Course Title: Computer Based Control
Course Code: COEG 402
Credit Hours: 3

Course Description:
This course will help students to study how computers are implemented and used for industrial control purpose, and impart the skills necessary for use of computers with confidence in modern control systems.

Course Contents:

Unit 1: Introduction
Process control techniques- history; Computers- analog and digital computers in process control-history; Systems; Applications; Static control; Continuous, Dynamic, Closed and open loop control systems.

Unit 2: Systems
Representation; State-space, Input/output; Modelling of continuous and discrete systems; SISO and MIMO system representation; Mass-spring-damper system, DC motor, Energy balance model, Discrete approximation, State description, Determining sampling interval.

Unit 3: Process Computer Problem
Real time control, Conventional, Interrupts, Pseudocode, Control complexity, Non-linearity, Process coupling, time delays, Controllability, Sequential control and direct digital control, Combinatory control; Case studies

Unit 4: Physical process Input and Output (I/O)
Components of process interface, Sensor properties, impedance matching, Different sensors and actuators, signal transmission, Conditioning, Coupling and grounding.

Unit 5: Signal Processing
Signal filtering, Analog filters, Multiplexing, sample and hold, Anti-aliasing, ADC, DAC, Characteristics of converters, Digital filters, Signal data processing.

Unit 6: Bus systems
Bus system parameters, Physical and logical concepts, Bus operation protocols, Interrupt-handling, VME and Multibus II, Comparison of bus systems

Unit 7: Operating systems and Real-Time Programming
Multi tasking, Non real-time, Real-time; Dynamic priority, Task scheduling, Task management, Functions of RT operating systems; Synchronization, Resource protection, IP communication, Mutual exclusion programming methods; RT operating systems and language examples.

Unit 8: Sequential Control
Boolean logic programming, Functional blocks, Grafcet, Generator sequencing control, PLC application cases.

Unit 9: Feedback Control
Supervisory control, Structure and representation of feedback controllers, Discrete plant controllers, discretized PID controllers, Position and velocity form, Wind-up, Switchover problem and solution, Algorithm, Performance limit of PID, Cascade control, Smith controller, Gain scheduling, Adaptive control

Unit 10: Digital Communication
Model, Communication aspects, OSI layers, Layer 1 and layer 2, MAP, TOP, Fieldbus, FIP, ProfibusvsBitbus, Ethernet, Polling and token bus.

Unit 11: Computer Numerical Control
Introduction, NC co-ordinate system, Part programming, Direct numerical control (DNC), Applications, adaptive control machining, Developments

Unit 12: Man-Machine Interface
Ergonomics, Organisation of MMI, Quantitative and qualitative parameters, MMI hardware, Design guidelines, User friendliness, Human cognition

Unit 13: System Integration
Standards, System structure, Centralized and distributed digital control systems, Hierarchial level and information flow, SCADA, Remote Terminal Unit (RTU), Functions of DDC system, System integration, Non-technical aspects.

References:
1. G. Olsson and G. Piani, *Computer Systems for Automation and Control*, PHI 1992
2. C. H. Houpis and G. B. Lamont, *Digital Control Systems: Theory, Hardware, Software*, 2nd Ed., McGraw-Hill, 1992
3. K. J. Astrom and B. Wittenmark, *Computer Controlled Systems: Theory and Design 2nd Ed.*, PHI 1994
4. B. Kosko, *Neural Networks and Fuzzy Systems*, PHI