WOLLO UNIVERSITY

KOMBOLCHA INSTITUTE OF TECHNOLOGY

DEPARTMENT OF MECHATRONICS ENGINEERING

Regulation and control

Course number: McEng 3174 **Course title**: Regulation and Control **Instructor :** Serkalem.B	**Credit hours**: 3 **Contact hours**: 2 Lectures and 3 Tutorials

Course Objectives:

This course enables the students to:

- Model common physical systems such as spring-mass-damper systems, resistor-inductor-capacitor networks, first and second order fluid systems, and first and second order thermal systems
- Represent different control systems (CSs) using TFs, block diagrams and state space functions (using both time variable and Laplace variable)
- Analyze common control systems in time domain and frequency domain
- Identify important characteristics like settling time, rise time, maximum overshoot, phase shift, peak resonance, resonance frequency and bandwidth
- Determine the accuracy of a control system
- Analyze the stability/instability of a control systems using different criteria such as Routh-Hurwitz, Root-Locus, Nyquist, Bode Plot
- Evaluate the relative stability (gain margin and phase margin) of CS
- Evaluate the sensitivity of a CS to disturbance
- Design simple controllers like P, PI, PID and lead-lag networks, and improving the stability, accuracy, etc of a control system

Course Description:

Modeling Linear Systems, Time and Frequency Domain Characteristics, Stability, Control Systems, and additional topics like simulation and PLC

Course Outline:

1. **Equations and Models of Linear Systems:** Introduction; Transfer functions; Block diagram; Basic control components; Mathematical modeling of physical systems , signal flow
2. **Time and Frequency Domain Characteristics:** Step response of a general second-order system; Time domain specifications; Steady-state frequency response
3. **Stability Analysis:** Routh-Hurwitz criterion; Root-Locus technique; The Nyquist stability criterion; Bode plot and stability; Gain-Phase plots and stability; Relative stability from frequency response
4. **Control Systems:** Control system components; Techniques to improve the general performance of servomechanism; P, PI, PID control; Phase Lead-Lag network control
5. **Miscellaneous Topics (optional):** Simulation of mechanical systems; Multivariable control systems; Programmable logic controller; Introduction to advanced control

Pre-Requisites: Math 331 Applied mathematics III

Teaching Methods:

- Lectures supported by tutorials,
- Assignments and laboratory exercises

Attendance Requirement:

- Minimum of 75% attendance during lecture hours; and
- 100% attendance during practical laboratory sessions, except for some unprecedented mishaps.

Evaluation:

- Continuous Evaluation systems 50%
- Final exam 50%