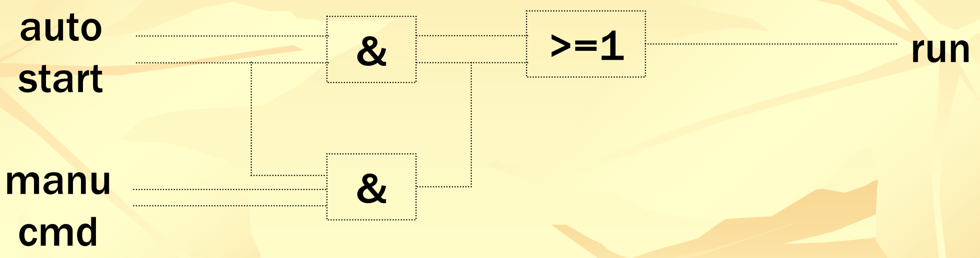
- Graphic elements organized in networks connected by power supply rails.
- Elements used: contacts, coil, functions, function blocks control elements (jump, return, etc.)



Write your notes

Function Block Diagram (FBD)

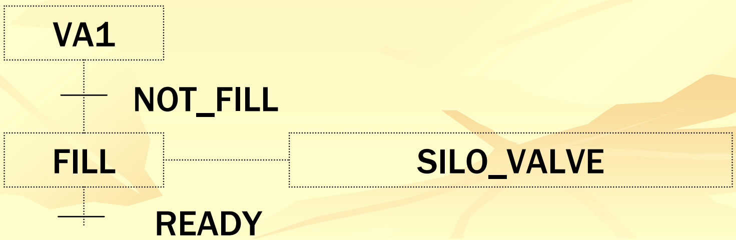
- Representation of functions by blocks linked to each other.
- Network evaluation : from the O/P of a function block to the I/P of the connected function block.



Write your notes

Sequential Function Chart (SFC)

- To describe sequential control function.
- steps & transitions represented graphically by a block or literally.
- Transition conditions in LD, FBD, IL or ST languages.
- Actions associated with the steps : Boolean variables or a section of the program written in one of the five languages.
- Association between action and steps in graphical or literal form.



Write your notes

Hardware – Software Equivalence

During the scan cycle:

- the PLC takes the action of an input hardware device,
- introduces it to the corresponding software and
- executes the related instruction.

What is the equivalent of an input device and its corresponding software?

Input Hardware Device	Corresponding Software	Equivalent Used
Normally Open	Normally Open	Normally Open
Normally Closed	Normally Open	Normally Closed
Normally Open	Normally Closed	Normally Closed
Normally Closed	Normally Closed	Normally Open

32 Mohamed I. MAHMOUD FEEM – DIECE

Write your notes

Program Design Steps

1. Description of system objectives.
2. Detailed description of system functions.
3. Circuit diagram and/or block diagram of the system.
4. Separation of function steps.
5. Choice of PLC Function.
6. PLC input/output connection.
7. Input/output addresses.
8. Program list or diagram.
9. Program test and verification.
10. System verification.

Write your notes

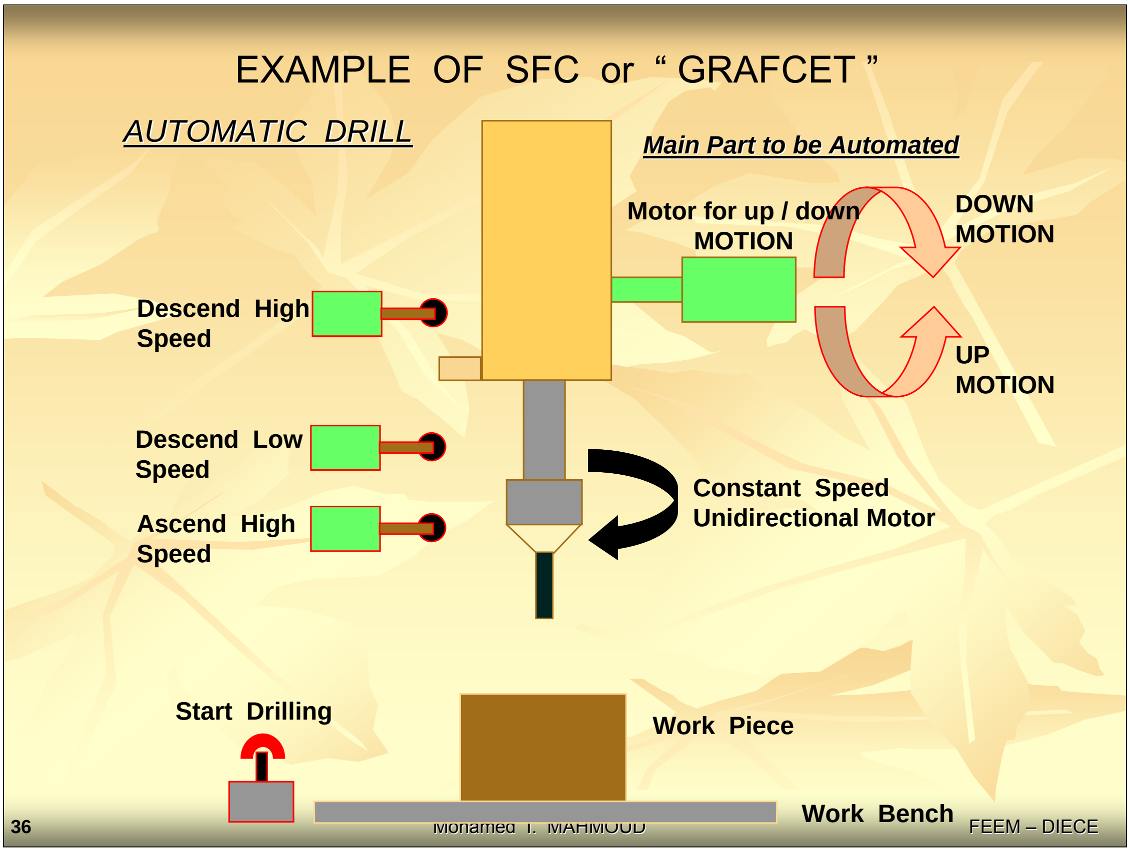
Second Level

PLC GRAFCET

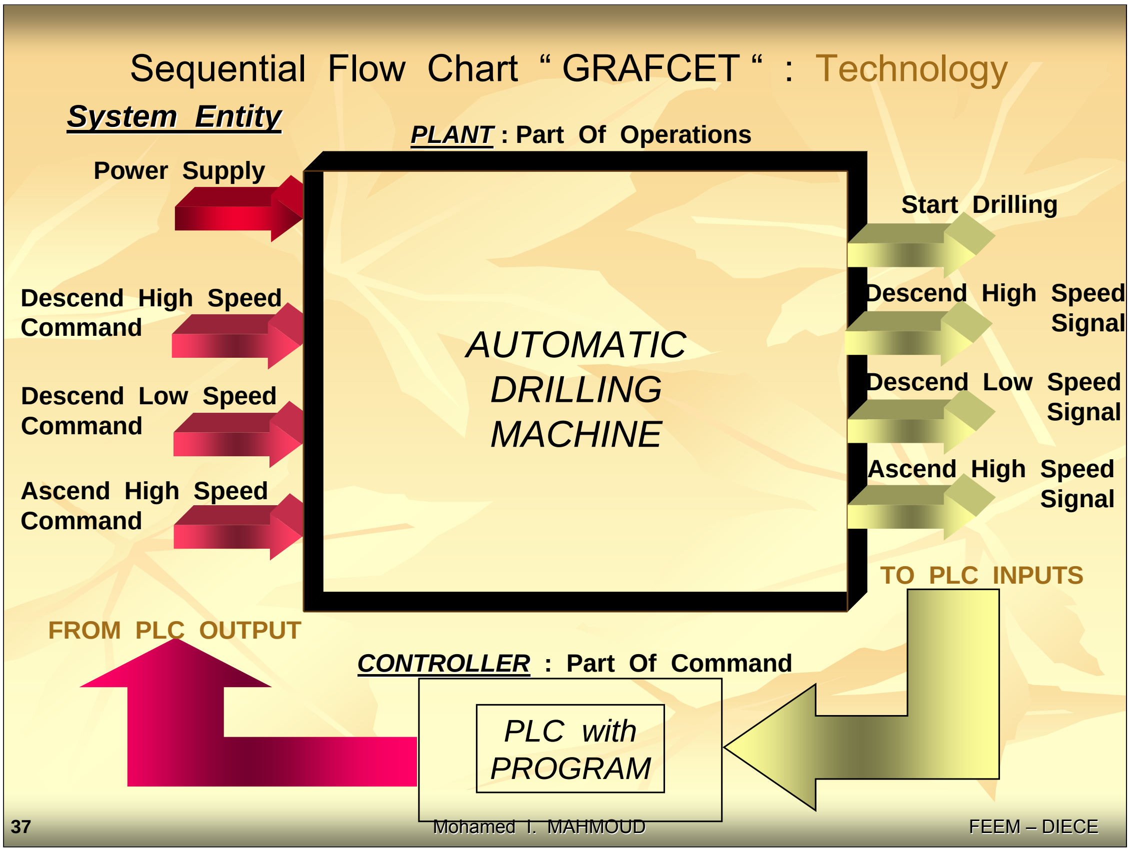
Programmable Logic Controllers PLCs

Write your notes

Write your notes



Write your notes



Write your notes

Sequential Flow Chart " GRAFCET " : Technology

System Addressing

INPUTS TO PLC :

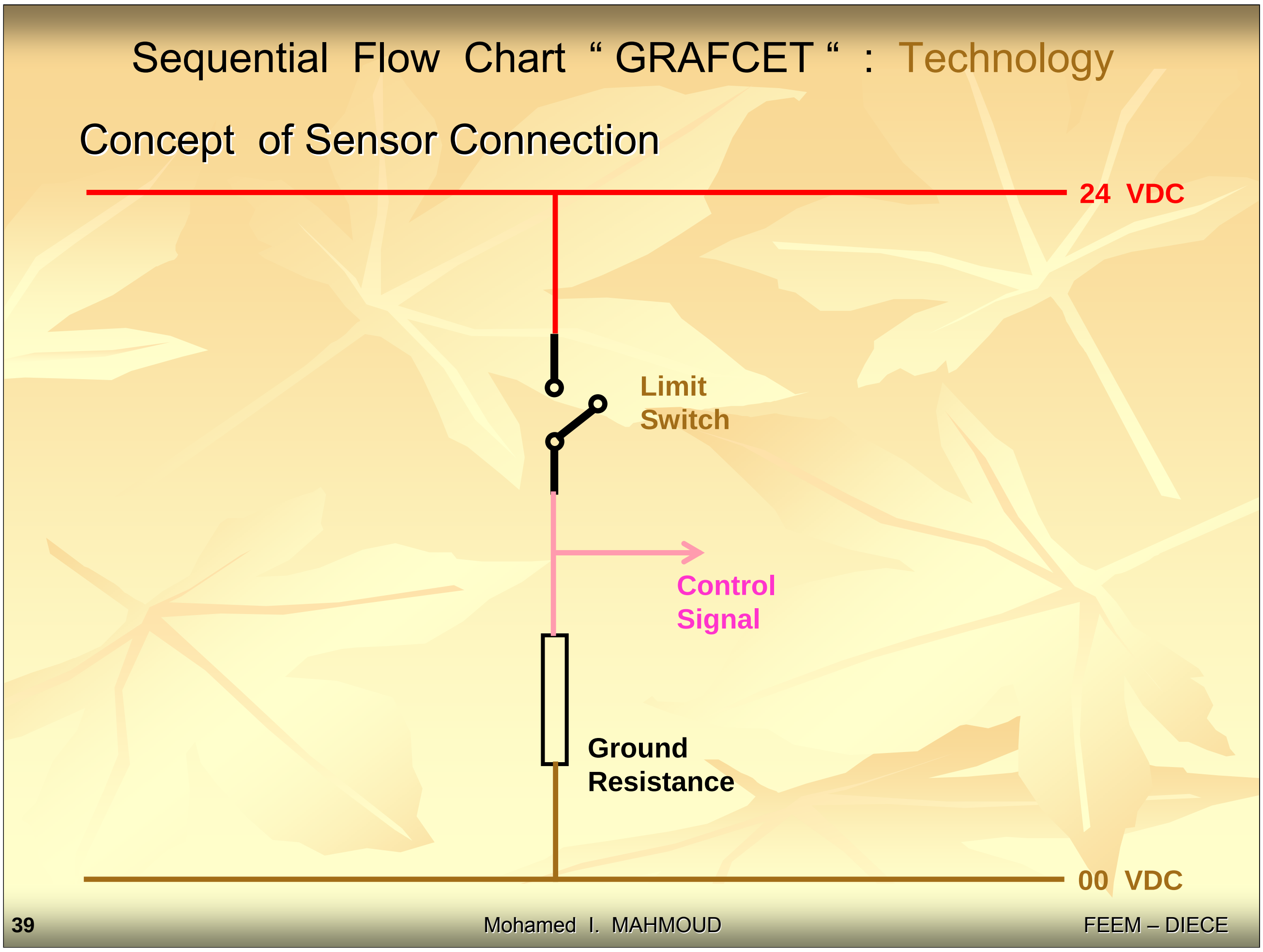
Signal Of Start Drilling . . . . I_0
Signal Of Descend High Speed . . . I_1
Signal Of Descend Low Speed . . . I_2
Signal Of Ascend High Speed . . . . I_3

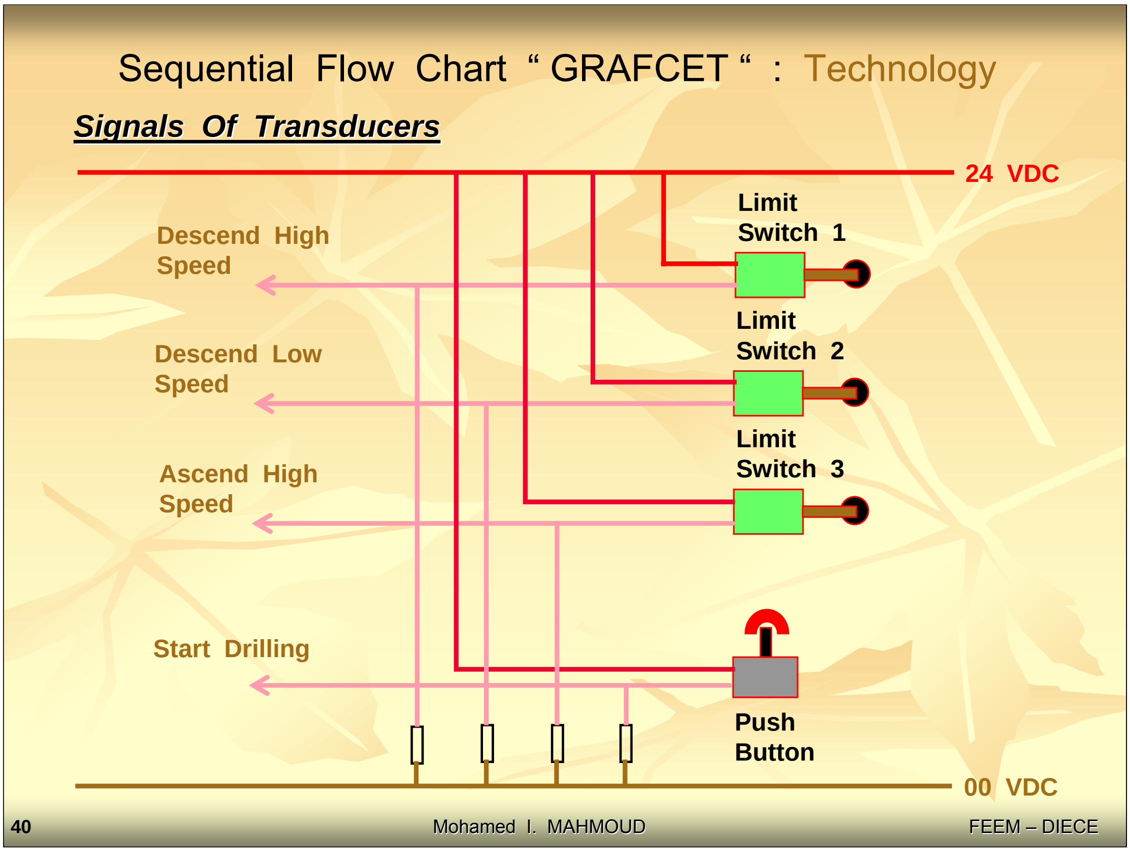
OUTPUTS FROM PLC :

Command Of Descend High Speed. . . . Q_0
Command Of Descend Low Speed . . . . Q_1
Command Of Ascend High Speed . . . . Q_2

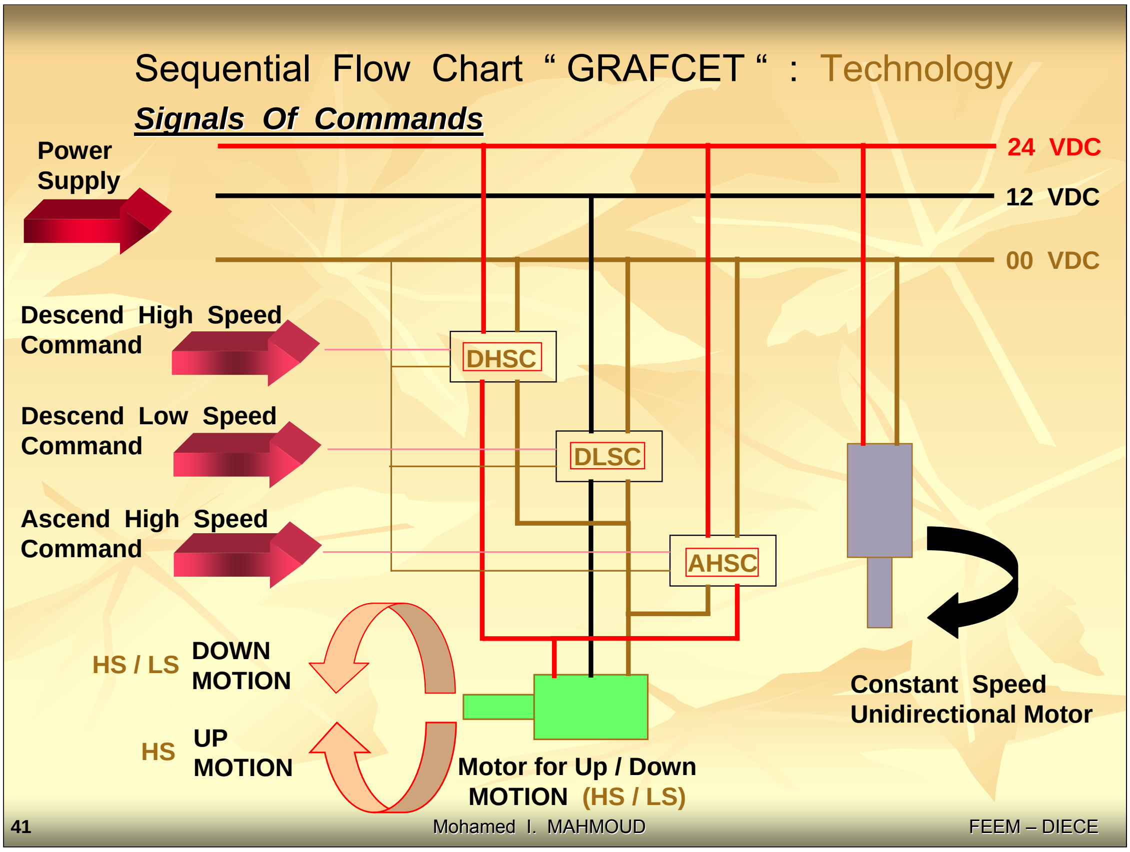
38 Mohamed I. MAHMOUD FEEM – DIECE

Write your notes

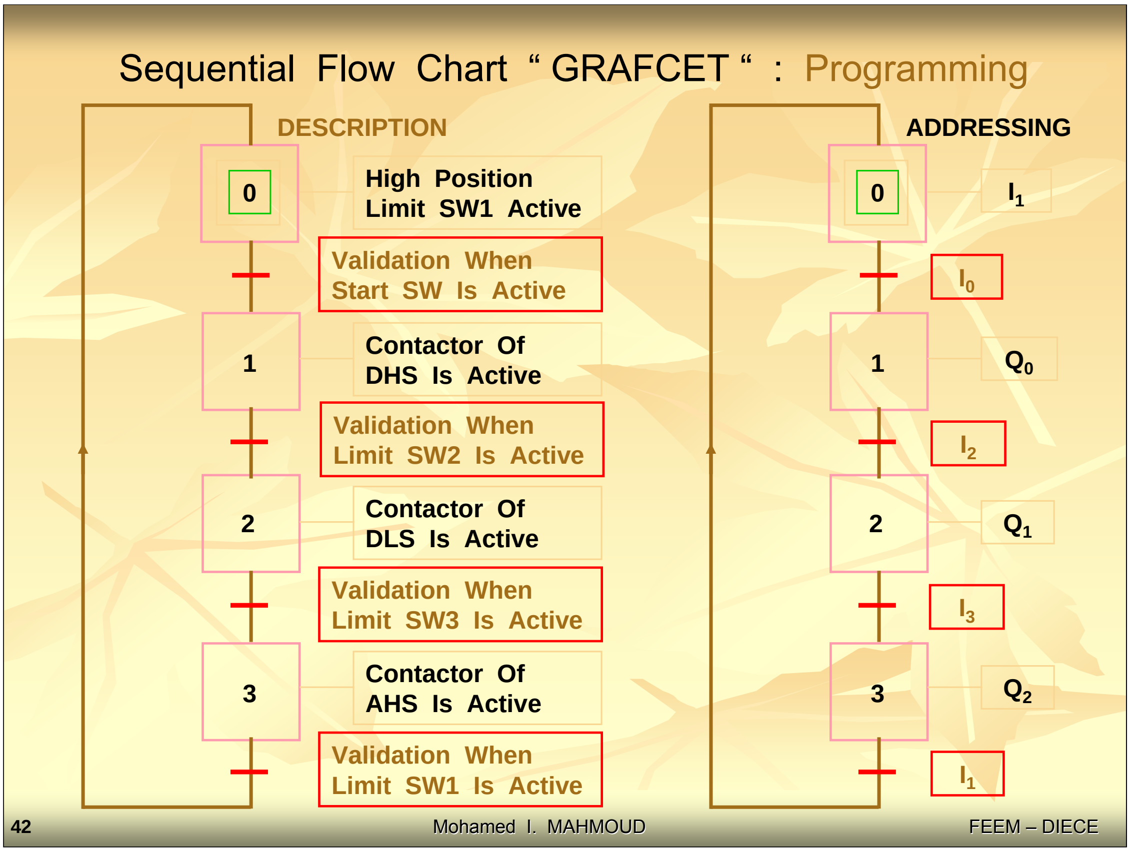

Sequential Flow Chart " GRAFCET " : Technology
Concept of Sensor Connection
24 VDC
Limit
Switch
Control
Signal
Ground
Resistance
00 VDC
39
Mohamed I. MAHMOUD
FEEM – DIECE



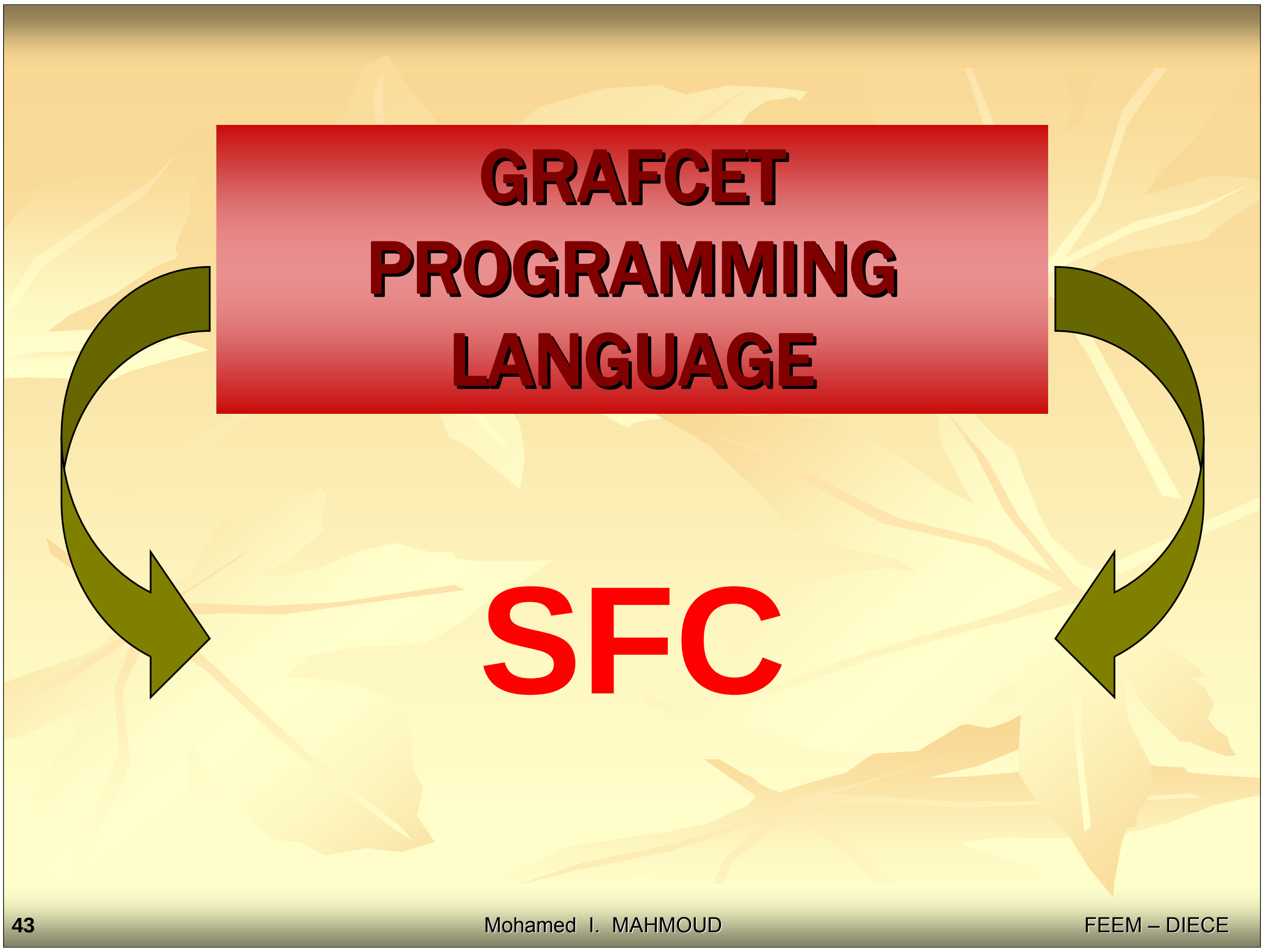
Write your notes



Write your notes



Write your notes



Write your notes

INTRODUCTION

GRAFCET is a special type of PLC programming languages that is used mainly for sequential programming of ON/OFF control purposes which are comprised of successive steps with associated actions and transition conditions to switch between such steps.

