

# MCT333 Mechatronics Systems Design

lecture

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- This Course based on Course Introduction to mechatronics
- The meeting will be every two weeks.

## Course Assessment

Student Activities	(40%)	progress / quizzes / Assignment
Mid term	(20%)	
project	(40%)	

## Main topics :-

1. Introduction to mechatronic Systems design.
2. VDI 2206 guideline for mechatronic design.
3. Actuator Sizing and selection.
4. Actuator's performance Curves and design of control loops.
5. Software tools for mechatronic systems design.

Mechatronics :- integration of mechanical engineering , electronic systems , control systems and intelligent Control in design . manufacturing of products and processes.

- Computers is not supposed to be a control system only.
- There is separation between Control System and Computer System.
- There are different types of Control Systems.

- Brakes are Mechanical system only at the old version now they are Mechatronic systems.
- We can't Measure Coefficient of friction directly
- Slipping action Causes Car to get out of Control.

Point of Contact  $\rightarrow$  Relative Motion  $\rightarrow$  #  
~~input relative NLL, نسبت انتقال~~  
 $\rightarrow$  Translated  $\rightarrow$  ~~جذور~~ سرعة في  
direction of wheel of car.

# Concern slipping by measuring Speed of each wheel of car.

Anti lock Braking Algorithm  $\rightarrow$  #  
 $\rightarrow$  Anti Locking Control، انتقال  
lock Release brakes  $\rightarrow$  وفاز slipping

Living lock takes  $\rightarrow$  ولو الحادث .  
 $\rightarrow$  Anti Lock Control  
Lock takes the best possible action  $\rightarrow$  ترتكب

locking the first few wheels  $\rightarrow$  ولاتا اولى .  
in just locking longer  $\rightarrow$  ولاتا اولى  
wheel braking forces  $\rightarrow$  لاتا اولى ، ولا slipping  
" قوى تحرير فيها او سرعات في point of action  $\rightarrow$   
للاتا اولى ، ولا slipping

لولعات سرعة زفل ملحوظة وله  
الاتجاه المعاكس لاتجاه المقدمة  
أكبر فائدة في زنة يديرك لسرعة زنة  
وهو زفل لوكينج ودمعناته (locking) حتى  
لا تحدث دعسات في مرحلة

عزم لفاف زنة وباقي المراحل  
سيكونوا متسارعين من الخطاقة (locking)  
locking أو slipping

→ Rolling of car (3 wheels) is greater than that  
of the wheel at which slipping will occur

→ في هذه الحالة نجد ان السرعة  
على الارض اقل من السرعة النسبية

Comands using actions in Apps

عمل على اسطوانات الهيدروليكي

Release braking

تراجع سرعه باقي المراحل وتحفيز

Command using cylinders

Brakeable

(locking)

locking

up to 20 times/sec

Call Frequency

الرواية في جميع المراحل  
braking system بالدروغ

Release  $\rightarrow$  in & will pulsating  $\rightarrow$   $\rightarrow$   
جذع  $\rightarrow$  will Repeatability  $\rightarrow$   
locking.  $\rightarrow$  will braking.

4 sensors.  $\rightarrow$  4 wheels; System: جذع  
 $\rightarrow$  4 will  $\rightarrow$  4 will all  $\rightarrow$  4 will.

4 speed sensors Connected to Electronic control unit  
Then it's forward directly Connection to hydraulic  
Control Unit from which There are 4 branches  
directly Connected to 4 wheels  
(Optical Encoder)  $\rightarrow$  في كل المموجات

Sends pulses due to detection of light from  
transmitter to receiver, sends these pulses to  
Electrical Control System.

pulses Corresponding to Number of obstructions  
of beam of Signals which detects Number of  
rotation of wheel (rpm)

as tooth  $\rightarrow$  tooth disk  $\rightarrow$  will send  
will beam light  $\rightarrow$  جذع  
as, " pulses of  $\rightarrow$  will reciever  
light.

will send,  $\rightarrow$  will reciever  $\rightarrow$  will (will)  
will, will  $\rightarrow$  will  $\rightarrow$  will  $\rightarrow$  will, will  
will  $\rightarrow$  will

Hydraulic Electronic System

Hydraulic Electronic System.

Control system

Control system

Mechanical system of brakes

Mechanical system of brakes.

Computer system

Computer system.

Electrical So we have full mechatronic system.

plus digital video controllers will be used.

الدن يسرّت لهم دلوقتي

# digital Controllers Called Computer Controller based on Architecture of Computer.

( Processing Unit , input/output, Analog/digital Memories. ) and

it is better than Analog controllers Due to low processing Capacity, less response

ـ من مميزات الصيغة اترونكس انه يقلل التوصيلات  
ـ الاتصالات المتعددة

## Mechatronics System Components:-

1. Mechanical system which contains Actuators and Sensors.

→ Actuators Control speed / Acceleration.

