

Topics for the course “Control Systems”

Instructor: Dr. Tushar JAIN (Assistant Professor, IIT Mandi)

Total contact hours: 10 hours

Prerequisites: Network analysis / Signals and systems

Intended for: B.Tech (EE/ECE/ME)

Preamble: Control Systems Engineering plays an important part in modern technological systems. The scope and benefits of an improved control strategy in the industry can be immense. However, a difficulty with this subject is perhaps that some of the more advanced aspects depend on sophisticated mathematical background. I intend to keep the mathematics at a reasonable basic level, thereby focusing on an application of the control theoretic tools. This short course covers two topics, which comprise a total of 8 hours of lectures and 2 hours of tutorials.

Topic - 1: Time domain analysis of first and second order system

Course Outline:

Session date : 27th Jan (2-4 pm) , 28th Jan (10-12 pm), 29th Jan (10-12 pm)

Module 1:

[2 hours]

- Transfer function and state-space model
- Standard process inputs
- Response of first-order systems
- Response of integrating systems

Module 2:

[2 hours]

- Response of second-order systems
- Poles and zeros and their effects on system response
- Systems with time-delays
- Approximation of higher-order transfer functions

Textbook:

1. D.E. Seborg, T.E. Edgar, D.A. Mellichamp, Process Dynamics and Control, John Wiley & sons, second edition, 2004.



Topic - 2: Design of feedback control systems

Course Outline:

Session date :

Module 1:

[2 hours]

- Feedback structures

- Nominal sensitivity functions
- Closed-loop stability based on the characteristics polynomial
- Root locus
- Nominal and relative stability

Module 2:

[2 hours]

- PID structure and Empirical tuning
- Ziegler-Nichols (Z-N) Oscillation Method
- Reaction Curve Based Methods
- PI and PID Synthesis Revisited using Pole Assignment
- Smith Predictor

Textbook:

1. G.C. Goodwin, S.F. Graebe, M.E. Salgado, Control system design, Prentice Hall, 2001.