Write your notes

How GRAFCET is Created

Initial step is the starting point of the graph.

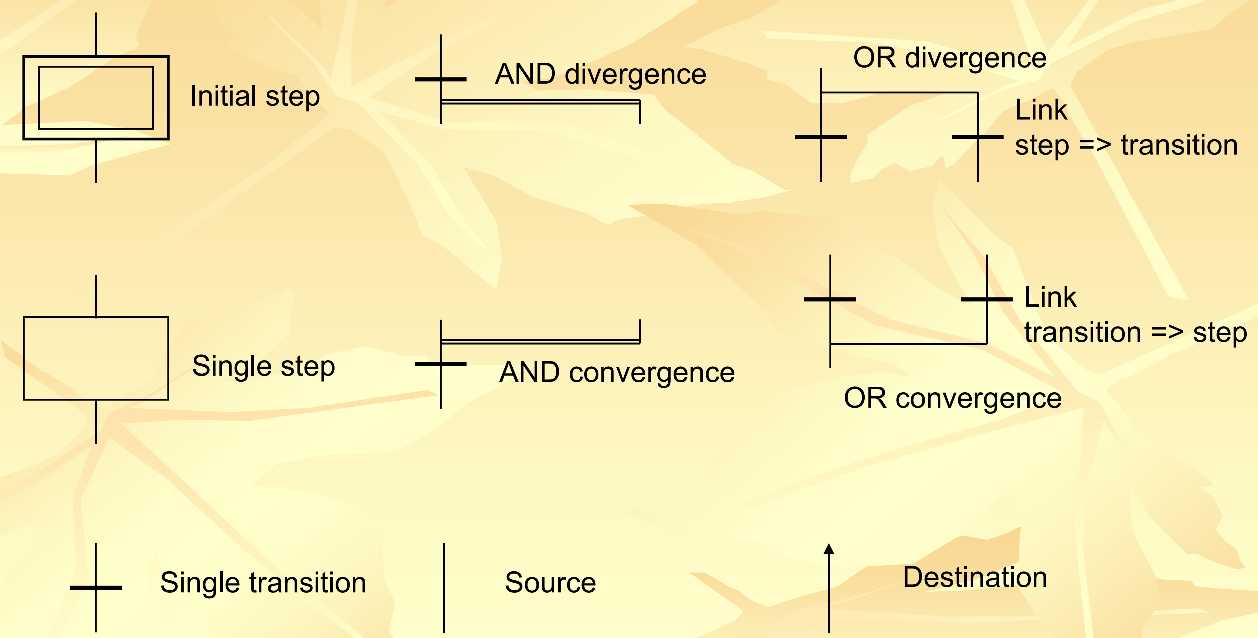
Single step is the main parts of the graph.

Transition separates all steps in the graph.
The transition activates the step that follows it, thus transferring control from one step to the next.

Trigger is a control statement with a true or false value.
The trigger controls the transition.

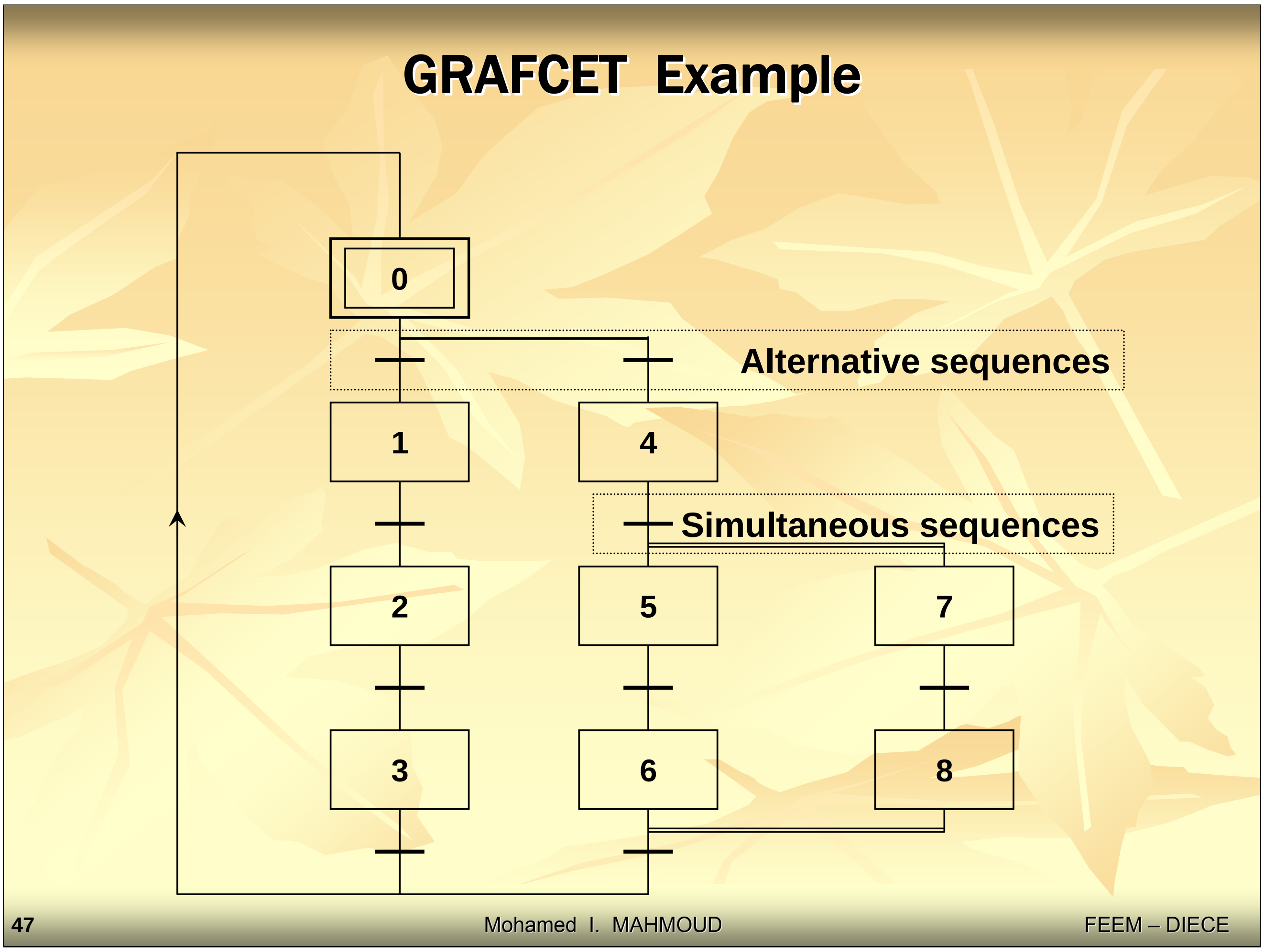
Write your notes

GRAFCET Graphic Objects

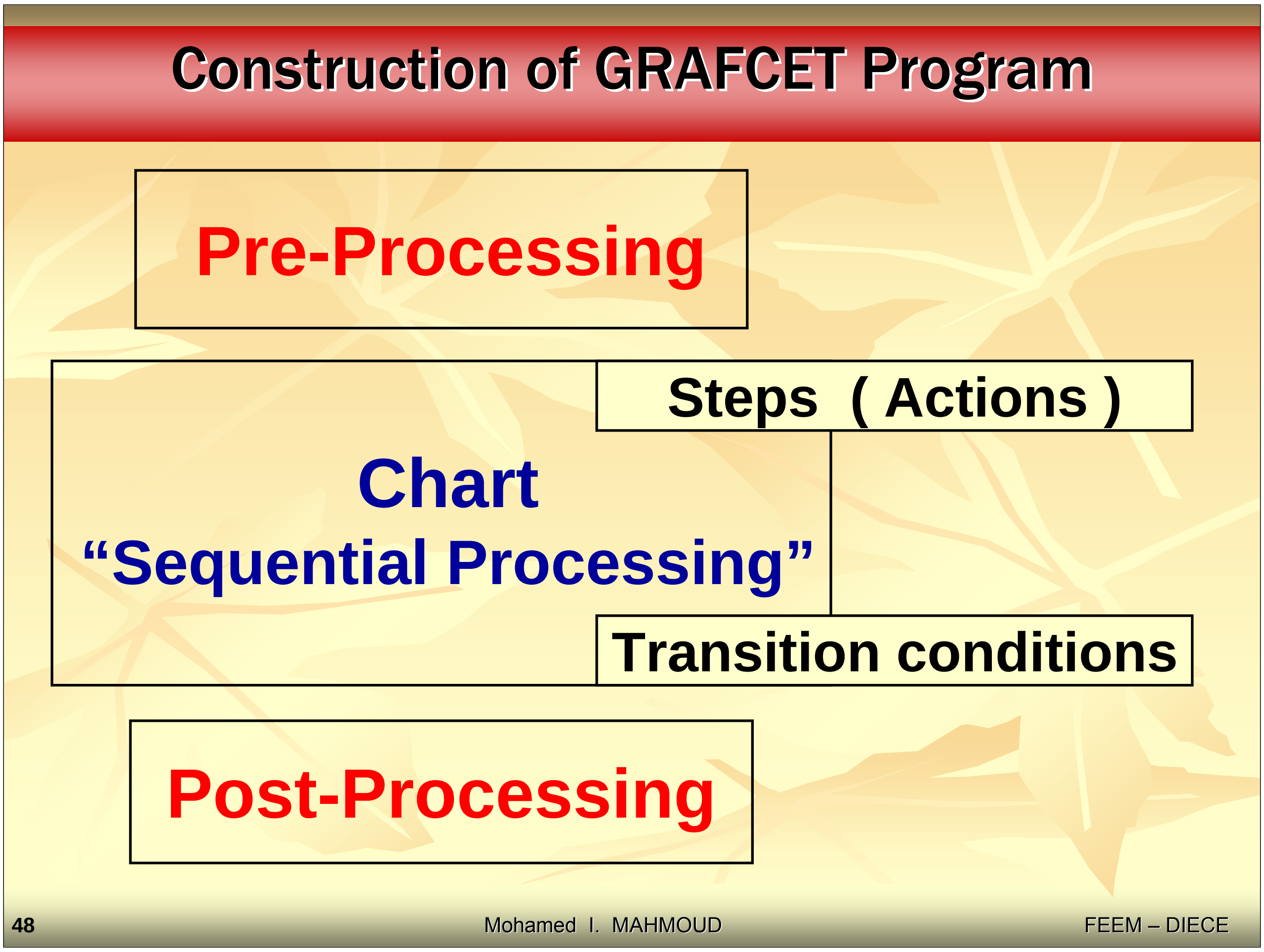


46 Mohamed I. MAHMOUD FEEM – DIECE

Write your notes



Write your notes



Write your notes

1 – PRE-PROCESSING

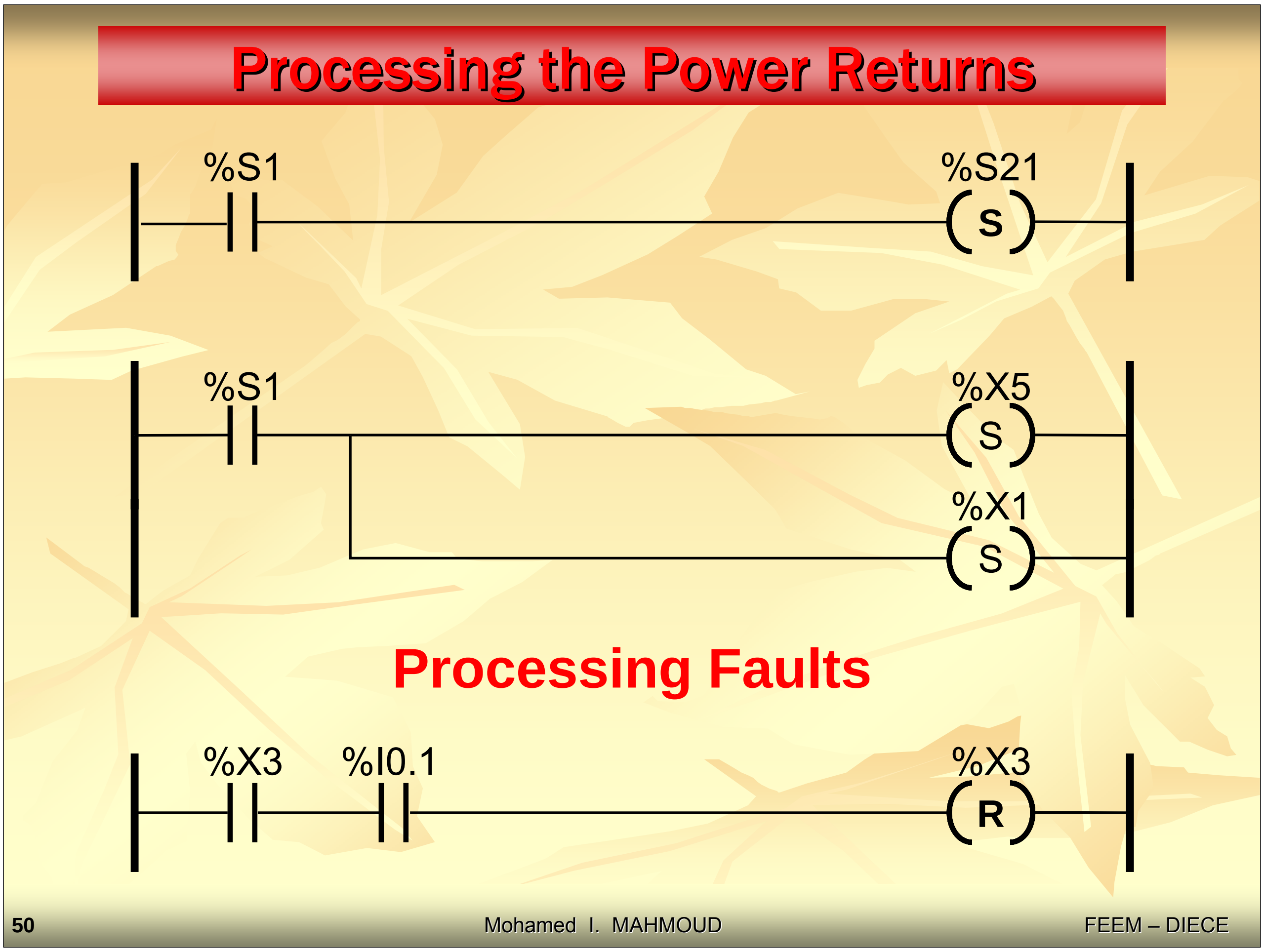
The following points determines the function of preprocessing part:

1) processing the power returns.
2) Processing faults.
3) Pre-positioning GRAFCET steps.
4) processing input logic.

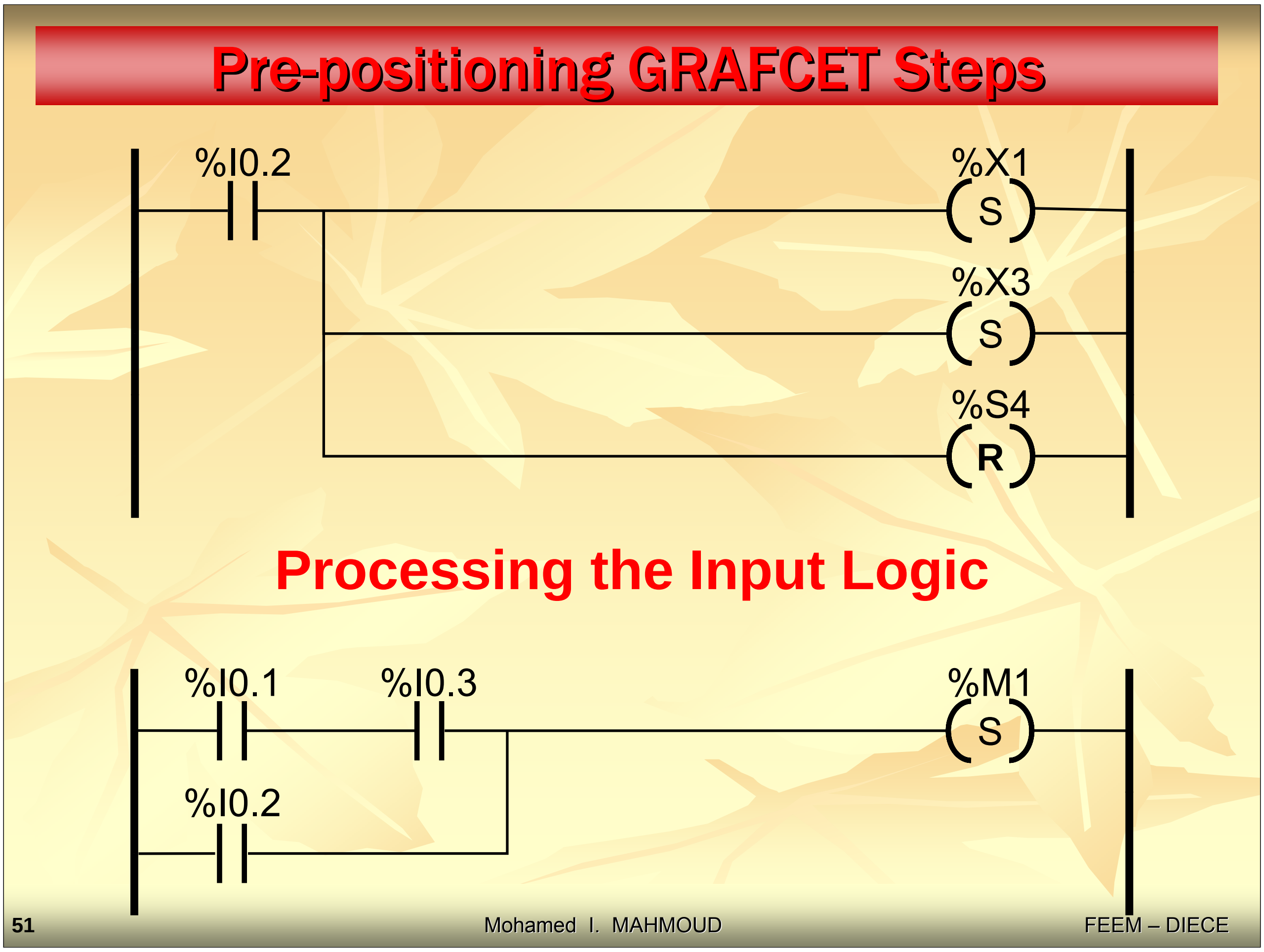
The preprocessing part of GRAFCET program is programmed using ladder or IL language and is scanned first before scanning CHART or post-processing part.

49 Mohamed I. MAHMOUD FEEM – DIECE

Write your notes



Write your notes



Write your notes

2 – CHART

In the CHART portion of the GRAFCET program, the sequential programming of the CHART is performed in one of two forms:

1) In a form of blocks and vertical connectors to represent the steps and transition conditions respectively.

2) In a form of ladder or IL program, also to represent the steps and the transition conditions of the CHART.

52 Mohamed I. MAHMOUD FEEM – DIECE

Write your notes

3 – POST-PROCESSING

The post-processing part is the last part of the GRAFCET program. “Last” means last in editing and in being scanned by the PLC processor after the two previous parts of the GRAFCET program.

The post-processing is programmed using ladder or IL language like the preprocessing

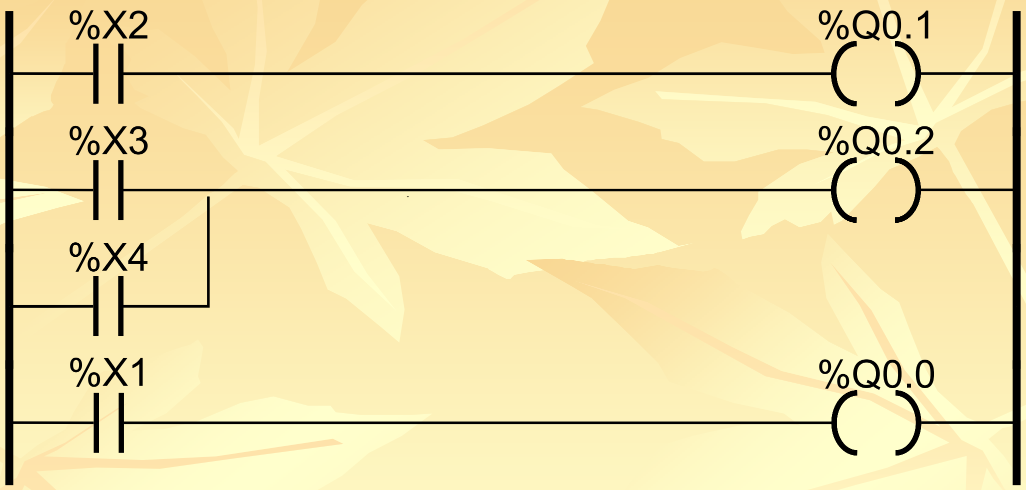
The series of instructions in the post-processing have the following functions:

1) Processing commands from sequential processing (CHART) for controlling the outputs.

2) Safety interlocks specific to the outputs.

