ME 4010: Control Systems Theory

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Whatsapp group

Scope of the course

Introduction to control systems

Modelling of systems: Frequency domain and State Space

Classical control theory: Frequency domain controller design

Modern control theory: Time domain controller design

Introduction to digital control systems

Brief introduction to higher level control system design

Practical applications/ implementations

Learning outcomes

1. Develop models of new systems; perform system ID
2. Develop a controller for 1st and 2nd order systems: theoretically and programatically
3. Develop controllers to overcome disturbances
4. Develop controllers and observers using state space

1. Matlab and Simulink programming to develop
   a. Models of systems
   b. Design controllers
   c. Analyse performance of controllers
2. Arduino based controller design to implement basics of digital controls

Expectations

Course work will be shared over Moodle

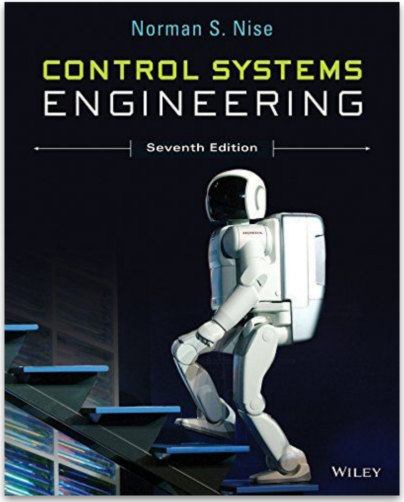
Attend class regularly (80% attendance)

Do all the programming assignments yourself. Assignments will be primarily Matlab and Simulink exercises. You may be asked to implement simple controls on arduino as well.

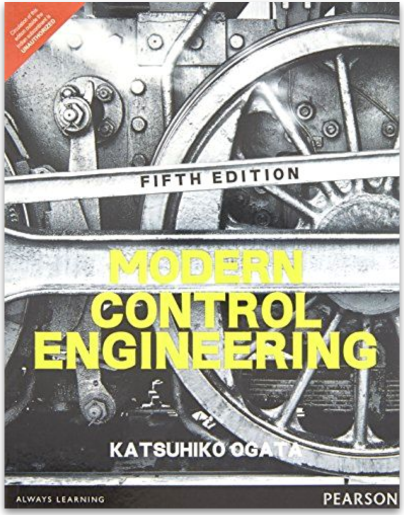
4 hours in class - 6 hours(at least) self study (per week)

Optional but recommended: Purchase an arduino kit from amazon with basic electronics components so we can do some experiments in class as well

