Department Of Computer Science and Engineering
Kathmandu University
Dhulikhel, Kavre

Subject: Instrumentation and Control **Course: COEG 304**

Level: B.E. 3rd Year/ 1st Semester **Credit Hours: 3**

Objective: *To become familiar with the principles, architecture and design of instrumentation systems used for measurement and control*

Syllabus:

Introduction: Definition of control systems, history and examples, concept of feedback and closed loop control, open-loop versus closed-loop systems, linear system, time-invariant system

Mathematical modeling: Physical balances, differential equations, mathematical modeling of mechanical systems and electrical systems, mathematical modeling of fluid systems

Laplace transform: Definitions, transfer functions, poles and zeros, mathematical block diagrams, block diagram reduction

Transient and Steady-State-Response Analyses: Standard test signals, transient response of first order systems, second order systems and higher order systems, concept of dominant poles, steady state error and type of systems

Stability Analysis: Definitions based on impulse response, Routh-Hurwitz stability criterion.

Introduction to Process Control: Control systems, process-control block diagram, control system evaluation, analog and digital processing, sensor time response, introduction of PID controllers, design of P controller

Analog Signal Conditioning: Principles of analog signal conditioning, passive circuits, operational amplifiers, OP-amp circuits in instrumentation, design guidelines

Digital Signal Conditioning: Review of digital fundamentals, AD and DA converters, data-acquisition systems, characteristics of digital data

Thermal Sensors: Definition of temperature, metal resistance versus temperature devices, thermistors, thermocouples, other thermal sensors, design considerations

Mechanical Sensors: Displacement, location, position and proximity sensors, strain sensors, motion sensors, pressure sensors, flow sensors, optical encoder

Final Control: Final control operation, signal conversions, power electronics, actuators (pneumatic, hydraulic and electrical drives), control elements, examples of control systems

Discrete-State Process Control: Definition of discrete-state process control, characteristics of the system, relay controllers and ladder diagrams, Programmable Logic Controllers (PLCs), examples of PLC control systems

References:

1. Stefani, *Raymond T. Design of Feedback Control Systems,* 4th Ed. Oxford 2002
2. Ogata, *Modern Control Engineering,* 2nd Ed. PHI 1990
3. Johnson, *Process control Instrumentation technology,* 4th Ed PHI 1995
4. J.B. Gupta, *Electronic and Electrical Measurement and instrumentation,* 12th Ed Kataria 2003
5. Krishna Kant, *Computer Based Industrial Control,* 2nd Ed. PHI 1998