Write your notes

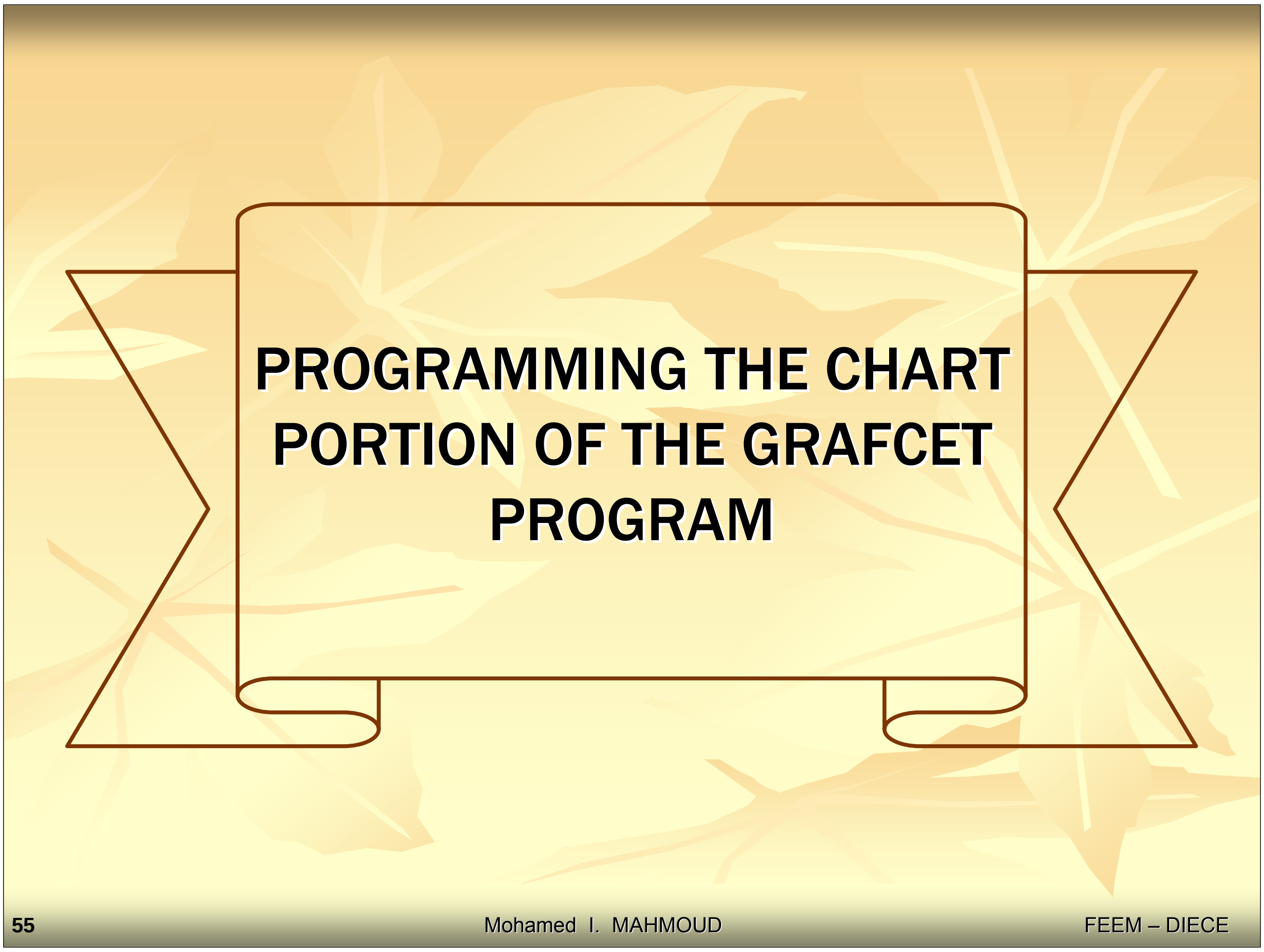
Processing Commands From Sequential Processing CHART for Controlling the Outputs



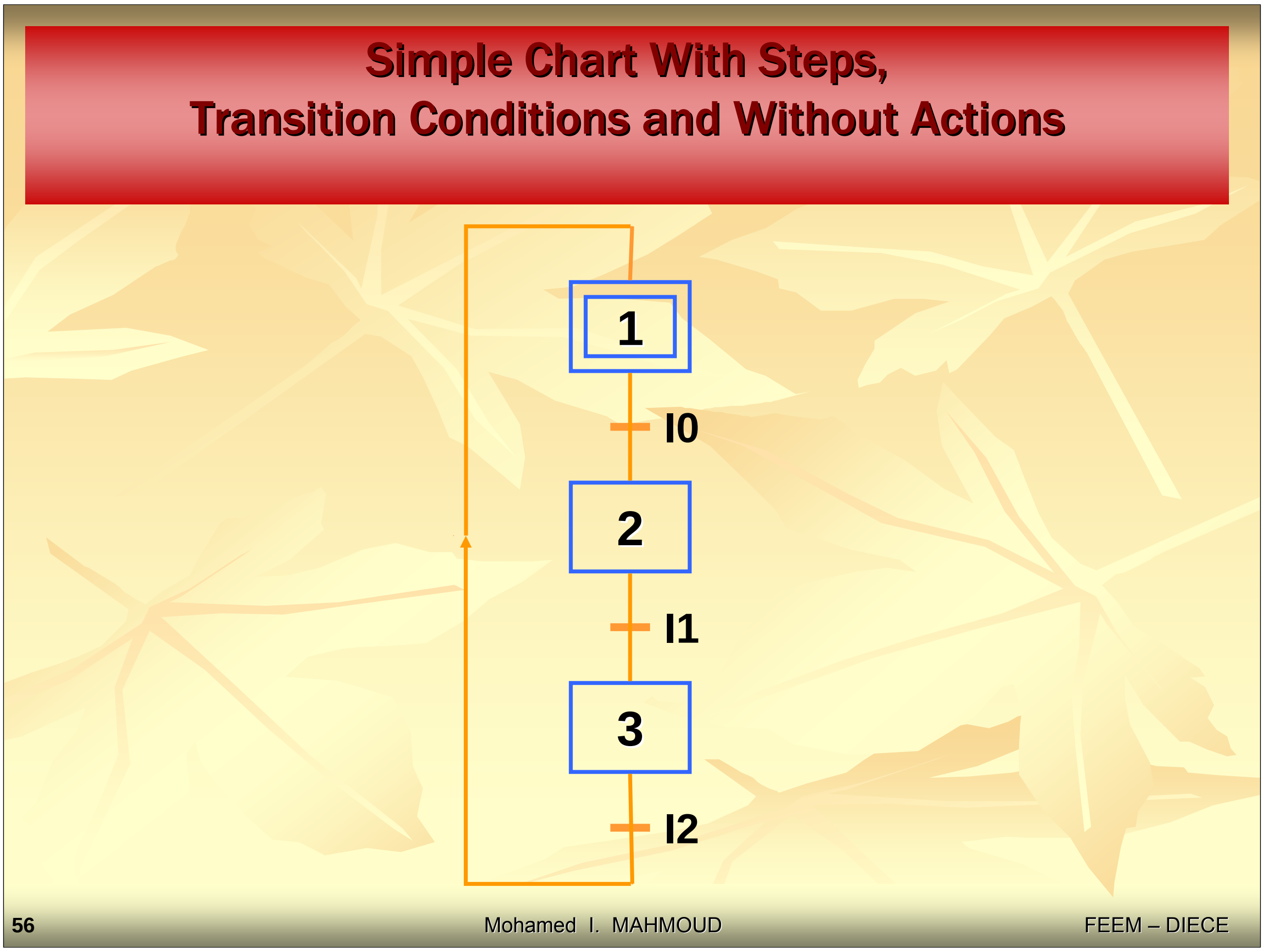
Safety Interlocks Specific to the Outputs

54 Mohamed I. MAHMOUD FEEM – DIECE

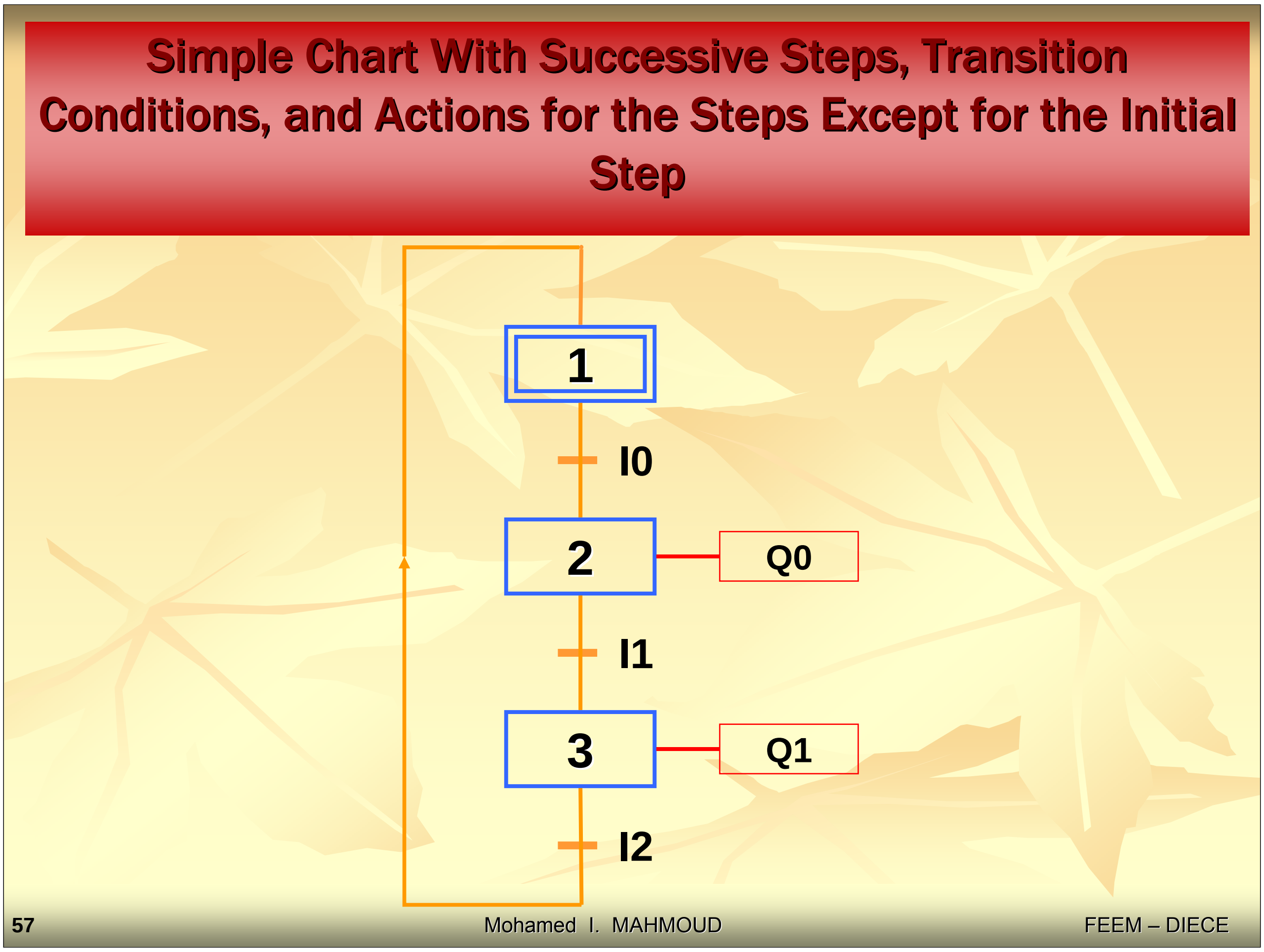
Write your notes



Write your notes

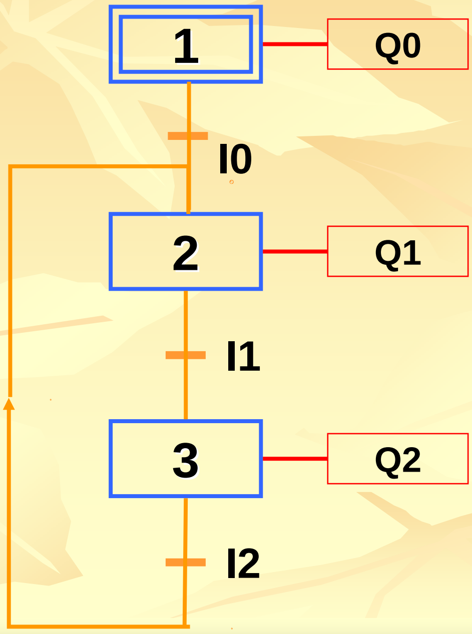


Write your notes



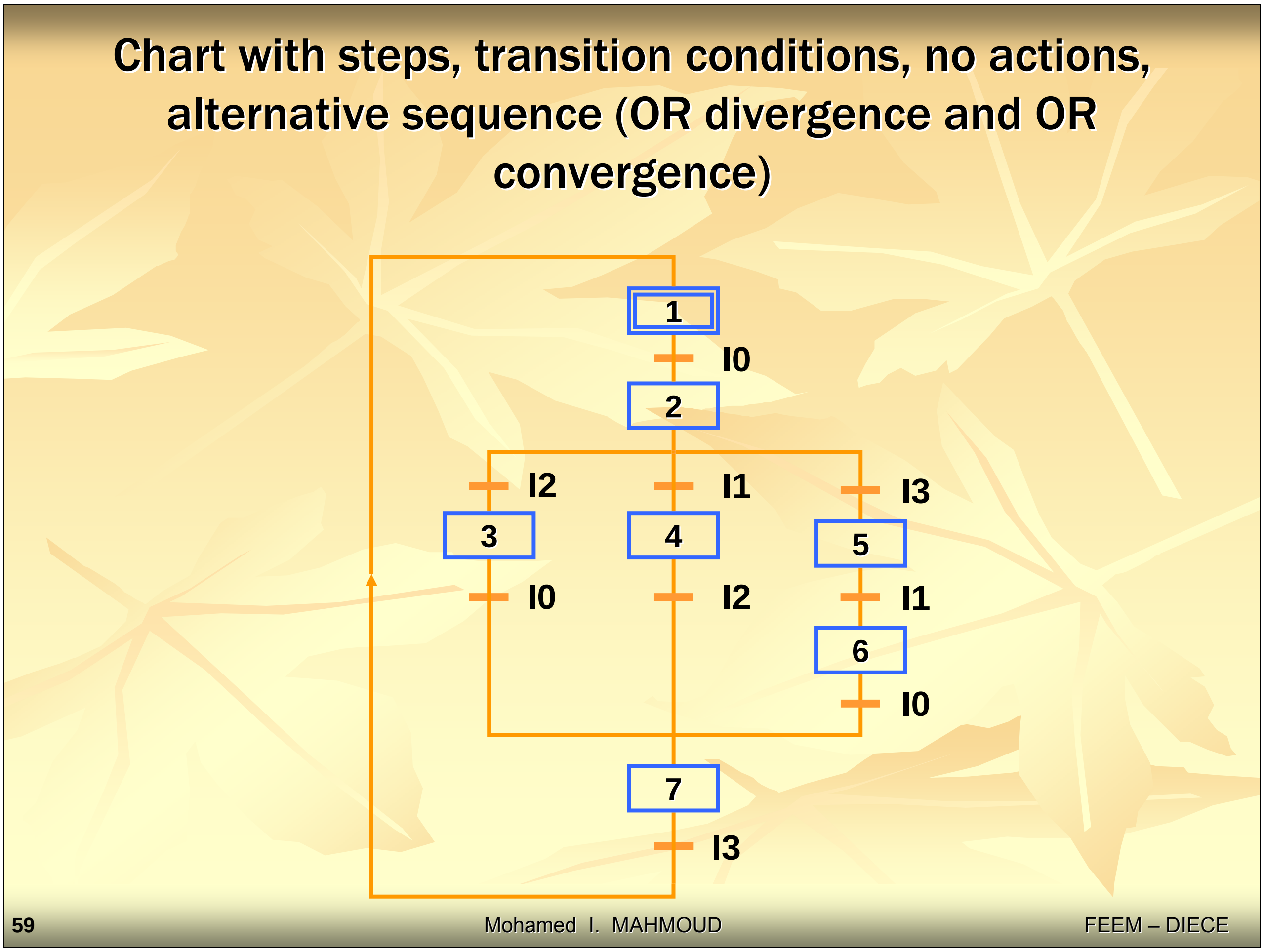
Write your notes

Simple Chart With Successive Steps, Transition Conditions, and Actions Including for the Initial Step

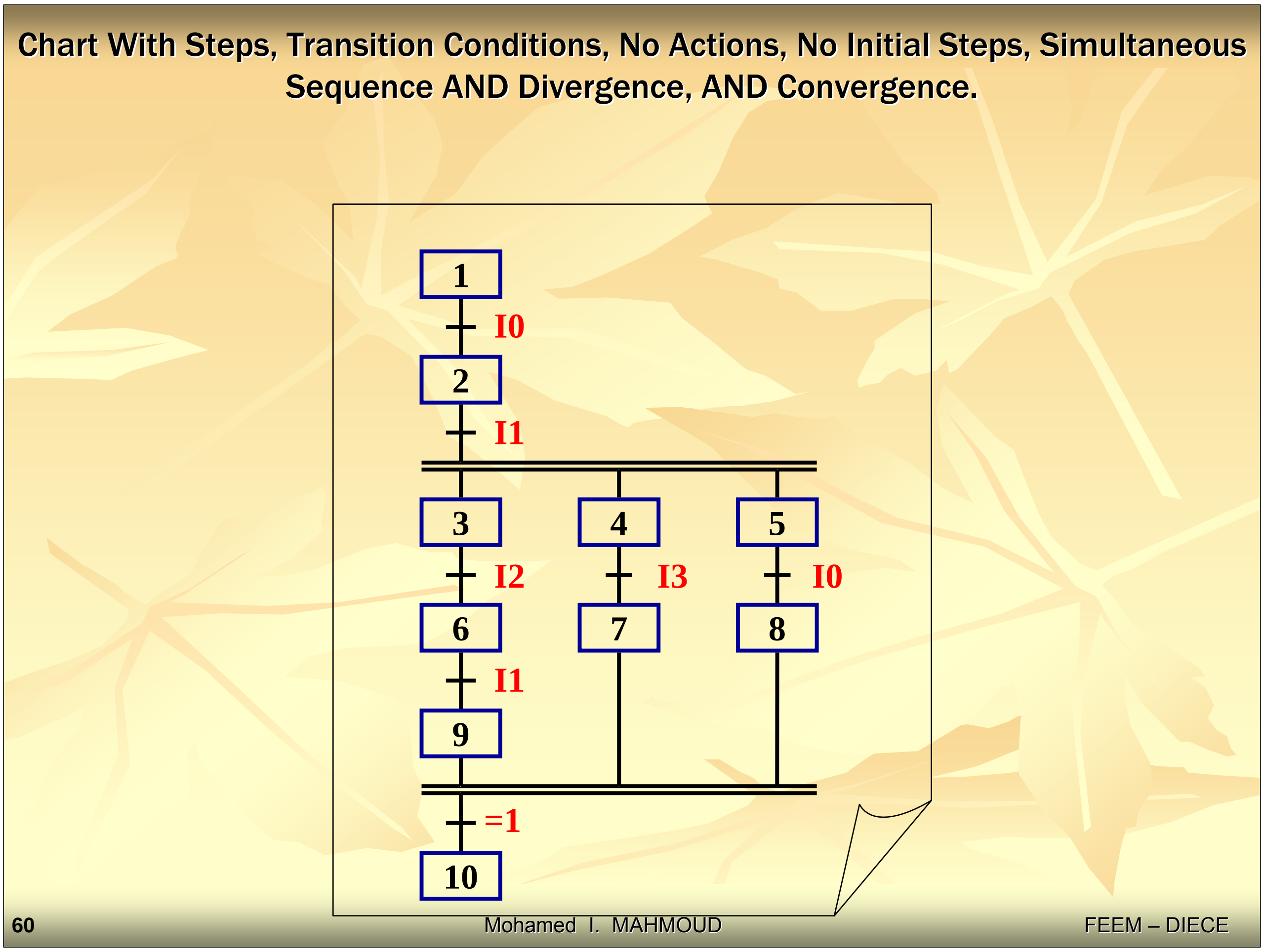


58 Mohamed I. MAHMOUD FEEM – DIECE

Write your notes

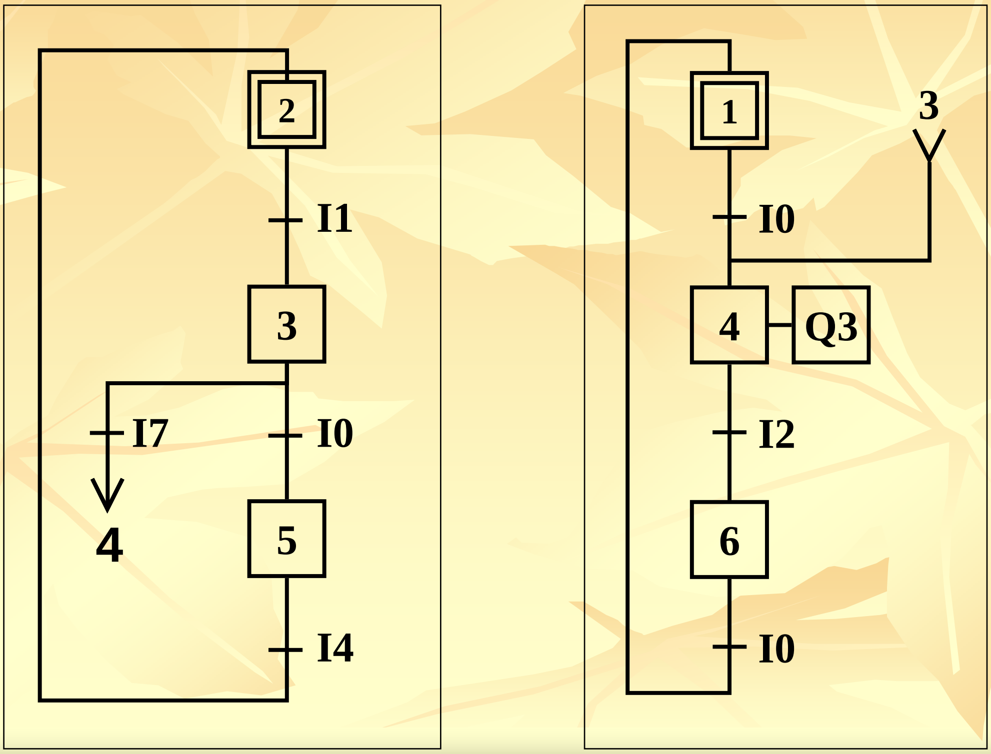


Write your notes



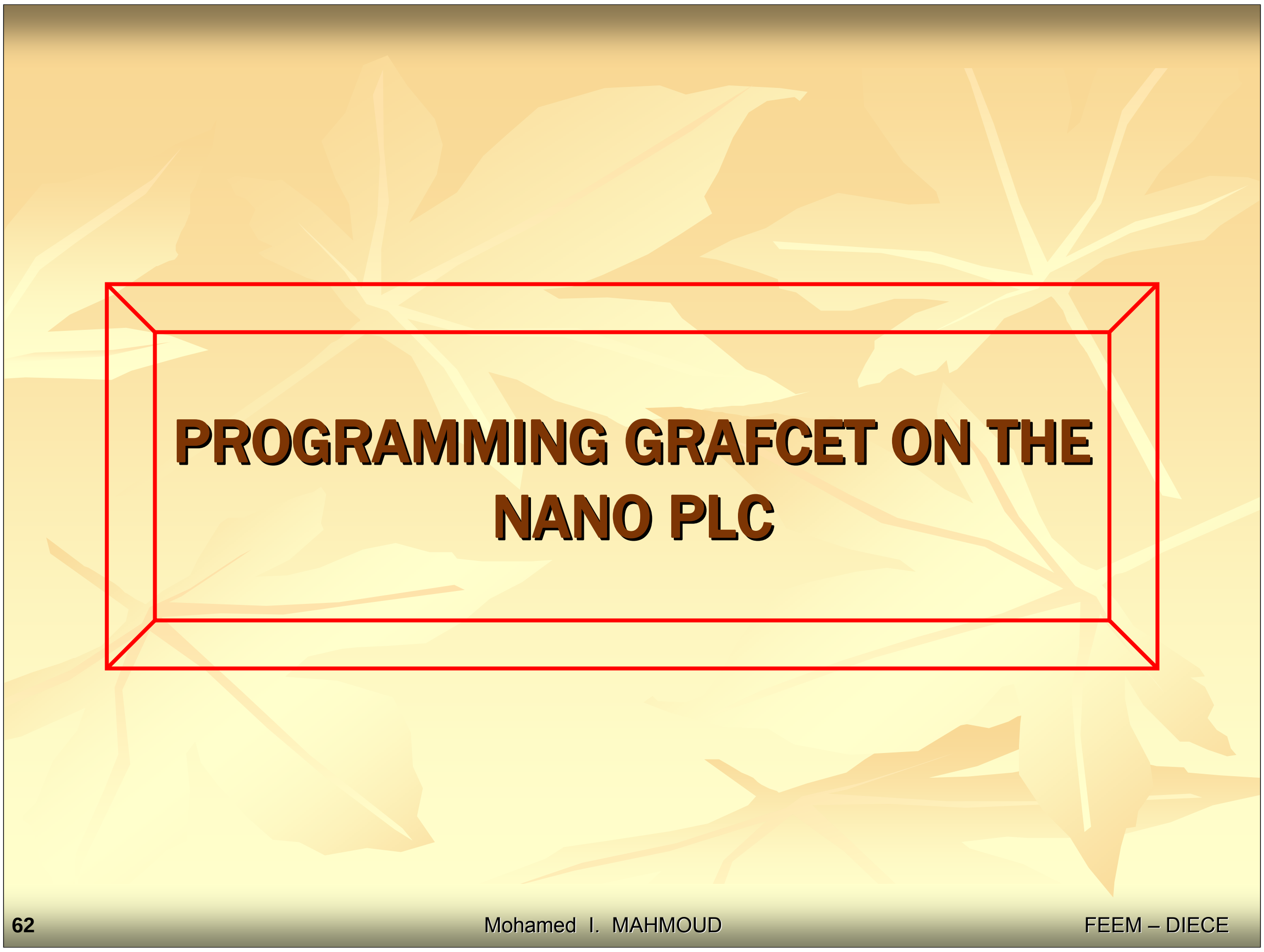
Write your notes

Two charts with two initial steps, source and destination connectors, and one action.