→ Jensor Senses The Current State of The System.

Tensors :-  $\leftrightarrow$  Signal و  $\leftrightarrow$  Signals (مُلْعَنٌ)

3.9 input signal Conditioning  $C_{in} 10^{-1} \rightarrow 1A$

## Filter (ADC) | Amplification Losses

Digital Control و نک ای سیگنال های دیجیتال

output signal) we help in circuit

## ( Conditioning )

Output Signal Conditioning - Actuator driver circuit  
Signal to Actuator  
Amplification  
Digital to Analog  
Actuators

Indicator and Graphical displays  
User interface  
Human Machine Interface - HMI

# Learn How to display / deal with interdisciplinary products?

Phases of system

Requirement phase → design phase → implementation phase

Philosophy of mechatronics based on Concurrent engineering  
معناه حفظ مراحل متعددة في نفس الوقت  
العمل بالموازنة ←  
مع بعضها البعض في نفس الوقت  
خاتمة معاصرة

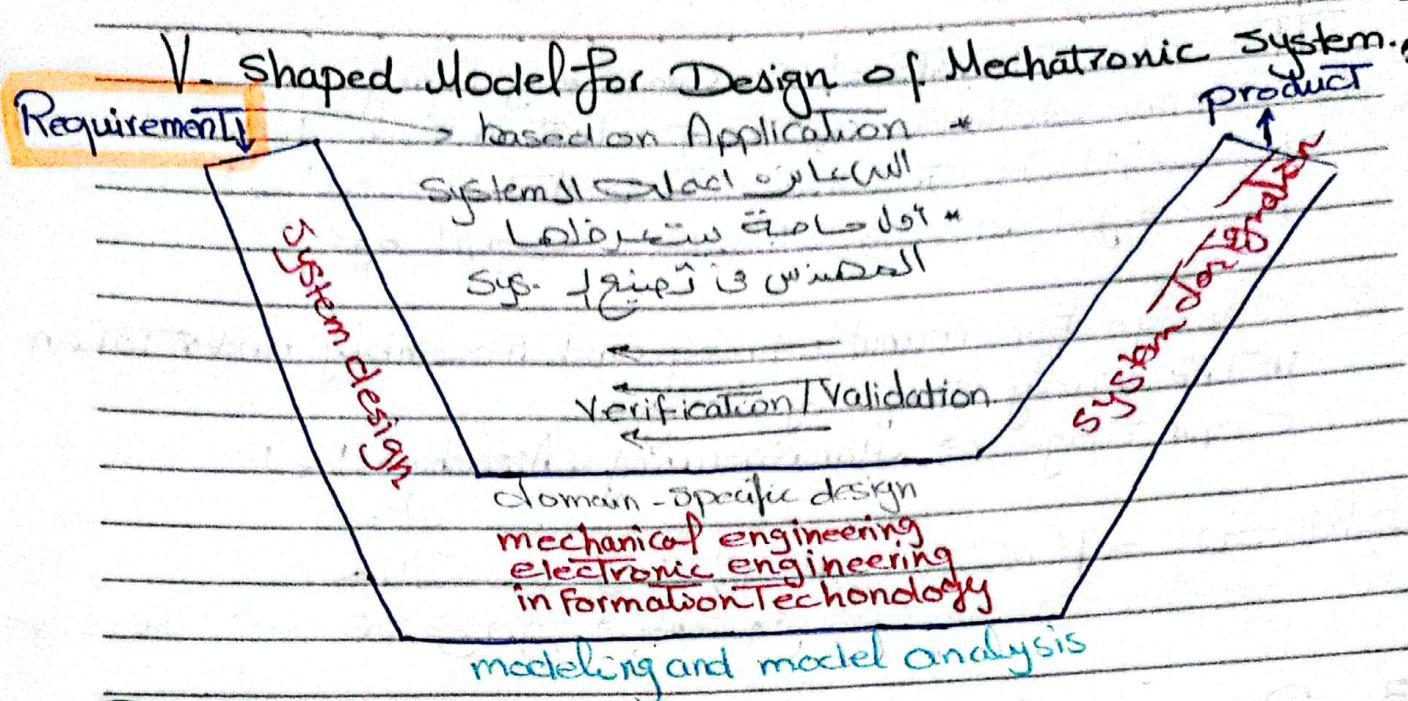
العمل بالموازنة سهل كثيـر  
الخطوات الـ "Stages" الأولى قبل الـ "implementation" ثم الـ "design" stages.  
الخطوات الأولى هي  
كل بعـضها يـخـطـب  
بعـضـهـا

