

Mechatronics for Rehabilitation Engineering: Course Notes

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Chapter 1

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1. Introduction to Rehabilitation Engineering

2. Mechatronics system design process

3. Linear Time-Invariant Systems review

4. Electrical circuits review

- Electrical circuit elements: voltage source, current source, resistor, capacitor, inductor.
- Electrical power and energy
- Kirchhoff's laws
- Thevenin's and Norton's theorems

5. Electronics review

- Diodes, bipolar junction transistors, Field effect transistors
- Operational amplifiers

6. Sensors & Signal conditioning

- Movement sensors: potentiometer, capacitive sensor, rotary encoder, accelerometer, gyroscope, Hall effect sensor, Tachometer
- Force sensor: Strain gauge
- Proximity sensor

7. Actuators

- Solenoids
- Brushed DC motor
- Models of DC motor
- Brushless DC motors
- Stepper motor

8. Microcontrollers

- Fundamentals

- Interfacing
- Communication protocols
- Fault detection

9. **System dynamics - Bond graph modelling**

10. **Automatic Control**

- Feedback systems
- Stability analysis
- PID Control
- Design of feedback control

11. **Case Studies**

- Rehabilitation robotics
- Functional electrical stimulation
- Prosthetic limbs
- Mobility aids
- Human-machine interaction