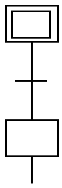
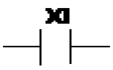
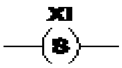
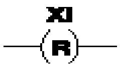


61 Mohamed I. MAHMOUD FEEM – DIECE

Write your notes



Write your notes

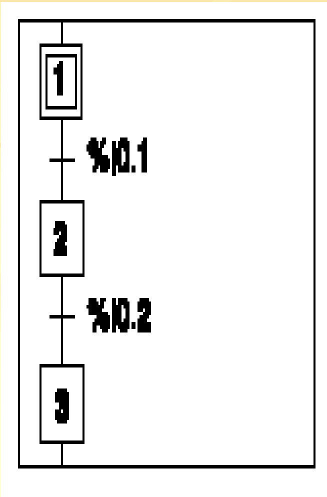
Graphic representation	Transcription in PL7 language	Role
 Initial step	=*= i	Start the initial step (1)
Transition	# i	Activate step i after deactivating the current step
Step	-*- i	Start step i and validate the associated transition (1)
	#	Deactivate the current step without activating any other steps
	#Di	Deactivate step i and the current step
	=*= POST	Start post-processing and end sequential processing
	%Xi	Bit associated with step i, can be tested and written (max. no. of steps : 62).
	LD %Xi, AND%Xi, ANDN%Xi OR%Xi, XOR%Xi,XORN%Xi	LDN %Xi, Test the activity of step i ORN%Xi
	S %Xi	Activate step i
	R %Xi	Deactivate step i

Write your notes

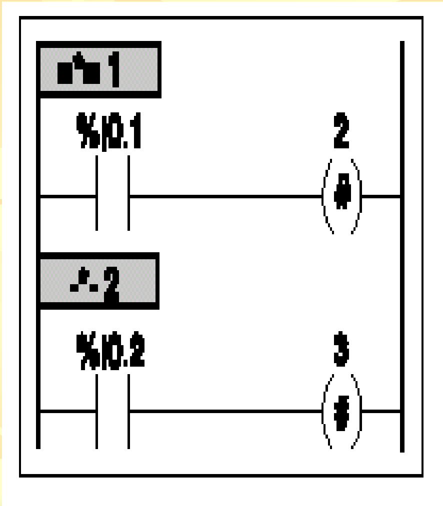
Programming the CHART using Nano PLC

1 – Linear sequence

Chart



Ladder



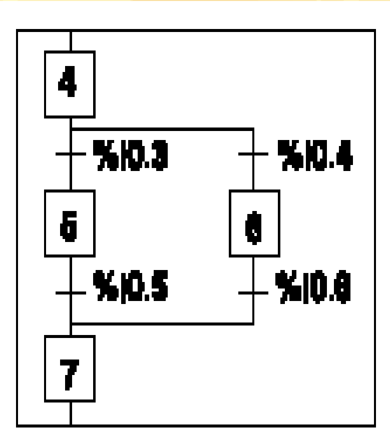
IL

```
=*=   1
LD    %I0.1
#     2
-*-   2
LD    %I0.2
#     3
```

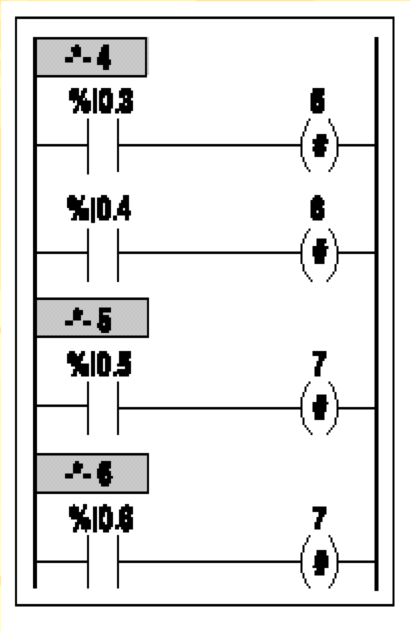

Write your notes

2 – Alternative Sequence

Chart



Ladder



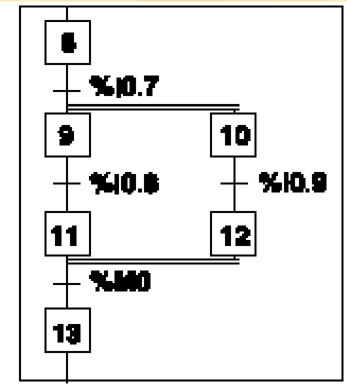
IL

```
-*-  1
LD   %I0.3
#    5
LD   %I0.4
#    6
-*-  5
LD   %I0.5
#    7
-*-  6
LD   %I0.6
#    7
```

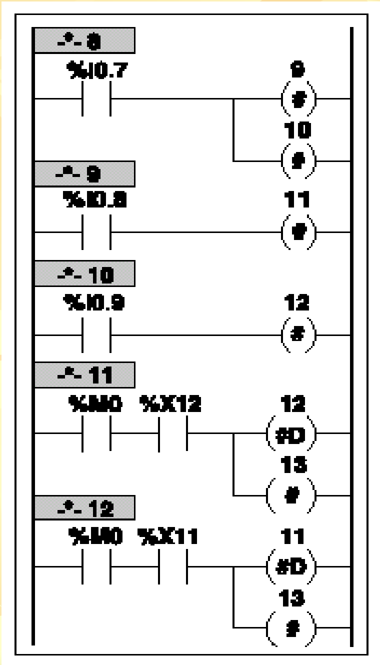

Write your notes

3 – Simultaneous sequence.

Chart



Ladder



IL

```
-*-   8
LD    %I0.7
#     9
#     10
-*-   9
LD    %I0.8
#     11
-*-   10
LD    %I0.9
#     12
-*-   11
LD    %M0
AND   %X12
#D    12
#     13
-*-   12
LD    %M0
AND   %X11
#D    11
#     13
```

66 Mohamed I. MAHMOUD FEEM – DIECE

Write your notes

General Notes on Programming GRAFCET on the NANO PLC

1) Edition of the GRAFCET program should start with the preprocessing part if it is programmed. Preprocessing consists of successive rungs in LADDER, or it consists of successive instructions in IL.

2) CHART (sequential processing) is edited using LADDER or IL after finishing the edition of preprocessing if existed. The start of CHART is marked by " = * = I" or " - * - I " in the header of LADDER or as instruction in the IL.

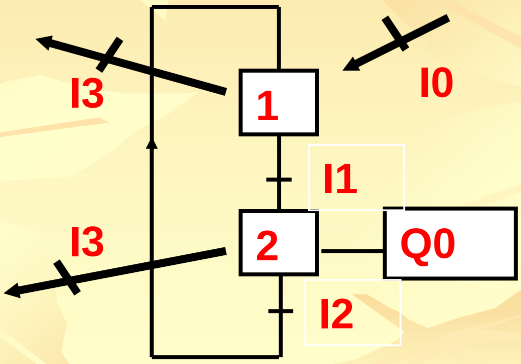
3) Edition of the post-processing part comes after editing the CHART previously in the same editor. Post-processing begins with " = * = post" in the header of the 1st rung in post-processing if LADDER , or as the 1st instruction of post-processing when IL.

4) System bits %S21, %S22, %S23 are for initializing, resetting, and freezing the CHART respectively.

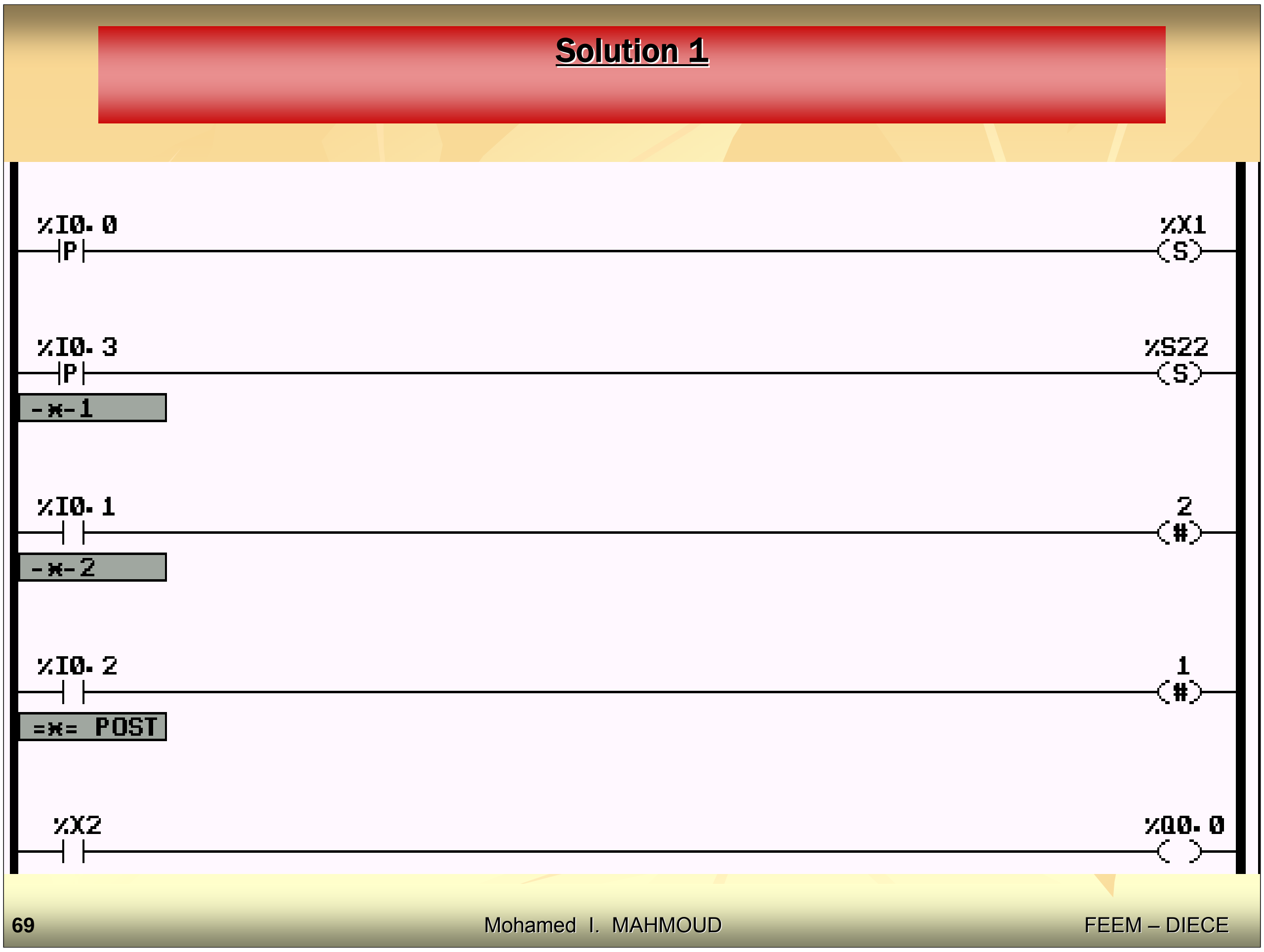
Write your notes

Problem 1

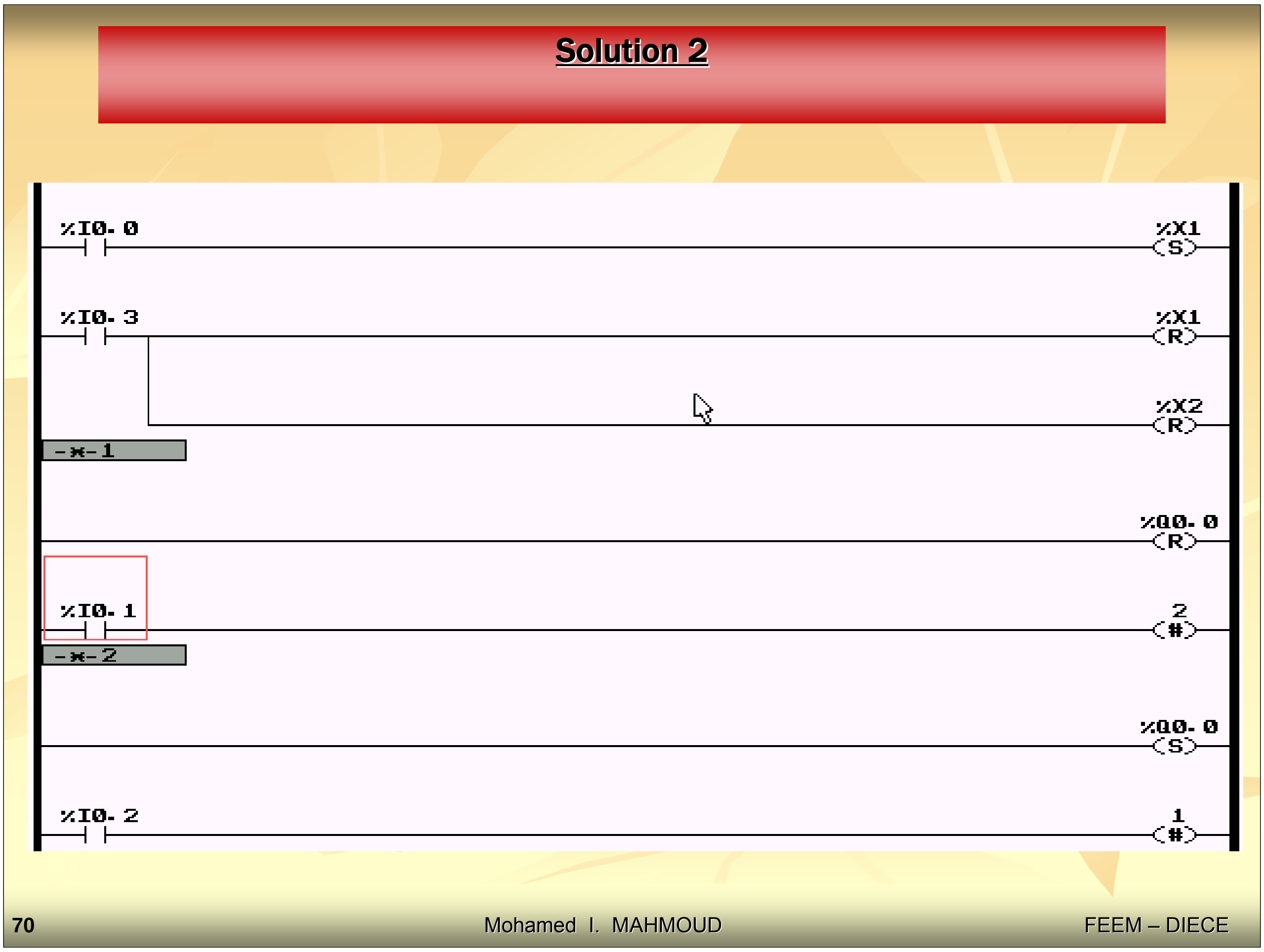
Design the complete GRAFSET program using LADDER for the following sequential operation:



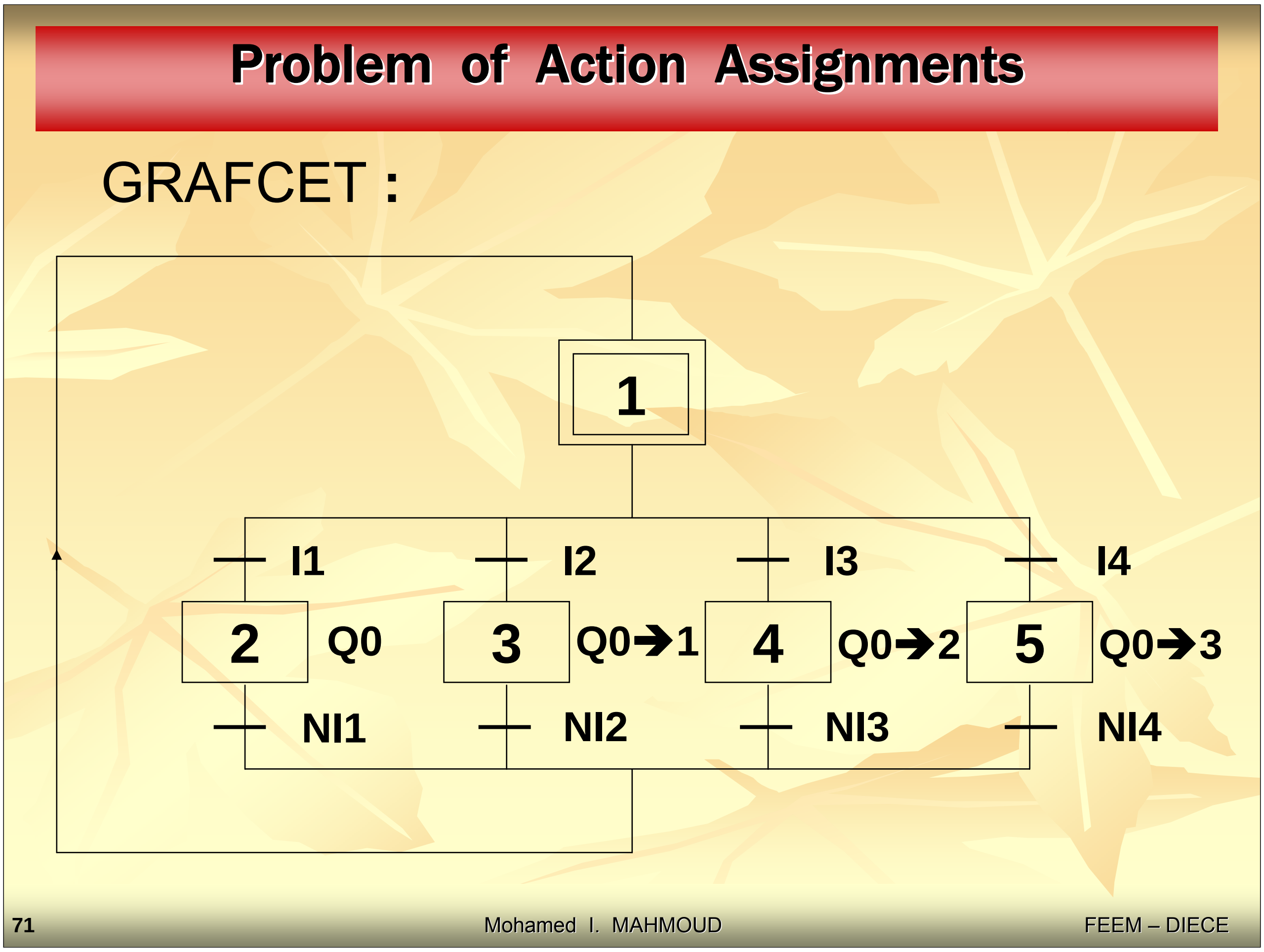
Write your notes



Write your notes

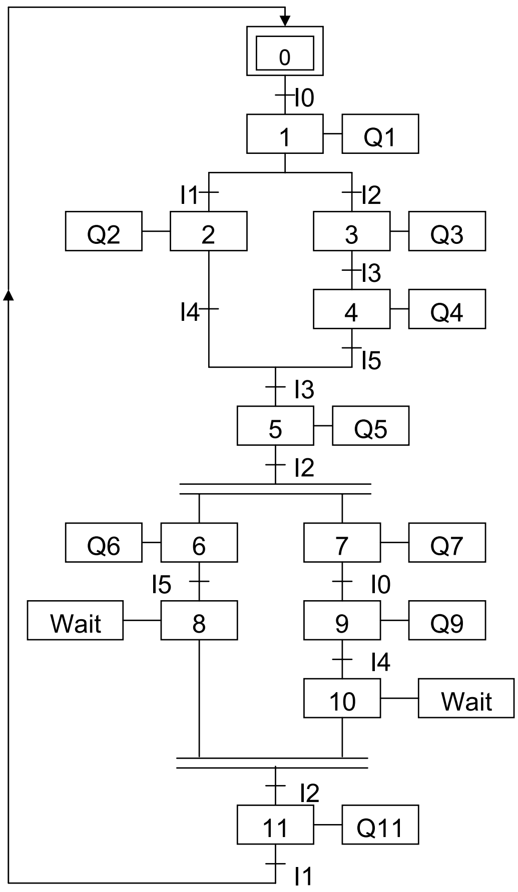


Write your notes



Write your notes

Problem 3



Write your notes

Information Technology in

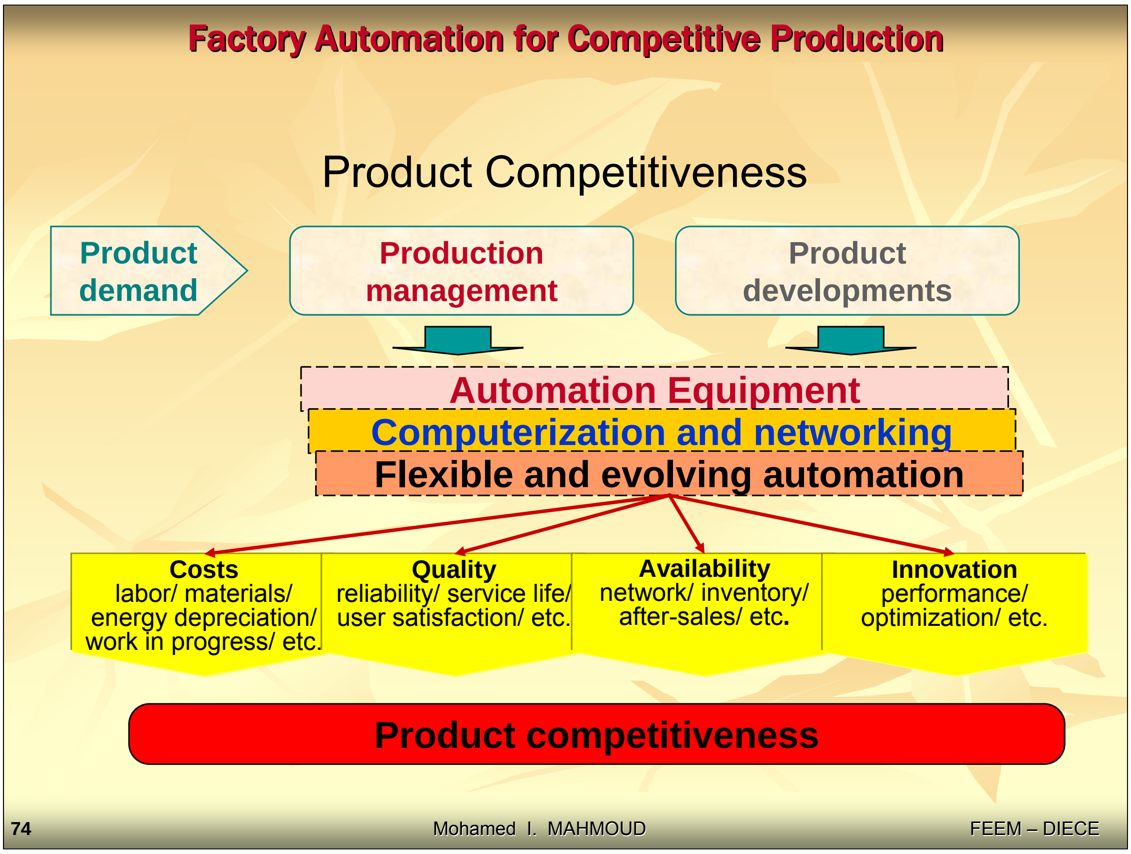
Industry Applications (ITIA)