فیصلہ ملکیت اداری میں  
Project Management میں  
Project Management میں

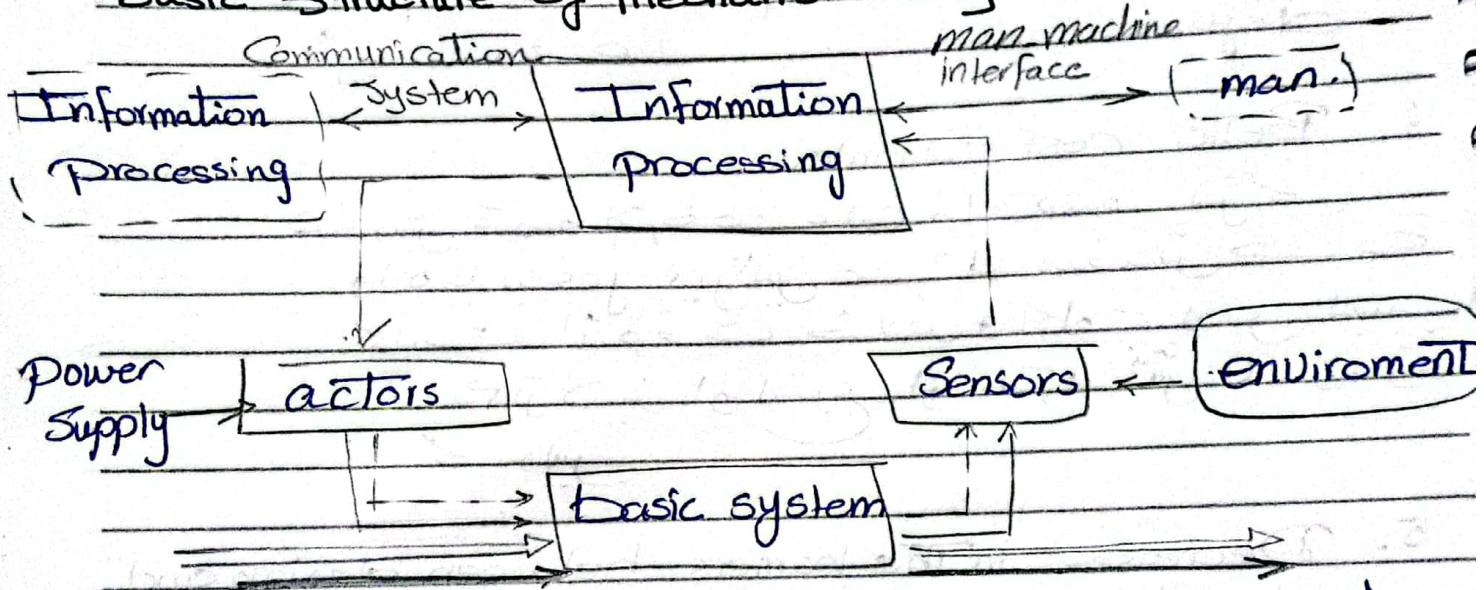
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The characteristic of Concurrent engineering are

1. Better definition of The product without late changes  
الیکٹریک اسٹرائیچن اور پروڈکٹ کا نئے نئے طرز کا دیکھنا
2. Design for manufacturing and Assembly undertaken in the early stage of design.  
اپنے تولید اور سامبھل کے لئے اسٹرائیچن کے ابتدائی مرحلے میں
3. Process on how The product development is well defined  
لہوڑی کے طور پر اسٹرائیچن کا پروسیس
4. Better cost estimates  
کم از کم تکمیل کرنے والے قیمتیں
5. Decreases in the barriers between design and manufacturing.  
اقلیفیل سینج بین الاداریں کا ان (لہوڑش خیز باریں) کا کم کرنا



### Basic structure of mechatronics system..



- Force Acting on basic system Causing work to be occurred.

→ information flow  
→ energy flow  
→ material flow

□ necessary unit

- - - optional unit

Starting point:

Set of requirement لبيانات المطلوبات  
and product processing لبيانات المعالجة

Stage أو مرحلة في كل عبء أو مشروع

System design المراقبة الرئيسية

Concurrent engineering المعايير المترافق

وهو دليل mechatronic engineer

حيث يكتسب فنونها وفقاً لها

لعرف معايير الـ Cross-domain.

essential physical and logical

characteristic of the future product.

hardware + modules, Connection of Component  
, integration + Control

Job System design المفهوم المترافق

Cui - task or job System تطوير المهام

Set of Requirement المطلوبات

والتي تحدد المهام

ويتم توزيع المهام على المهام

في المدى المنخفض

Mechanical department الميكانيكي

ويتطلب في المدى المنخفض

domain specific Job كائن ابتدائي

design more detailed Analysis then implementation.

مهمة الميكانيكي

mechanical

electronic

Information Technology.

## System integration

ابتدئي استوفى نت ←  
overall system. →

والمراحل الستة في تصميم الميكانيك

## modeling and model analysis

## Schematic of System

## Geometric representation

### 3D model.

mathematical modeling  $\rightarrow$  load  $\leftarrow$  force  
Components:  $\Pi$ ,  $\text{tip} \rightarrow$  size

Domain specific design. Integration facilitates