

# **Control Systems Analysis and Design with MATLAB and Simulink**

## **Course Syllabus**

### **DAY 1: Review of Control Systems Analysis and Design Principles**

#### **1. Presentation of the basic automatic control concepts :**

- the basic definitions and terminology in control theory
- from practice to theory: closed loop control benefits and limitations
- examples

#### **2. Control Systems models formulation and representation :**

- from practice to math : using linear differential equations to obtain the transfer function ;
- using the Laplace transforms
- examples

#### **3. Linear Control Systems Characteristics :**

- transient response , frequency response and control requirements
- 1<sup>st</sup> and 2<sup>nd</sup> order linear systems: time constant, system damping, natural frequency – how they impact the control system design?
- Error Coefficients concept
- Stability limitations of Closed Loop Control Systems
- Examples

#### **4. HANDS ON Lab using Matlab to practice solving example problems presented in topics [2] and [3]**

## **DAY 2: Analysis and Design Methods of Control Systems**

### **5. Frequency Domain Analysis With Bode Plots**

- Bode Plots concept / how they work?
- Phase margin , gain margin and their impact with design constrains
- Examples

### **6. Frequency Domain Control Design with Bode Plots**

- Polynomial Compensation Design with Lead/Lag networks
- PID compensation network concept
- Examples

### **7. Transient Domain Synthesis with ROOT LOCUS**

- Improving steady state error and transient response
- Feedback compensation
- Examples

### **8. Hands on Lab using MATLAB and Control Toolbox to practice examples of control problems presented in topics [5] , [6] and [7]**

## **DAY 3: Control Systems Design and Simulation**

### **9. Control System analysis and design using Simulink**

- Control System Modelling and Simulation via Simulink
- PID tuning using MATLAB and Simulink
- Digital Compensation
- Examples

### **10. Control System Design Projects**

- Velocity Control System project : design and simulation
- Position Control System project : design and simulation

### **11. Hands on Lab using MATLAB and Simulink to practice solving exemplary design problems presented in topics [9] and [10]**