FACTORY

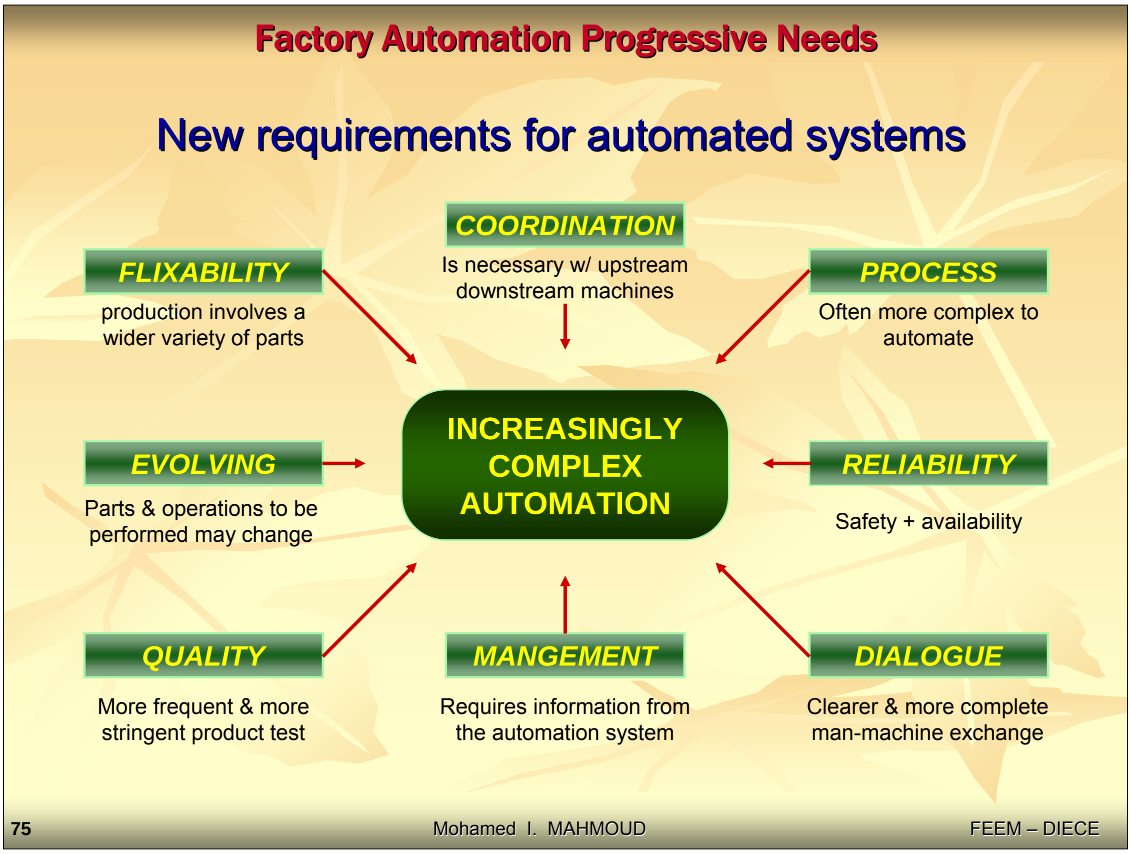
AUTOMATION

73 Mohamed I. MAHMOUD FEEM – DIECE

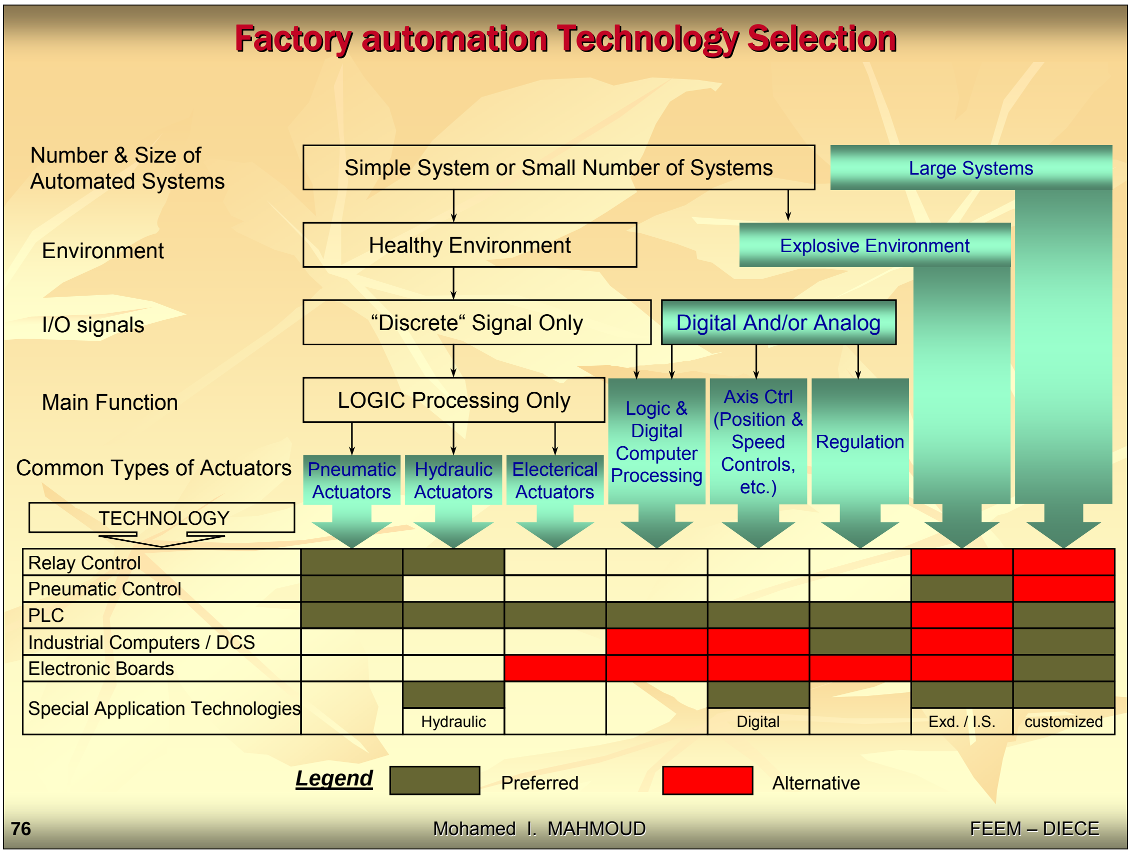
Write your notes



Write your notes



Write your notes



Write your notes

Information Technology in

Industry Applications (ITIA)

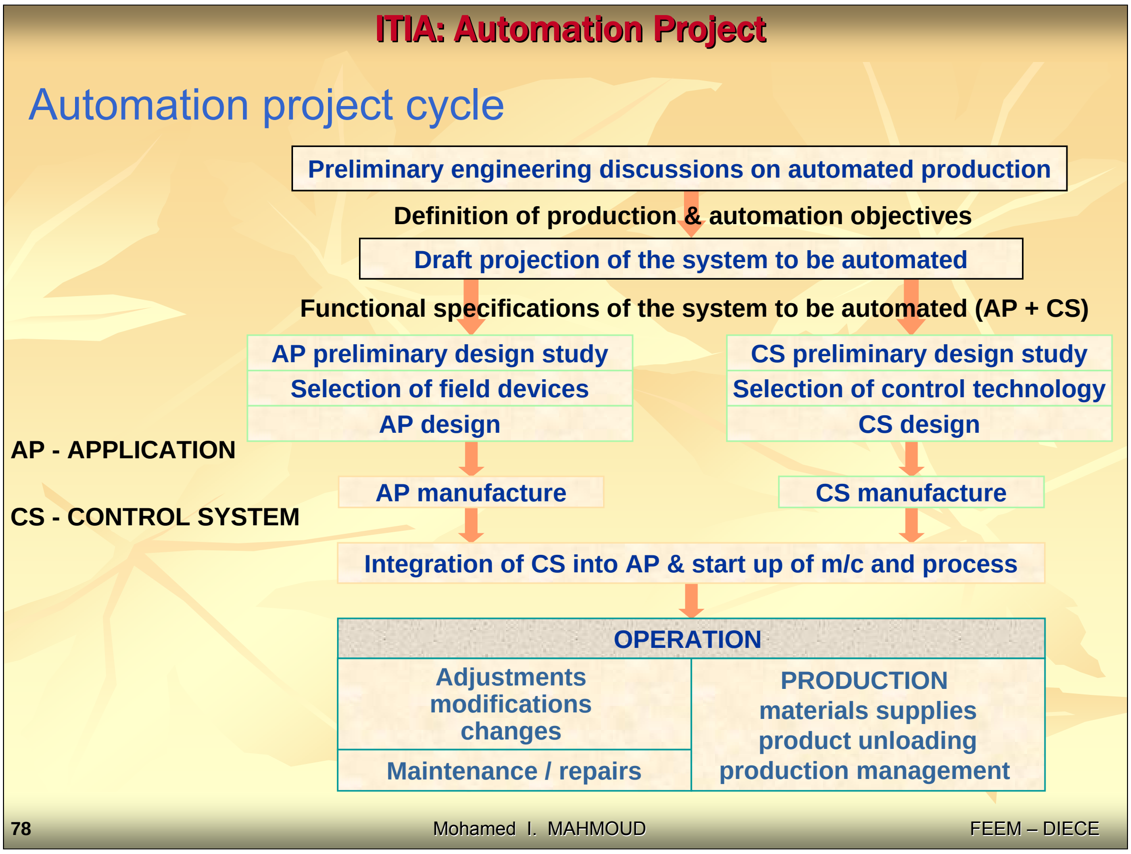
FACTORY

AUTOMATION

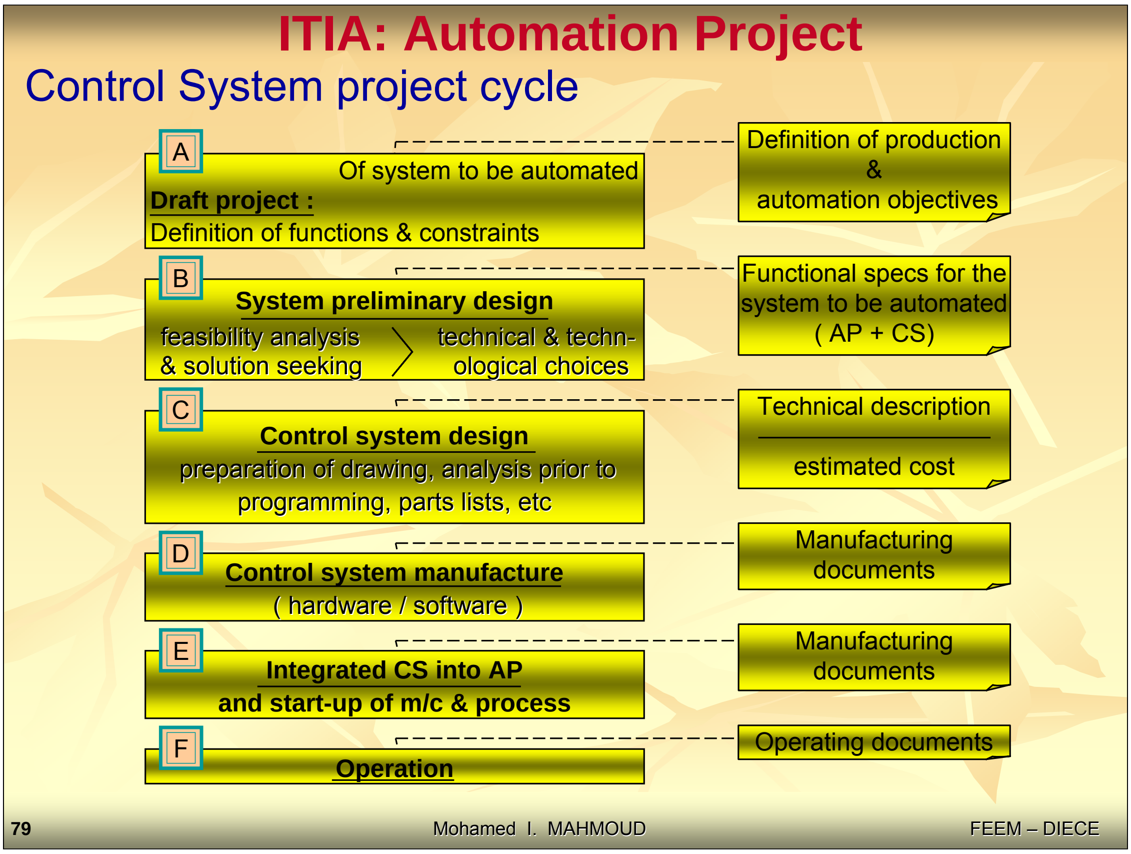
Automation Project Design Example: Proportional Mixing

77 Mohamed I. MAHMOUD FEEM – DIECE

Write your notes



Write your notes



Write your notes

A

Draft Project of Proportional Mixing

General System Review

1

Selected processes
- **Storage function to maintain a degree of independence from raw material supplier.**
- **Due to variability of product, weighing will secure accuracy to be achieved.**

2

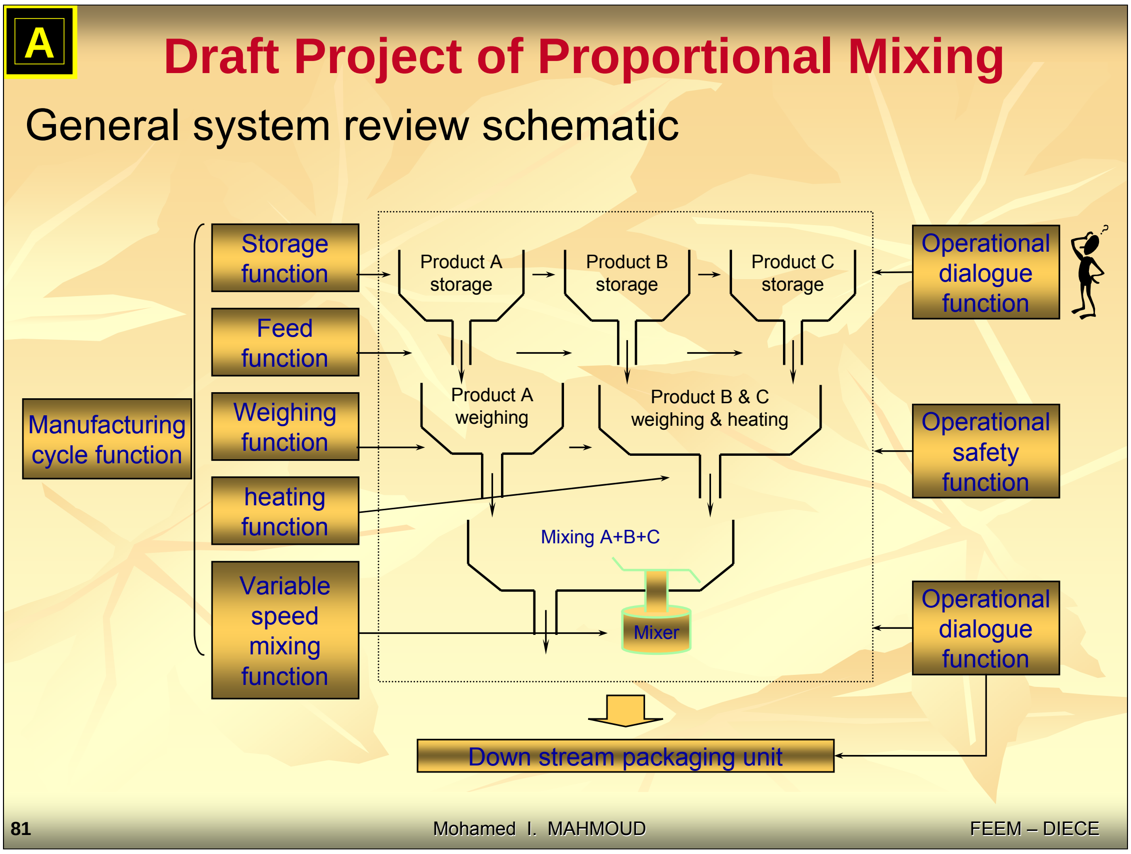
Operating cycle

the basic cycle for a production batch involves 3 tasks :
- **batching of constituents.**
- **Filling of mixer.**
- **Mixing, followed by unloading of the finished products.**

To meet the production objective, weighing and mixing can take place in parallel.

80 Mohamed I. MAHMOUD FEEM – DIECE

Write your notes



Write your notes

A

Draft Project of Proportional Mixing

General System Review

	Product 1	Product 2
A	50-120kg depend on B&C	50-120kg depend on B&C
B	300 +/- 2kg	200 +/- 2kg
C	300 +/- 2kg	300 +/- 2kg

1 Product desired
- Constituent A, a low viscosity paste.
- 2 fluid constituents B &C.

Process capacity < 1000kg/batch

2 Performed operations

1. Pre-mixing B & C, at a predefined temperature, depending on composition.
2. Finished product by mix of B & C result with A at a given speed, time and temperature.
3. Speed depends on mixture viscosity, ratio 1:4. Speed must increase gradually.

3 Production

Day shift : operator & 1 technician
Night shift : 1 technician
Estimated production rate : 3000kg/hour

4 Operation

- Fully automatic night shift.
- Log printout w/ daily backup.
- Weekly shutdown.

5 Operation safety

availability: max. 10 days shutdown w/o weekly rest
safety : no loss. No leak nor overflow (hazardous products, which are costly and difficult to remove).
Maintainability : 20 min. max. for 1st maintenance level, 1hr. For change of constituents and 1 day for repair.

6 Environment

coastal salty spray (Mediterranean climate)

7 Planned start-up

8 months

8 Flexibility & ability to evolve

memorizing & modifying recipes, change of capacity in volume and batch, data for forecast

82 Mohamed I. MAHMOUD FEEM – DIECE

Write your notes

A

Draft Project of Proportional Mixing

Function and Constraints

Functions	Sensors
Storage	•Supply reserve ....24 hrs •min. level detection ....to be defined
Feed weighing	•Weight acuracy ....+/-2kg •product flow rate ....100kg/min (max) •overflow ....none
Mixing temperature	•Capacity ....1100kg/min. •speed range ....to be defined •temperature ....15 to 60°C •setting accuracy ....+/-2°C
Operational dialogue	•Duration for 1100kg ....20min. (max) •programmed product parameters supervision … 1operator (night shift) •diagnostics ....any AP/CS failure
Operational safety availability maintainability	•MTBF(1) ....1000hrs •MTTR (2) 1hr

(1) MTBF: Mean Time Between Failures (2) MTTR: Mean Time to Repair

83 Mohamed I. MAHMOUD FEEM – DIECE

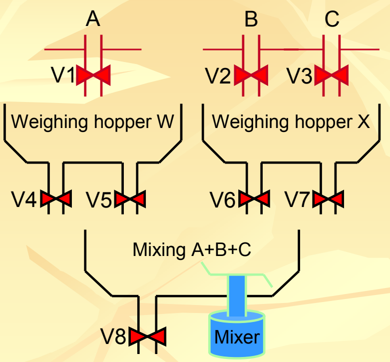
Write your notes

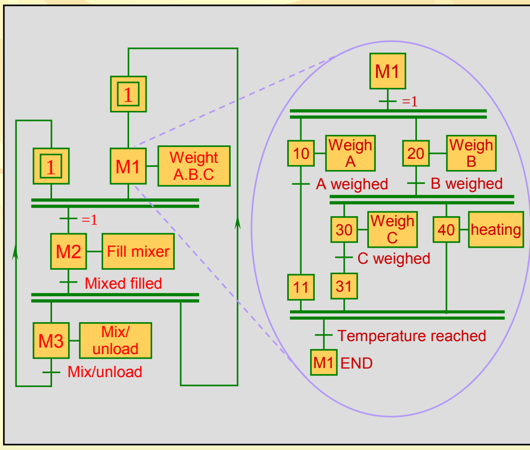
B

CS Preliminary Design Study of Proportional Mixing

Analysis of manufacturing cycle

Preliminary design study is limited to developing function chart, describing the coordination of tasks and for structuring the application production rate, availability, simplicity and control under normal or downgraded operation have been considered in defining the cycle.





- Proportioning task, expressed by macro step M1. A is weighed in W, B & C are wieghed in X. The premixture is heated to set temperature.
- If the mixer is empty, step 1 is active, it is filled once weighing & heating have been completed.
- After filling is completed, it is possible to simultaneously :
- mix the products.
- Start a new weighing operation.

84 Mohamed I. MAHMOUD FEEM – DIECE

Write your notes

B

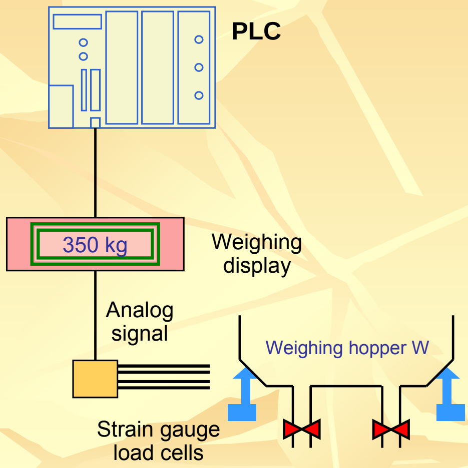
CS Preliminary Design Study of Proportional Mixing

Analysis of the weighing function

Two solutions are possible:
1- The weighing system amplifies the signal produced by the gages and sends it to PLC, where it shall be processed identifying the weighing completion within system accuracy.

2- PLC sends the weighing instruction to the weighing system.
The later processes the data and only returns the end of measurements signal to PLC.

The second solution, as illustrated, shall be used because :
It is highly reliable.
It is accurate.
It facilitates operation (changing weight settings).



Write your notes

B

CS Preliminary Design Study of Proportional Mixing

Analysis of variable speed mixing function

The mixing function preliminary design stage led to the following :
•Drive via a unidirectional geared induction motor 3KW.
•Electrical speed variation from 5 to 20rpm (ratio 1:4).

The technical specs set the following constraints :
•Gradual starting to prevent liquid spillage.
•An MTBF of more than 1000 hours.
•Motor protection complying to standards.
•Supervision and indication of motor faults required for diagnostics (trip-outs, short circuits, etc.)

•The mixing function comprises 3 closely interlinked elementary functions, that need to be optimized:
•A speed variation function.
•A motor control & protection function.
•A diagnostic dialogue function.

Write your notes

B

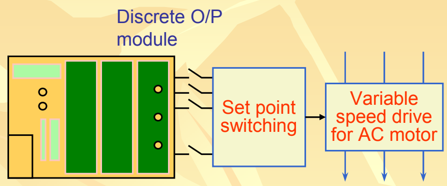
CS Preliminary Design Study of Proportional Mixing

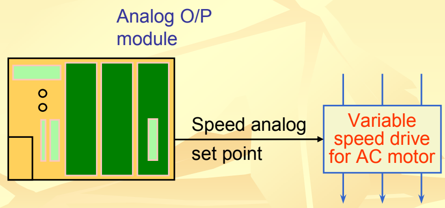
Speed variation function

•Type of variable speed drive
The speed range (1 to 4) & motor type (AC) requires a voltage frequency variable speed drive. The application is such that a single speed drive, used directly is sufficient.

•Setting the speed
2 solution are possible :
Solution # 1 : by switching preset set points.
Solution # 2 : by an analog O/P module of a PLC, which is a more flexible solution in terms of adjustment and ability for modifications.

•Gradual starting:
Acceleration adjustment can be performed :.
– Either manually by a potentiometer.
– Or by external analog control.





87 Mohamed I. MAHMOUD FEEM – DIECE

Write your notes

B

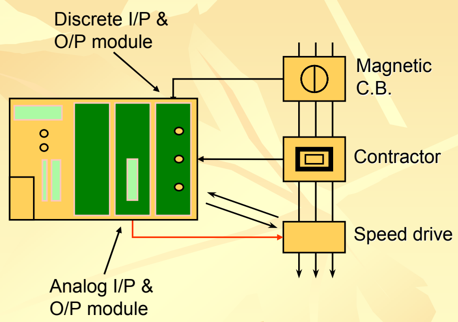
CS Preliminary Design Study of Proportional Mixing

Other functions & selected solution

•Protection function
Factory regulations require the following:
-25A magnetic C.B.
-9A line contactor for power breaking.

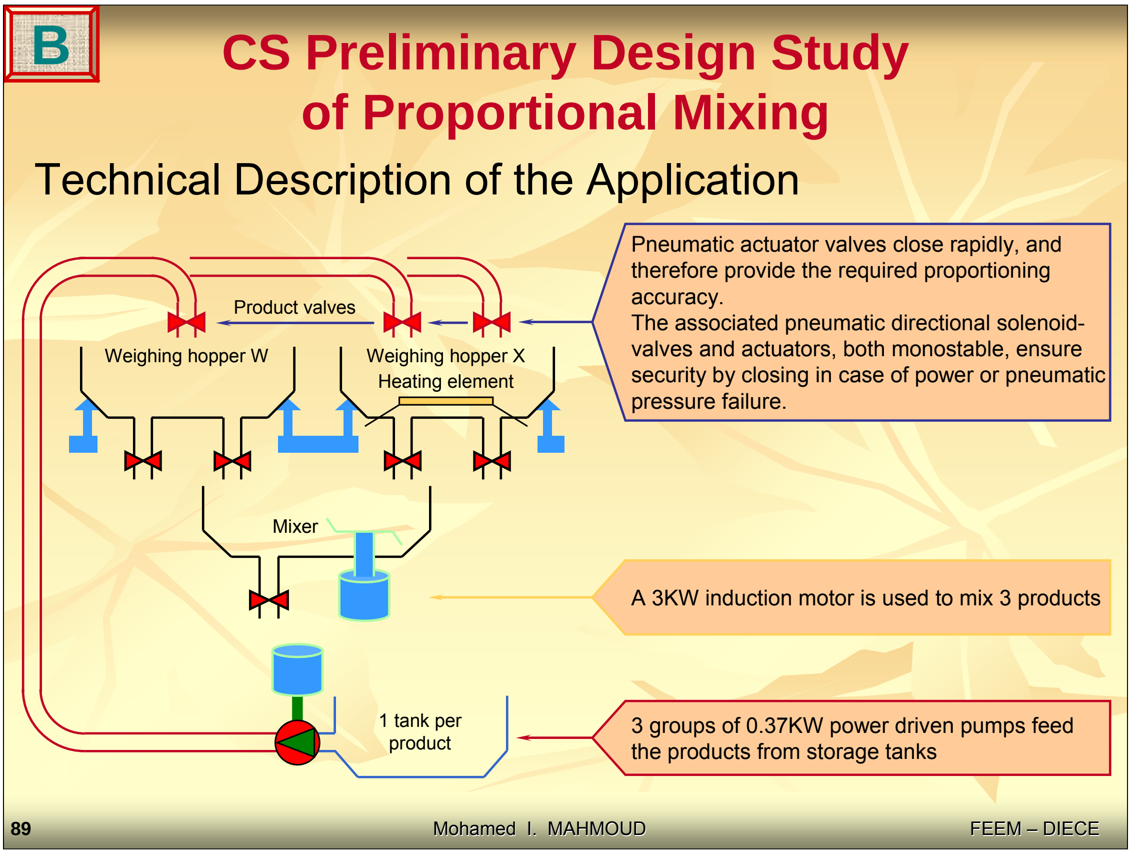
•Dialogue function
Various other solution can be used to meet diagnostics and maintainability requirements:
-Status indicating contacts for the various function devices.
-Dialogue capabilities associated with variable speed drive to detect and indicate faults.