Reference Books



Norman S Nise, Control Systems Engineering, Wiley India Edition, Wiley, 2018



Ogata, Modern Control Engineering, Fifth Edition, Pearson Education, 2015

Grading Scheme

Quiz 1	20
Quiz 2	20
End Sem	40
Tutorials, Assignments, etc.	20

Introduction

Super old and awesome control systems

Case study: Angular speed control

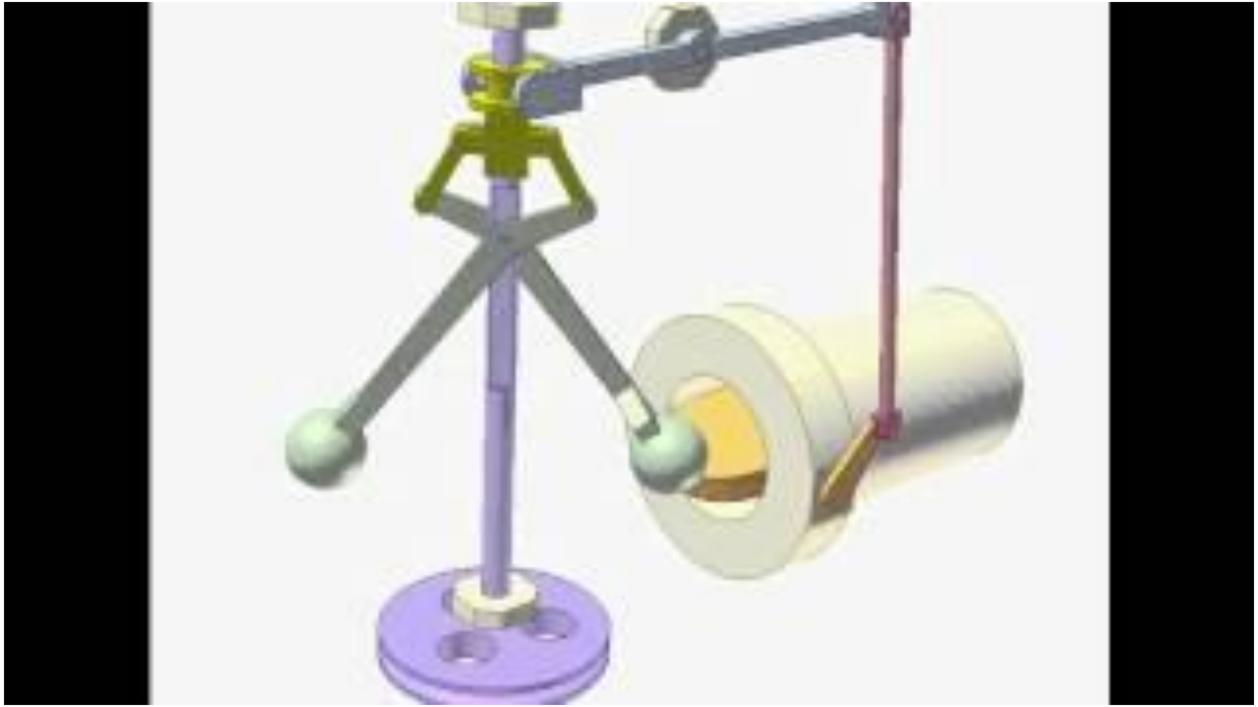
Measure the variable i.e. speed (ω)

Have a set point (ω_0)

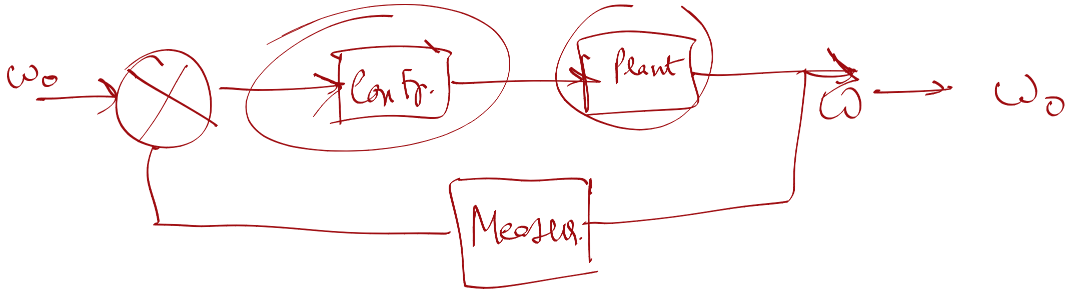
Know the natural dynamics of the system (eg. motor equation, rotary spring inertia system etc.)

↳ I/P ↔ O/P relationship.

Super old and awesome control systems

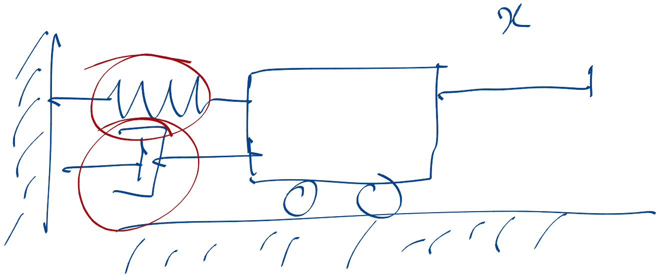


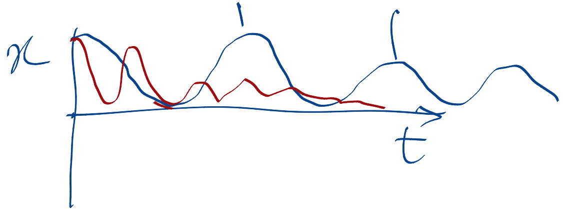
Open loop and closed loop control



What is a control system

- Gives a particular o/p depending on i/p
- A system which can make a decision without human intervention.
- Achieve a set target outcome, ~~despite~~ the natural dynamics of the system.





$\xi \qquad \omega_n \qquad \omega_d$

$$\ddot{x} + 2\xi\omega_n\dot{x} + \omega_n^2 x$$