•Technical solution selected
The technical solution for motor speed variation and protection, selected has the following criteria :
-Required dialogue level.
-Wiring time.
-Safety regulations, etc.



88 Mohamed I. MAHMOUD FEEM – DIECE

Write your notes



Write your notes

B

CS Preliminary Design Study of Proportional Mixing

Technical Description of Control System

Functions	Sensors	Actuation	PLC
Discrete control for valves, pumps & tanks	•8 limit switches. •6 level switches. •1 min. level switch for mixer.	•8(3/2) pneumatic directional solenoid valves 1/4". •3 contractors 3-pole, 380V. •3 magnetic C.B.s 0.37KW.	•15 digital I/Ps-24VDC •11 digital O/Ps-24VAC, 0.5A.
Variable speed control & mixing motor protection		•1 AC speed drive with integrated motor protection. •1 contractor 3ph., 380V-9A. •1 magnetic C.B., 380V-25A.	•1 analog O/P (4-20mA). •3 digital I/Ps-24VDC. •1 digital O/P for locking. •1 digital O/P-24VAC, 0.5A
Heating	•2 thermal probe 10-100ºC	•1 auxiliary contractor, 3ph. 1Kw.	•A analog I/P (4-20mA) for threshold processing (min. - max.). •1 digital O/P-24VAC, 0.5A
Weighing	•2 x 3 strain gauge load cells on each hopper.		•2 weighing indicators providing data processing. •1 weighing module, 2 channels.

Write your notes

B

CS Preliminary Design Study of Proportional Mixing

Technical Description of Control System (cont'd)

Functions	Sensors	Actuation	PLC
Operating dialogue	•3 position selector switch (auto-off-man.) •10 pushbuttons	•5 indicator lamps. •3 lamps sets for pumps.	•6 digital I/Ps-24VDC •3 digital O/Ps-24VAC, 0.5A •1 operator interface, 2lines.
Communication	•1authorization unit for unloading.		•6 digital I/P-24VDC •1 communication module.
Operational safety	•2 max. level sensors •3 emergency pushbuttons. •Temp. sensor (fire).	•1 master relay. •1 audible alarm.	•1 safety module.

91 Mohamed I. MAHMOUD FEEM – DIECE

Write your notes

B

CS Preliminary Design Study of Proportional Mixing

Cost estimation

•Purchases	…………………	EGP
•Design (H/W & S/W)	…………………	EGP
•Manufacturing & integration	…………………	EGP
•Installation	…………………	EGP
•Start up	…………………	EGP

Write your notes

C

CS Preliminary Design Documents of Proportional Mixing

Manufacturing documents & system software

1. Equipment description lists
•sensors, instruments.
•Preactuators & power components.
•Programmable controllers configuration.
•Auxiliary components and devices (relays, fuses, junction boxes, cables, etc.

2. Site installation layouts
•the installation is divided between 2 floors.
•tank installation layout should show the location of the actuators, sensors, junction boxes, cables laying and the enclosure.

3. Electrical distribution diagrams
power & control electrical distribution for each system (proportioning, tanks, …)

4. Monitoring & control diagrams
integrating the security interlocks (direct safety devices, motor protection, …) and control points including interfaces.

5. Installation layouts connection diagrams
terminal blocks, connections, etc.

6. Program analysis
documents of combinational & sequential :
•function chart for normal production consist of charts showing coordination between tasks and 3 function charts detailing the macro steps.
•Operational function charts describe sequential behavior of system for different operating & shutdown modes. This is also should be specified in written.
•A description of processing & dialogue required for operational safety (monitoring, fault signaling and diagnostics), using function chart, function blocks, a written description and logic expressions.
•A description of the processing and dialogue required to operate the system including setting of parameters such as product quantities, temperature, times, product changes and storage of new data.
•A description of maintenance related processing and dialogue.

93 Mohamed I. MAHMOUD FEEM – DIECE

Write your notes

D

CS Manufacturing of Proportional Mixing

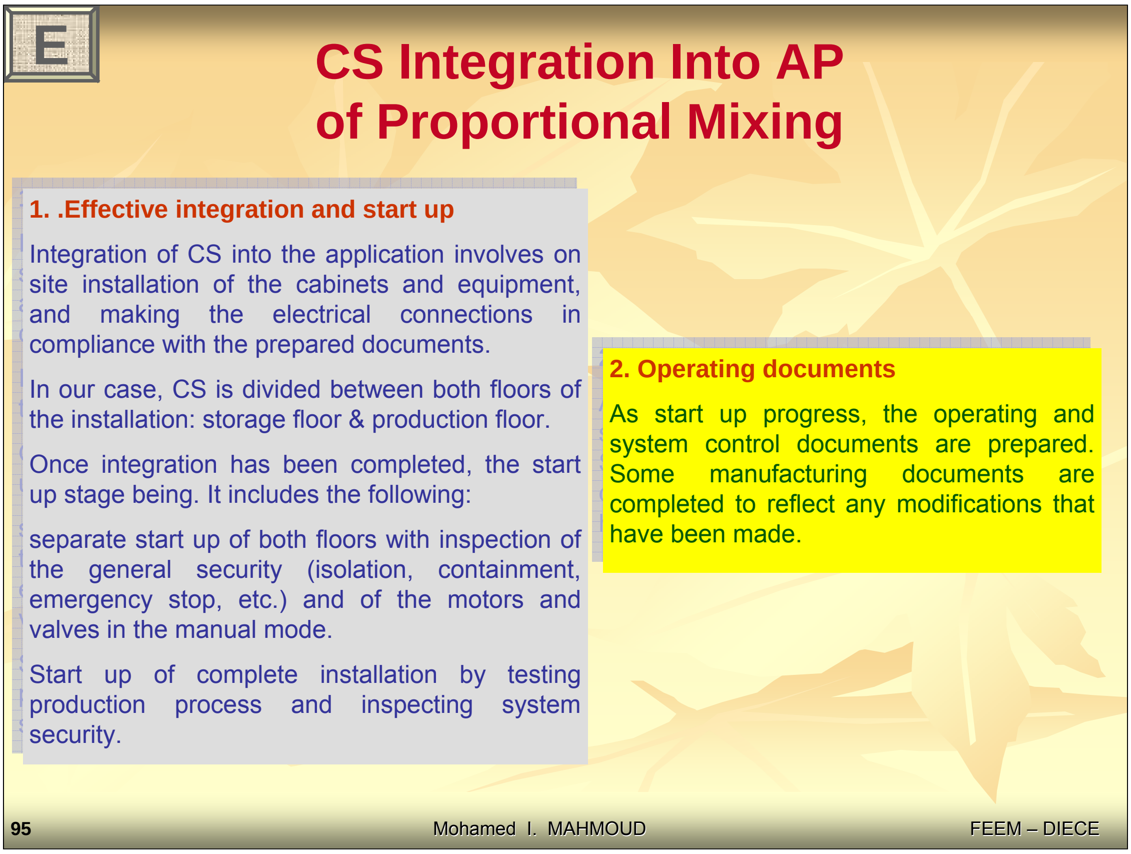
The enclosures, cabinets and control panels should be ideally prepared using slotted plates and tested in the workshop.

The cable harnesses are also prepared and combined to suit the organization of the installation.

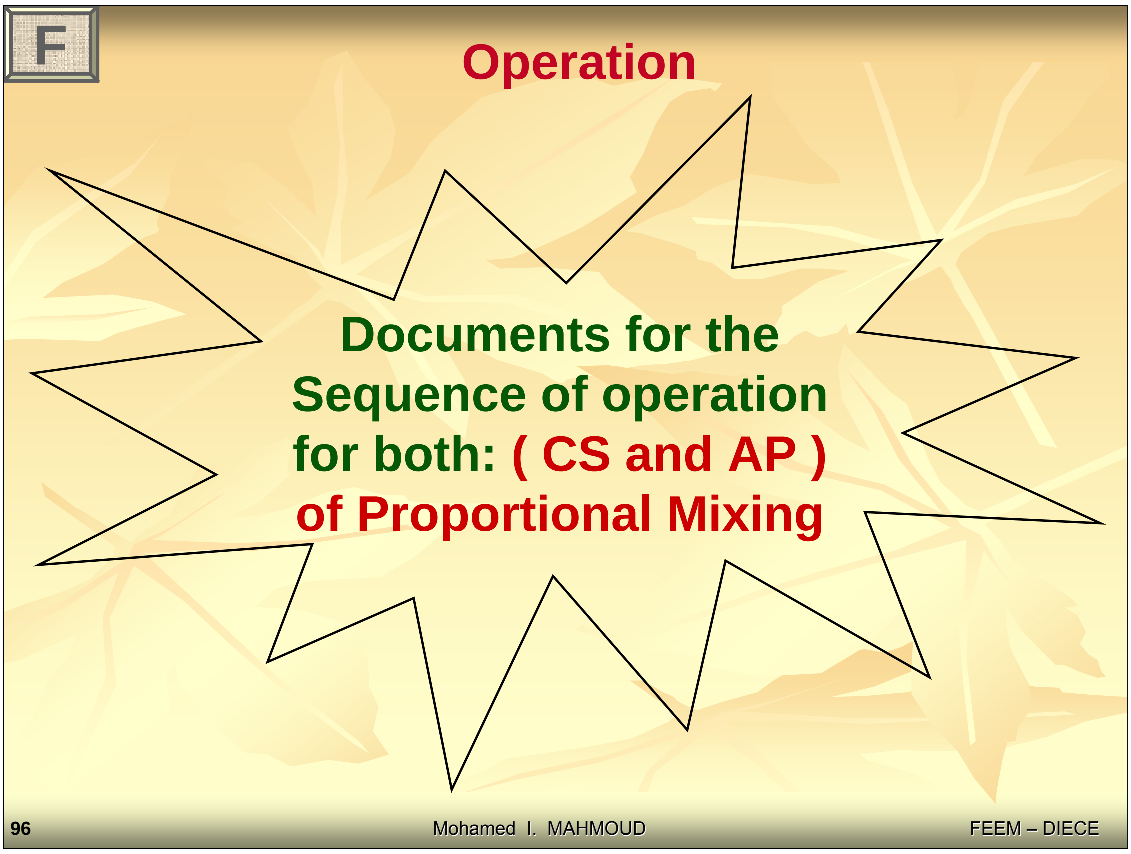
In the design office, the program is entered directly from the programming forms specific to the PLC. The complete program is then printed out on the printer.

94 Mohamed I. MAHMOUD FEEM – DIECE

Write your notes



Write your notes



Write your notes

DEVELOPMENT OF GRAFCETS

Intuitive approach

And

Reasonable approach

Write your notes

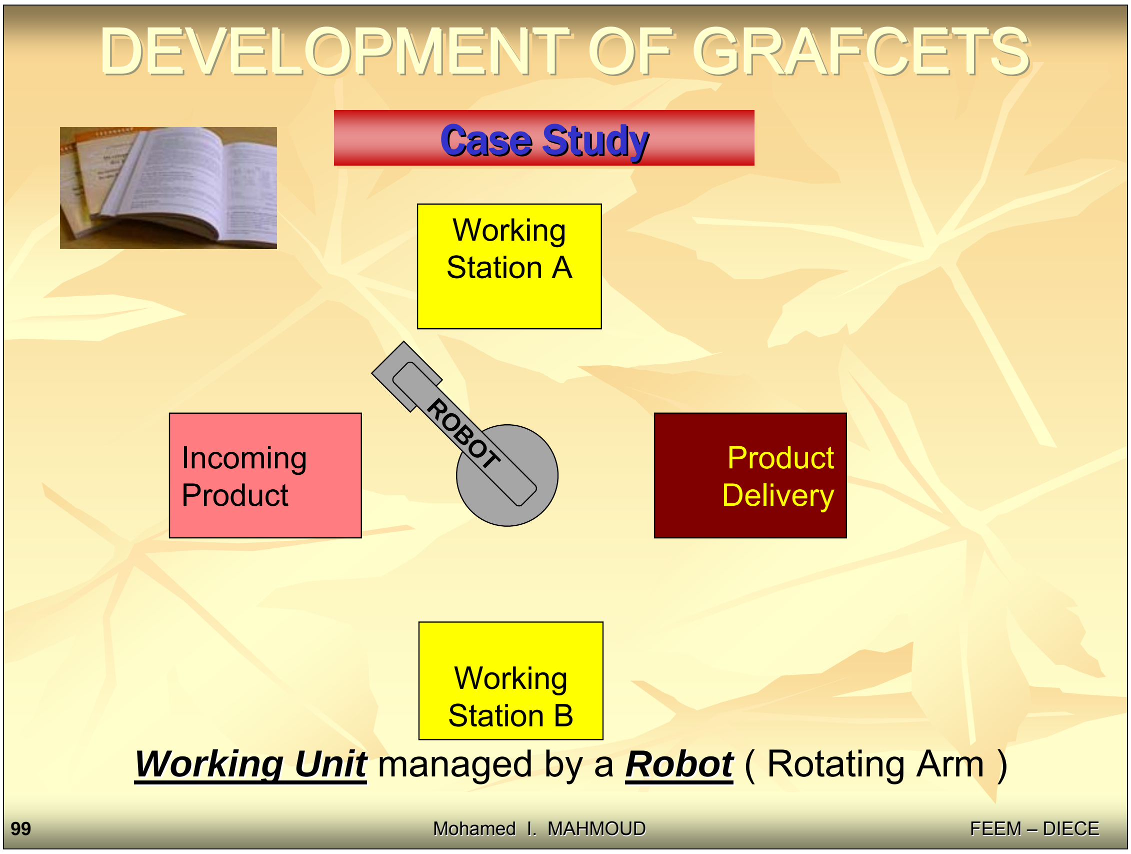
DEVELOPMENT OF GRAFCETS

Objective

- To indicate – through a simple example – the difference between ***intuitive approach*** of an automation problem and ***reasonable approach***.

98 Mohamed I. MAHMOUD FEEM – DIECE

Write your notes



Write your notes

DEVELOPMENT OF GRAFCETS

How this system works

Suppose a ***robot*** is used to manage the flow of pieces through a ***working unit*** that composed of two ***working stations A and B***.

The ***incoming product*** which is presented in front of the ***working unit*** may subject to an operation: either on the ***Working Station A*** or on the ***Working Station B***.

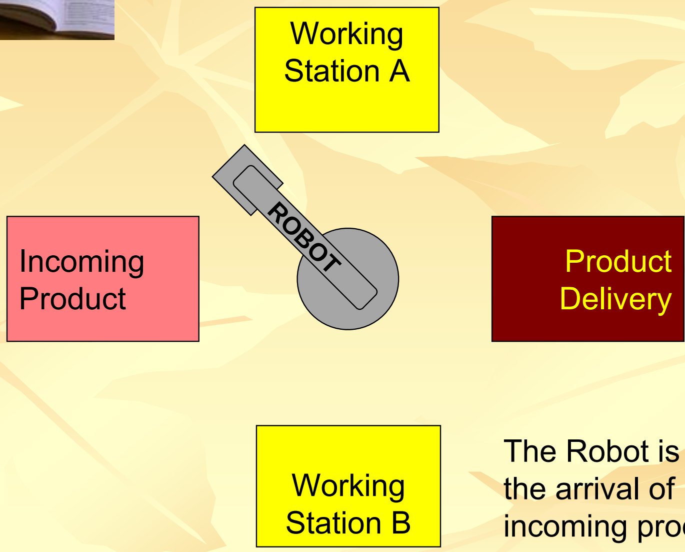
Finally, at the end of operation for each ***working station***, the product will be delivered to the ***back of working unit***.

100 Mohamed I. MAHMOUD FEEM – DIECE

Write your notes

DEVELOPMENT OF GRAFCETS

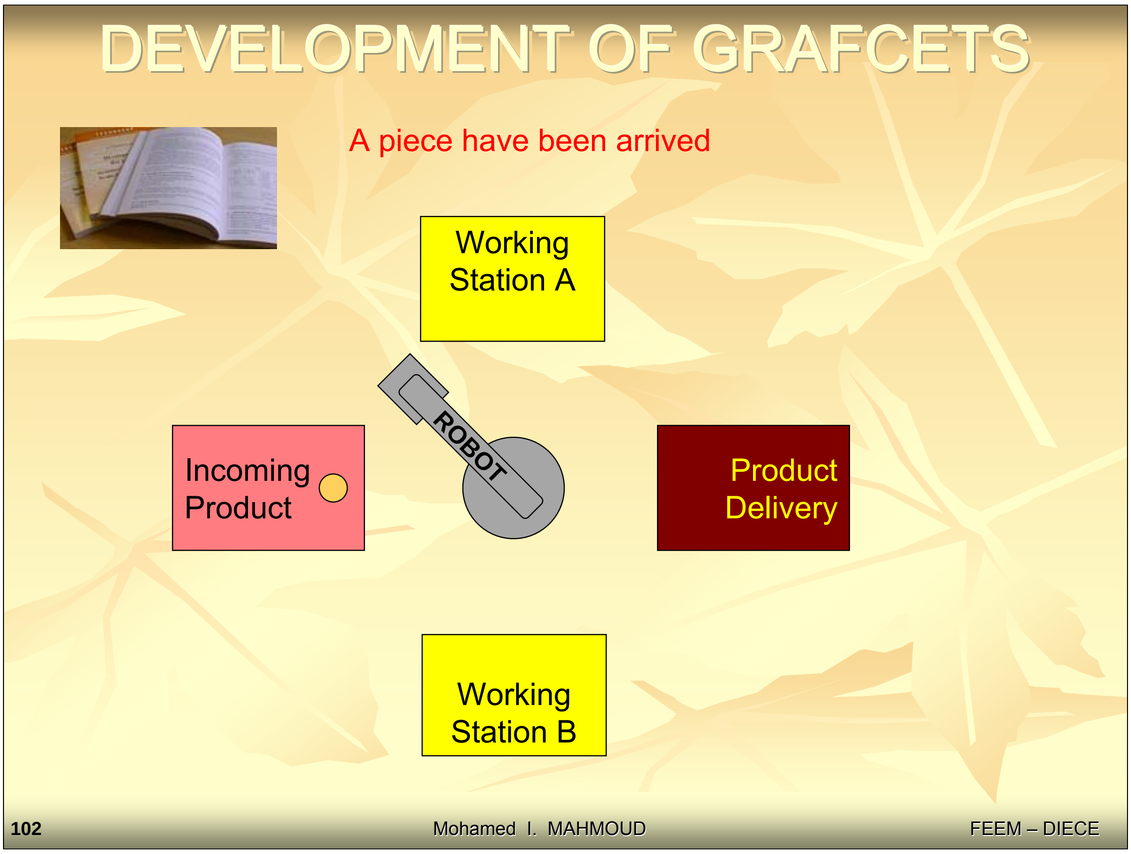
Before making a GRAFCET, we observe the function of this work unit.



The Robot is waiting for the arrival of piece on the incoming product side.

101 Mohamed I. MAHMOUD FEEM – DIECE

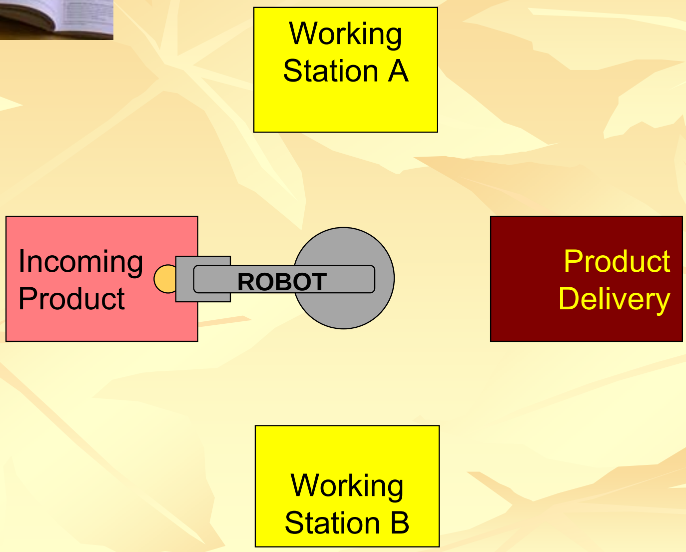
Write your notes



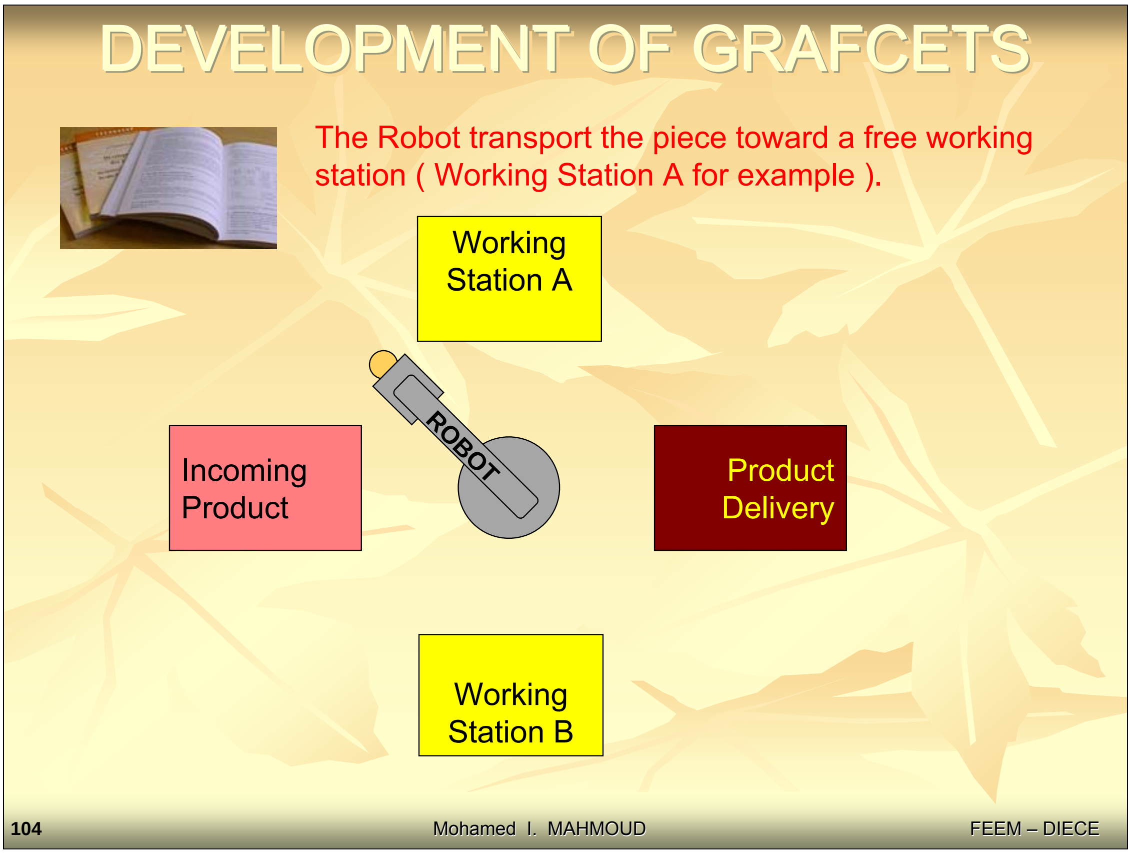
Write your notes

DEVELOPMENT OF GRAFCETS

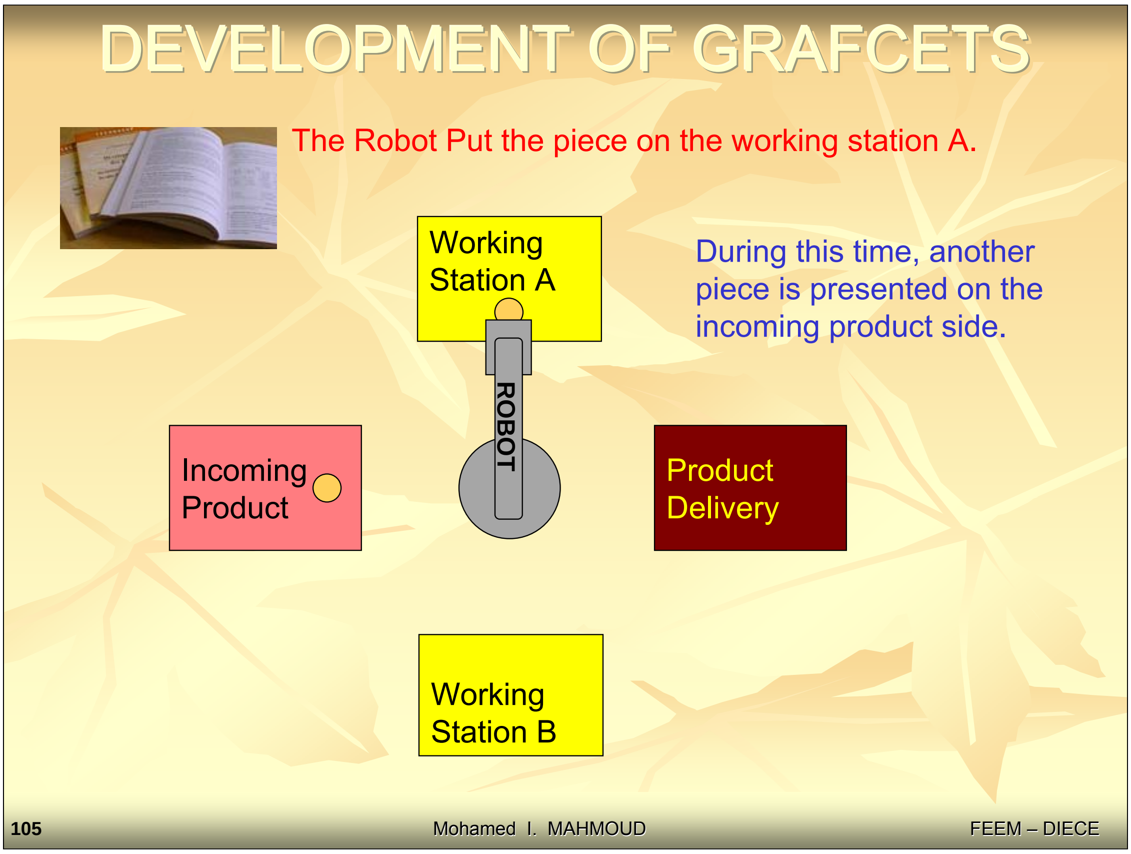
The Robot rotate to tack it.



Write your notes



Write your notes

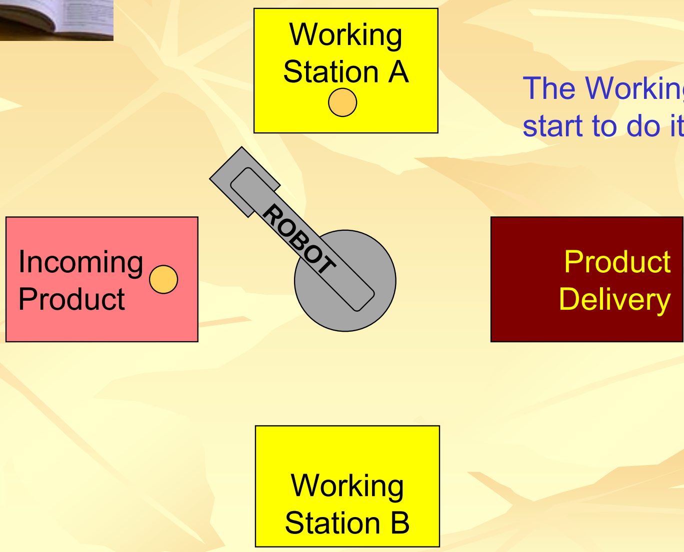


Write your notes

DEVELOPMENT OF GRAFCETS

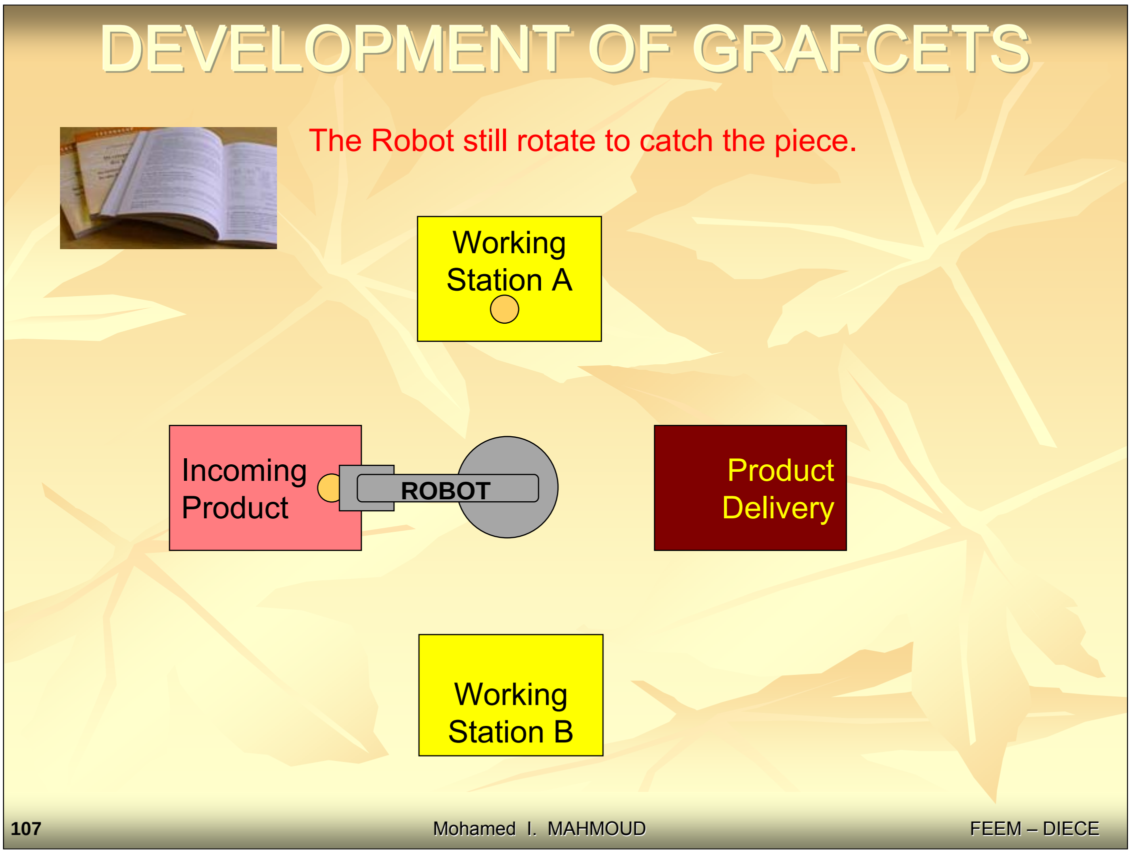
The Robot rotate in the direction of incoming product side.

The Working Station A start to do its work.



106 Mohamed I. MAHMOUD FEEM – DIECE

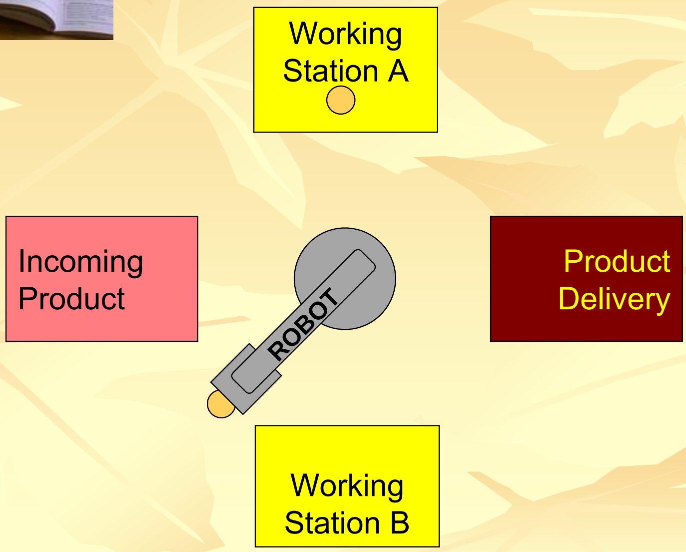
Write your notes



Write your notes

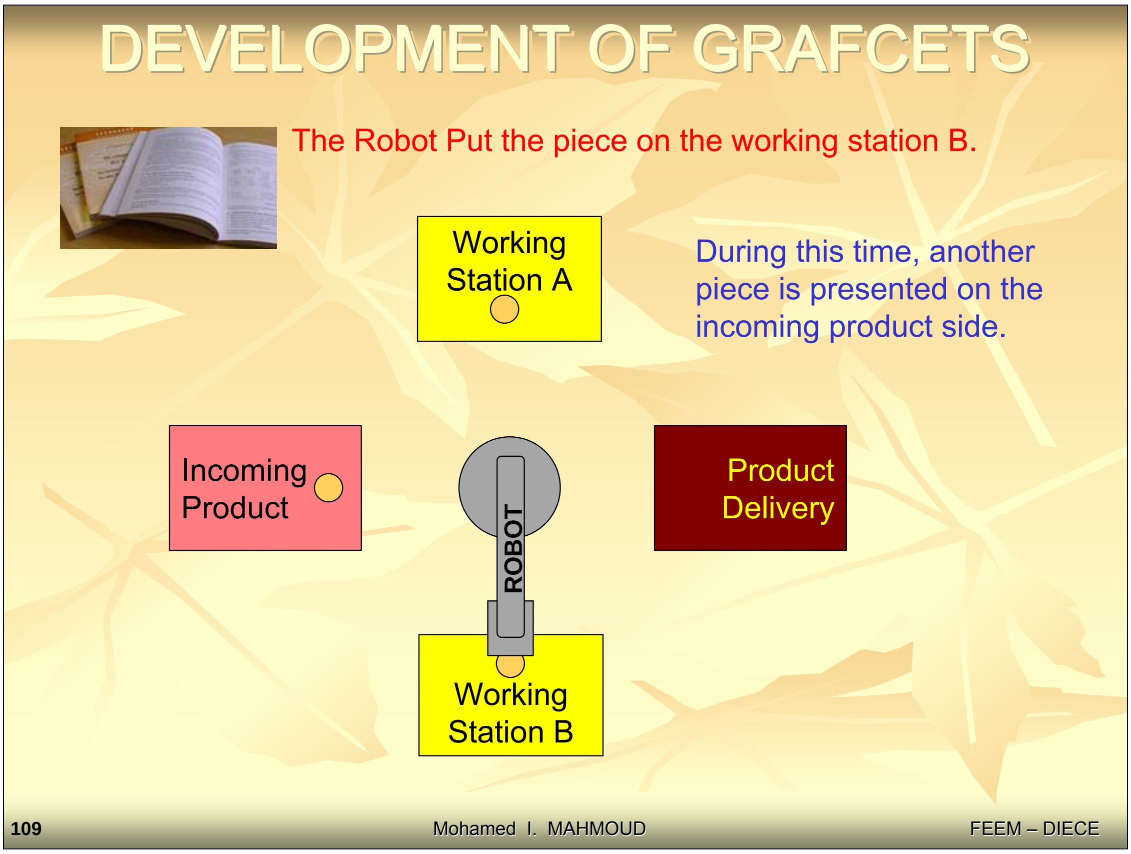
DEVELOPMENT OF GRAFCETS

The Robot transport the piece toward the free working station (Working Station B).

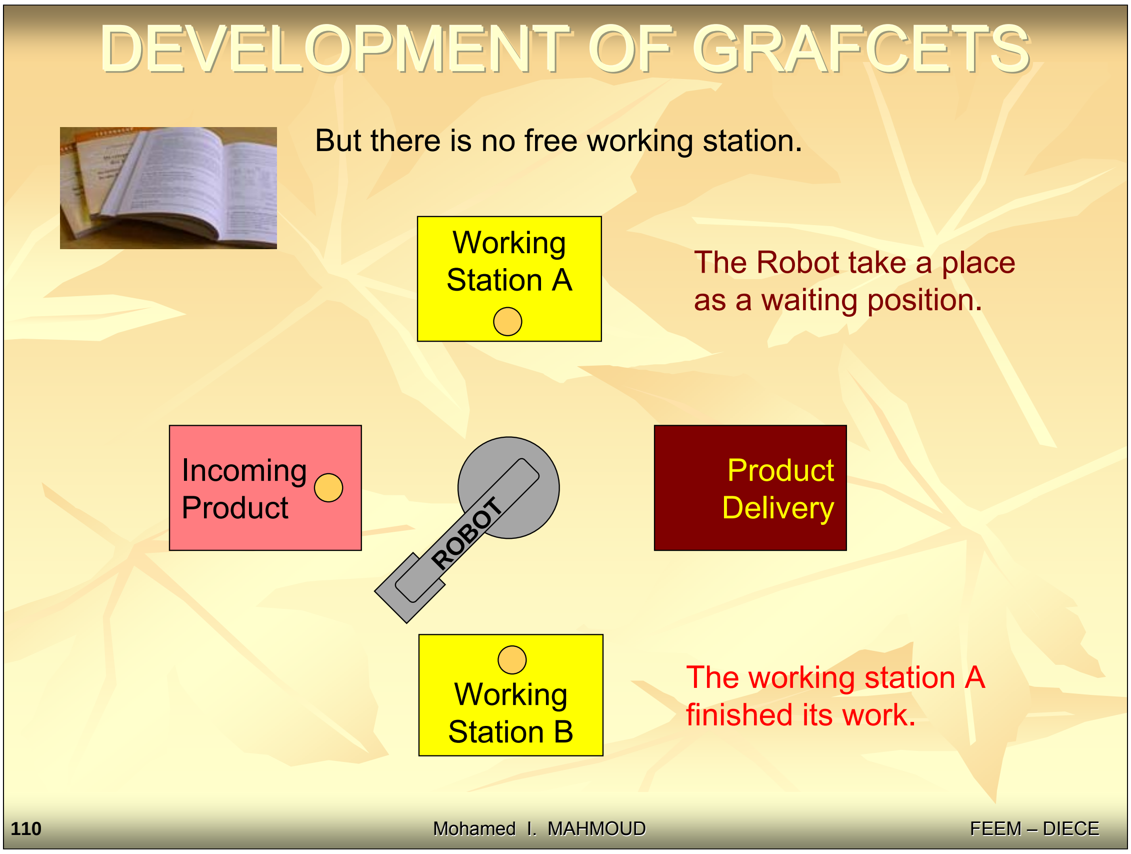


108 Mohamed I. MAHMOUD FEEM – DIECE

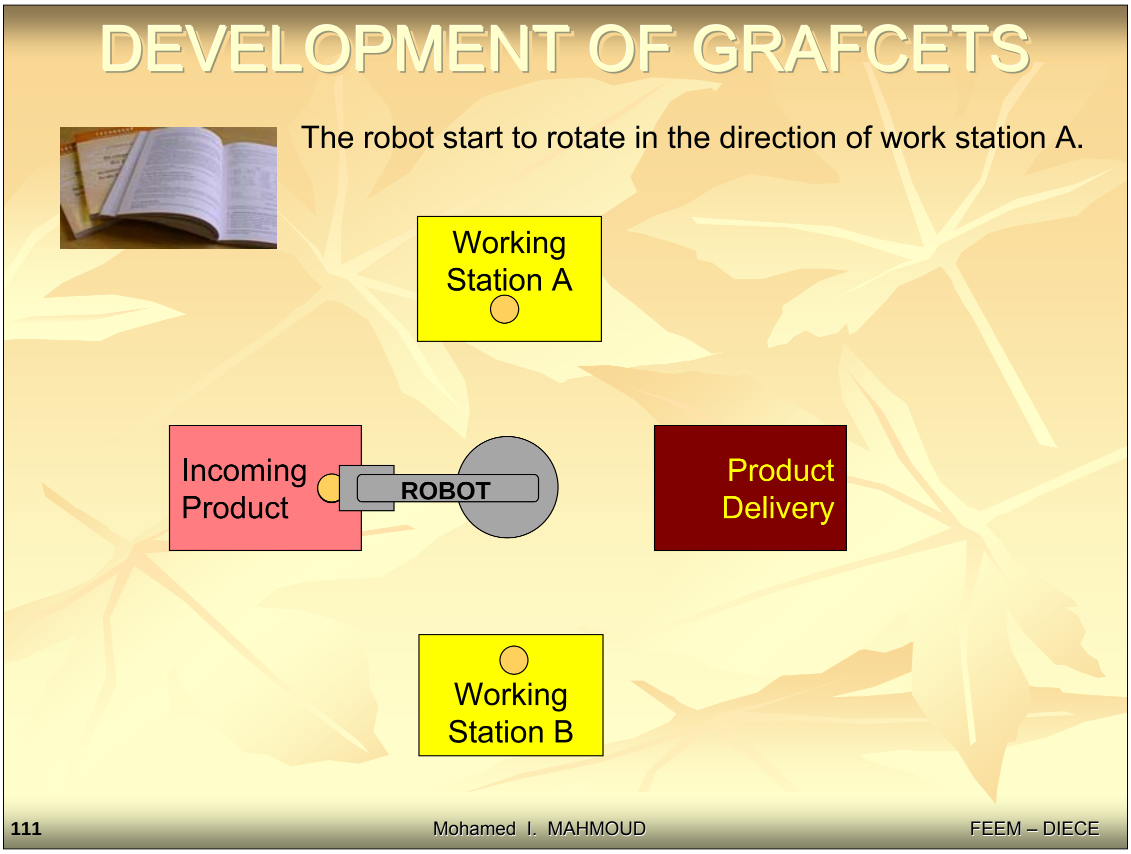
Write your notes



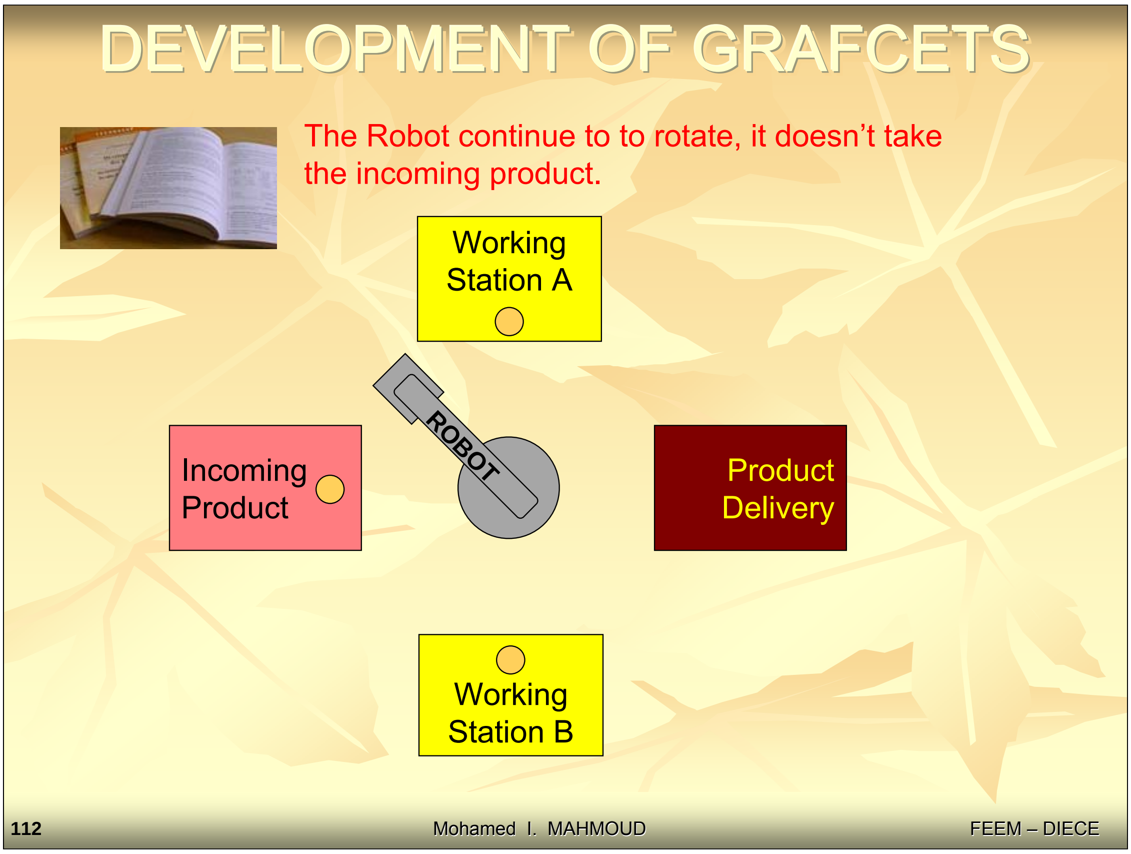
Write your notes



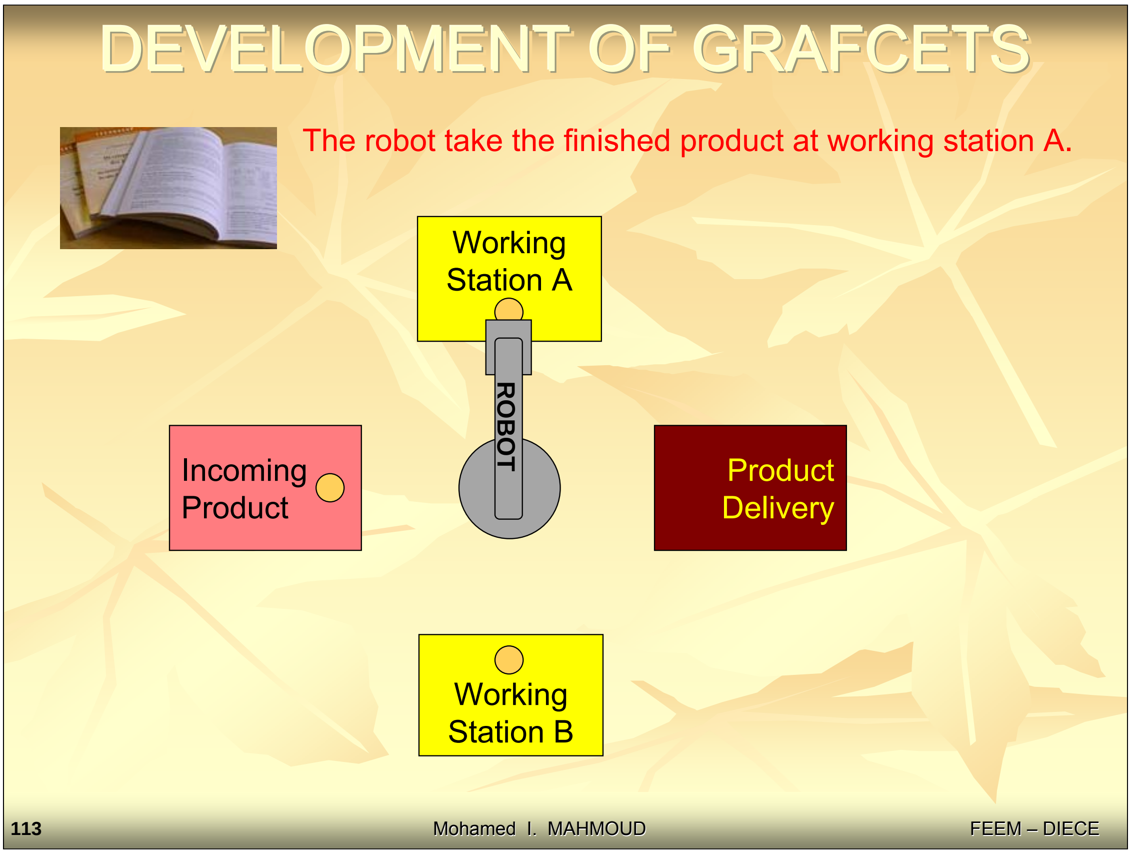
Write your notes



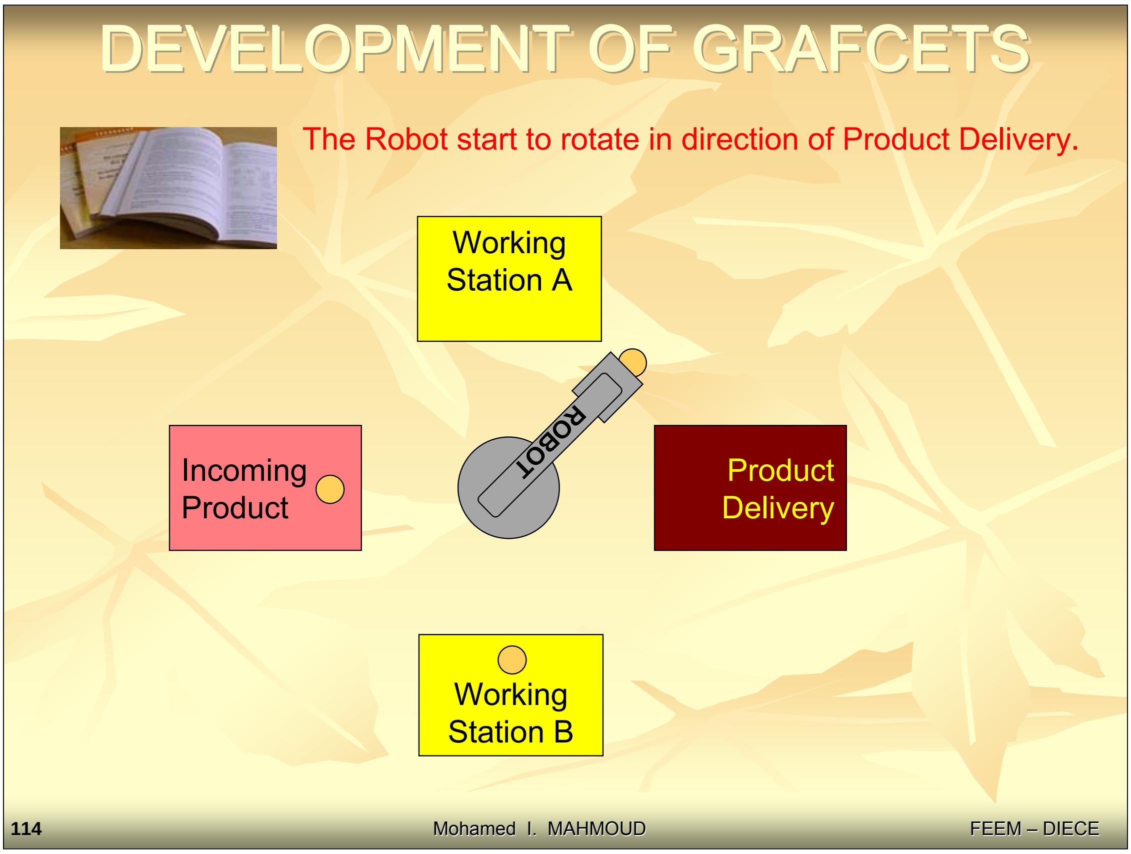
Write your notes



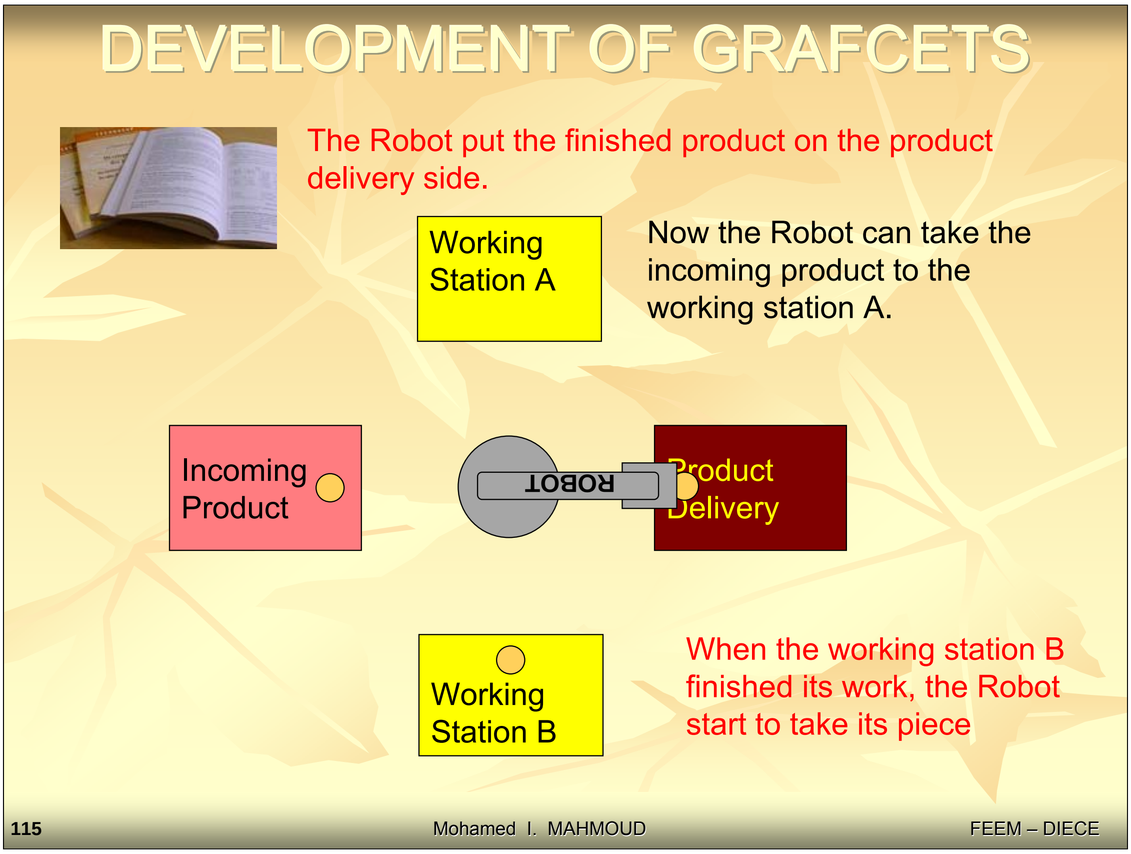
Write your notes



Write your notes



Write your notes



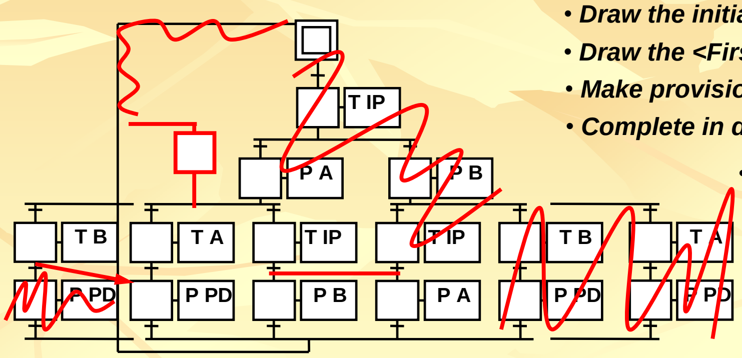
Write your notes

DEVELOPMENT OF GRAFCETS

Normaly, we solve this type of problems by an inituitive method as . . .

➢ *Draw a first version* *, then do management.*

- *Draw the initial step*
- *Draw the <First > action*
- *Make provision for passible evolutions*
- *Complete in details allover the cases*
- *Dont forget any thing?*
- *Correct it*
- *« Simplified it »*



T : Take
P : Put
A and B : Working station A and B
IP and PD : Incoming Product and Product Delivery.

116 Mohamed I. MAHMOUD FEEM – DIECE

Write your notes

DEVELOPMENT OF GRAFCETS

What we can say for this procedural method :

We see that this proceeding is not a rigid method.

Many phases of attempt are leading to a quit clear solution.

It is possible to found some errors are still existed :

Are we make sufficient corrections and enhancement?

Are we make provision allover the cases?

117 Mohamed I. MAHMOUD FEEM – DIECE

Write your notes

DEVELOPMENT OF GRAFCETS

Presenting now, how the proposed method can solve this type of problems .

Definition of the principale function level 1

Principal Function :
MANAGEMENT OF PIECES FLOW

In the formulation of the functions, we will use a

general vocabulary,

we will not referred to the employed technology

118 Mohamed I. MAHMOUD FEEM – DIECE

Write your notes

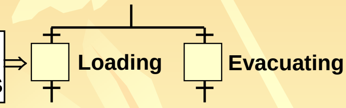
DEVELOPMENT OF GRAFCETS

Decomposition of the principal function : level 2

Principal Function :
MANAGEMENT THE FLOW OF PIECES

X Component of the function :
Loading Working Stations

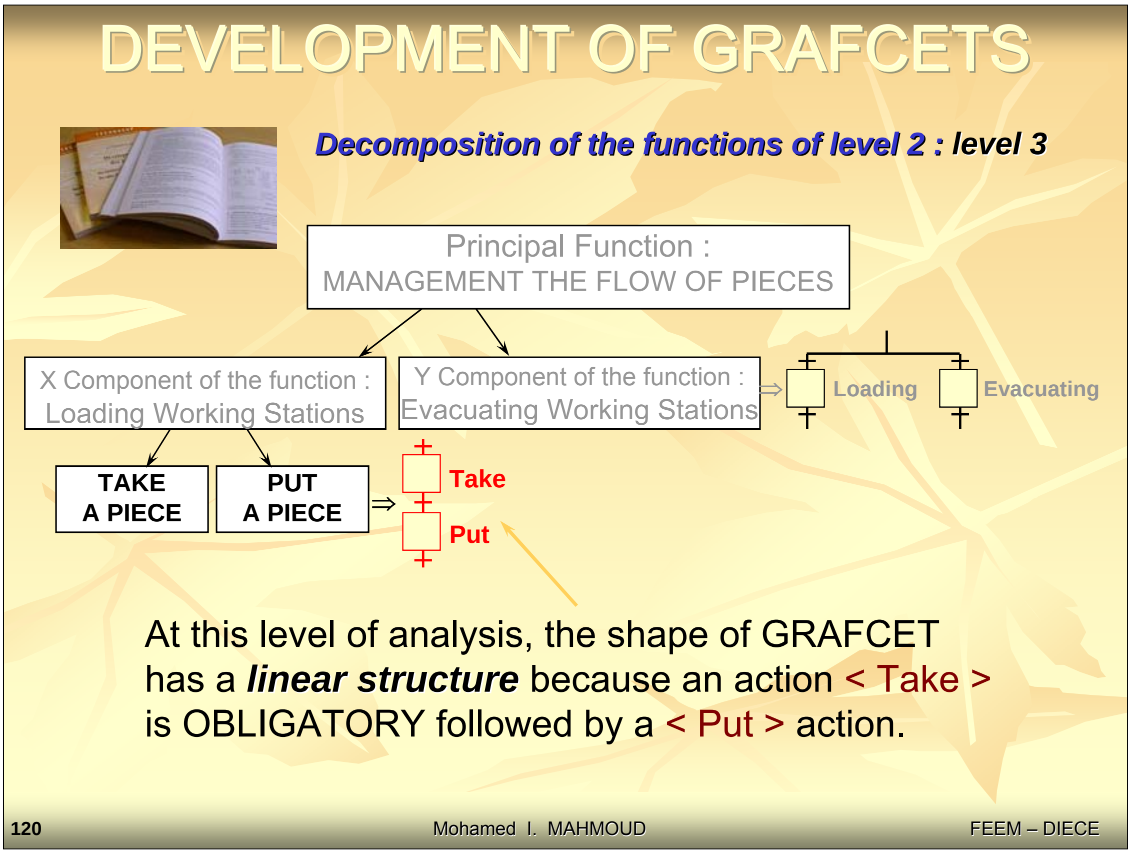
Y Component of the function :
Evacuating Working Stations



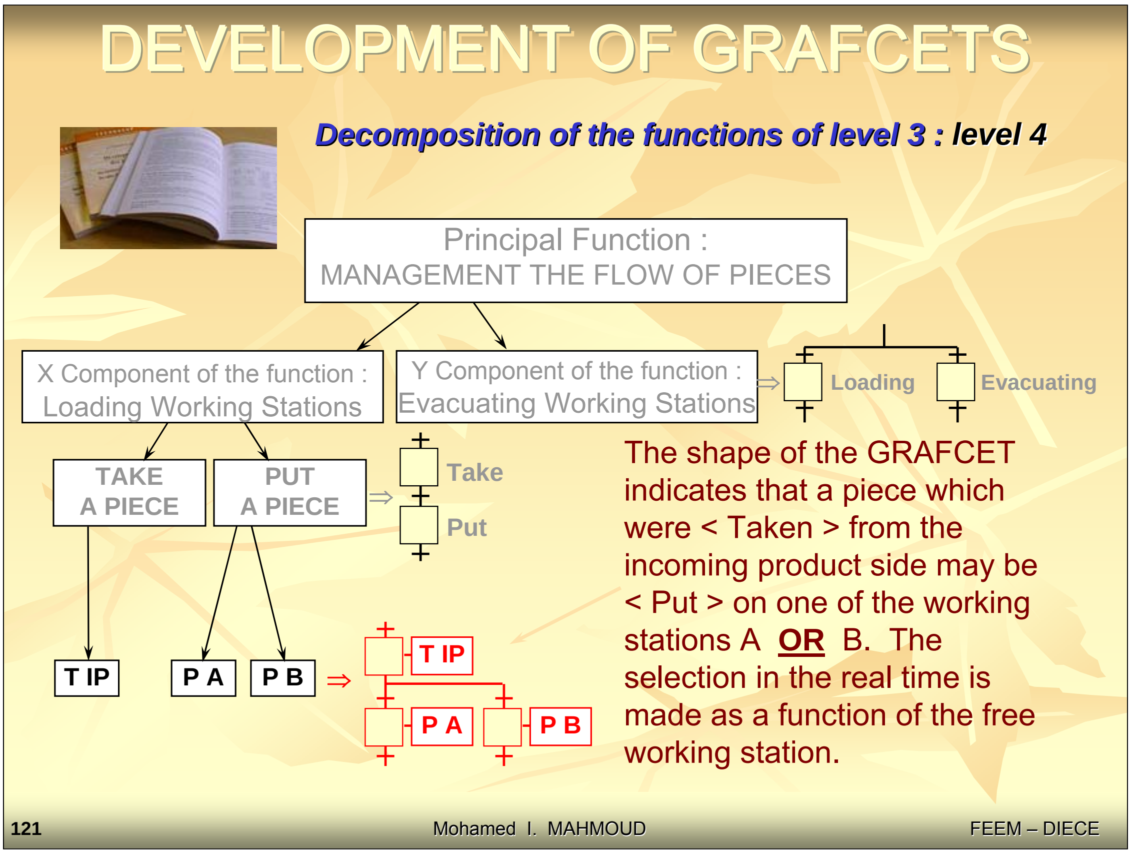
The synchronization of these functions is represented by a part of GRAFCET has an OR divergence, because the ROBOT may be rotated either to loading or evacuating a working station, without a predefined definite systematic actions.

119 Mohamed I. MAHMOUD FEEM – DIECE

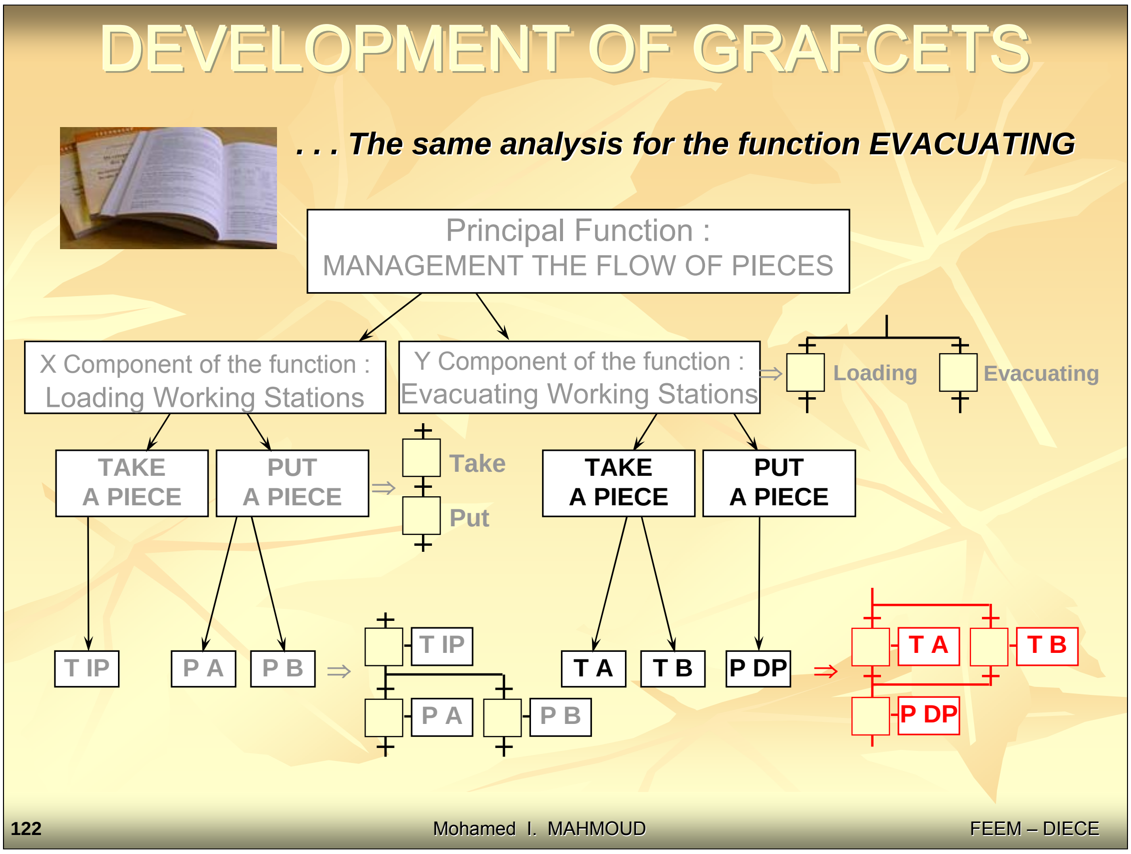
Write your notes



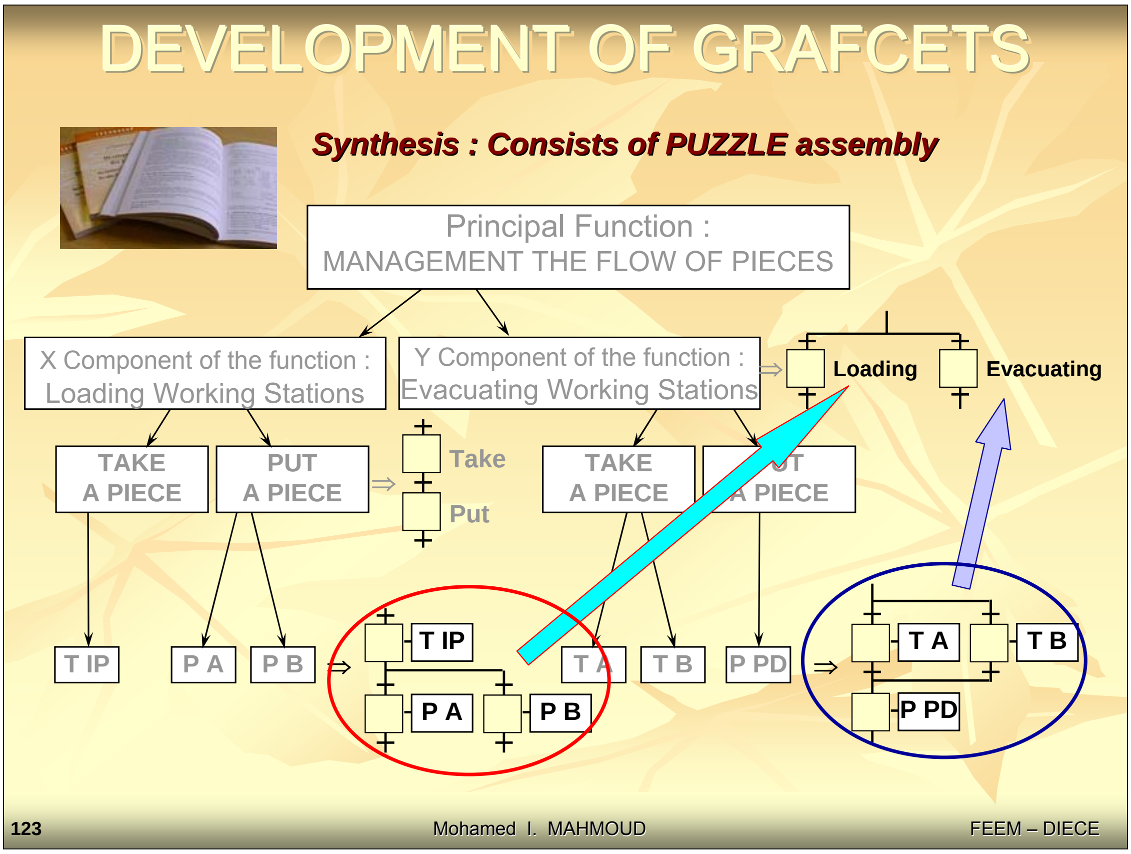
Write your notes



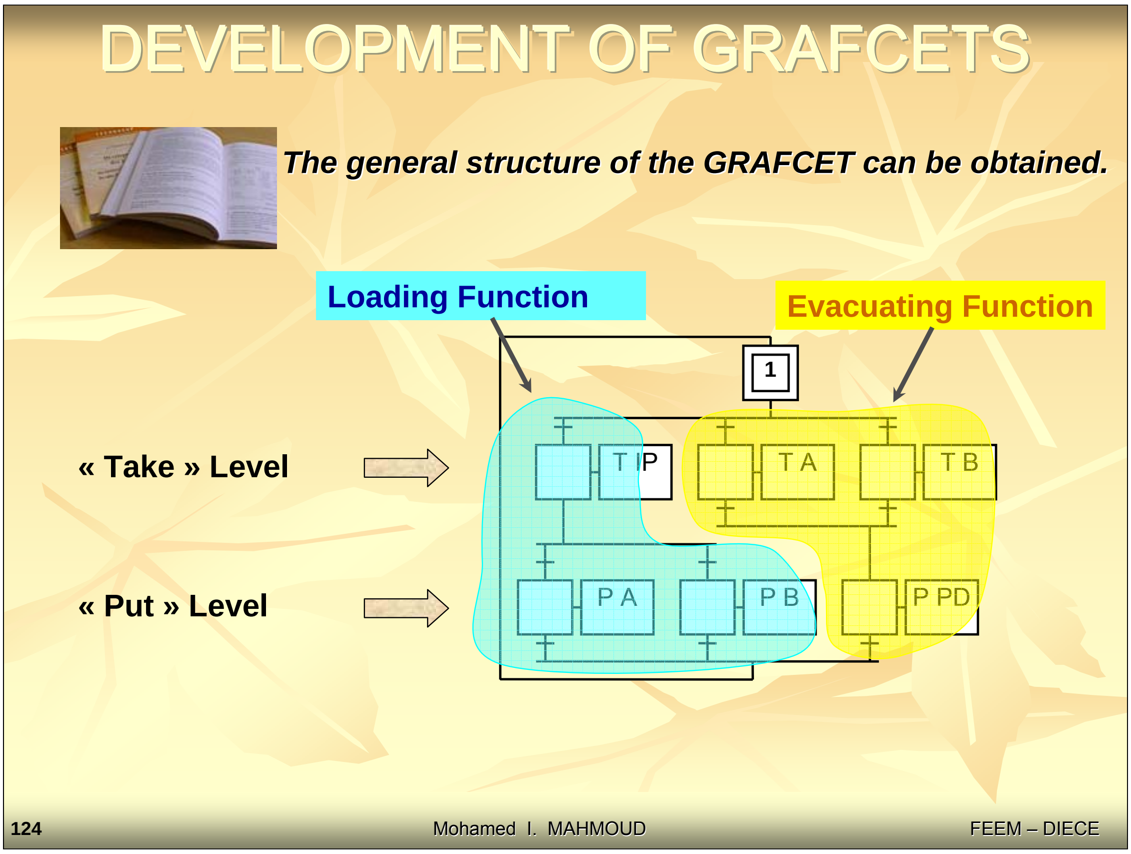
Write your notes



Write your notes



Write your notes

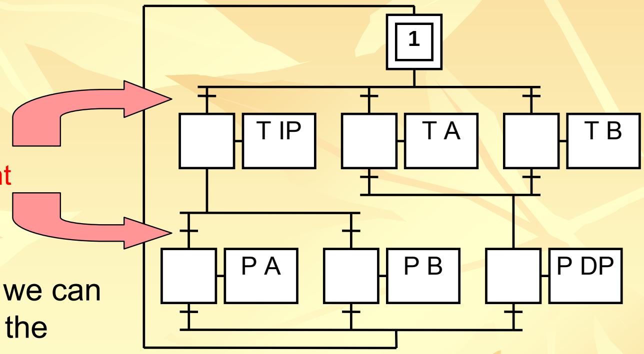


Write your notes

DEVELOPMENT OF GRAFCETS

Now, we complete only by the transitions receptivity.

Logic Equations For
Periority management

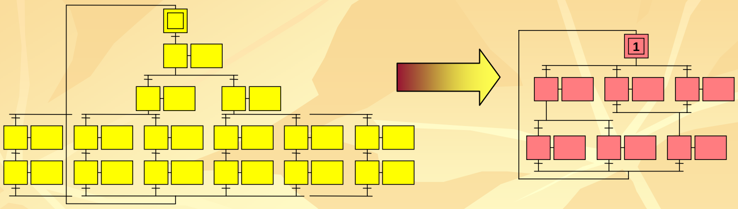


According to our needs, we can increase the flexibility of the system using ***Data Structure*** as a complement of the GRAFCETsuch as priority, stacks, queues . . . :

125 Mohamed I. MAHMOUD FEEM – DIECE

Write your notes

DEVELOPMENT OF GRAFCETS



Technical Advantages

- Clear Interpretations the structure of the GRAFCET still very readable although the random and complex function of the working unit.
- Stable Structure the GRAFCET complexity is not increase when the number of working stations increased.
- Progressive Adjustment of the Evolution Conditions It is very convenient, during the consequent utilization of the working unit to change or enhance its function, simply by adding on or modifying the test conditions at the transition level.
- Flexibility Enhancement when using the data structure of priority or queues types these gives a wide large flexibility.

Write your notes