Subject Description Form

Subject Code	EE4008 / EE4008A / EE4008B
Subject Title	Applied Digital Control
Credit Value	3
Level	4
Pre-requisite/ Co-requisite/ Exclusion	Pre-requisite for EE4008: EE3005 Pre-requisite for EE4008A: EE3005A
Objectives	1. To facilitate a working knowledge of principles of reduced-order modelling, digital control algorithms, system identification, and adaptive control. 2. To enable students designing industrial control systems for applications in different engineering areas.
Subject Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Understand the concepts of reduced-order modelling, deadbeat control algorithm, system identification and adaptive control. b. Understand the notions of offline and online system identification. c. Design conventional and adaptive controllers based on user specifications. d. Use MATLAB simulation for digital system design and simulation.
Subject Synopsis/ Indicative Syllabus	1. ***Process control*****:** Process modelling, Performance Specification, Industrial controller, Ziegler & Nichols tuning, Advanced process control, Reduced order modelling. 2. ***Elementary concept: digital control system*****:** Linear difference equations and the Z transform, Analog to digital and digital to analog converters, Zero order hold, Analysis of digital control, Real Implementation of digital control, Internal model control. 3. ***Digital PID control system design***: Discretization of PID control, Integral windup, Digital PID parameter tuning methods, 2DOF-PID 4. ***System identification*****:** Discrete-time and continuous-time systems, identification by correlation, principle of least squares, Recursive least squares. 5. ***Self-tuning control*****:** Introduction to adaptive control, Self-tuning controller. **Laboratory Experiment:** There will be two laboratory experiments on the topics of reduced order modeling, digital control design and system identification by least-squares technique. **Case study:** Individual assignment related to above methods. Students will write a report and present their finding to the class.

Teaching/Learning Methodology

Lectures and tutorials are the primary means of conveying the basic concepts and theories. Experiments and case study are designed to supplement the lecturing materials. The students are encouraged to take extra readings and to look for relevant information.

Teaching/Learning Methodology	Outcomes			
	a	b	c	d
Lectures	✓	✓	✓	
Tutorials	✓	✓	✓	
Experiments and case study			✓	✓

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed			
		a	b	c	d
1. Examination	60%	✓	✓	✓	
2. Class test	20%	✓	✓	✓	
3. Project report	10%				
4. Case Study	10%				
Total	100%				

The outcomes on concepts, analysis and design are assessed by the usual means of examination and tests.

Student Study Effort Expected

Class contact:	
▪ Lecture/Tutorial	33 Hrs.
▪ Laboratory	6 Hrs.
Other student study effort:	
▪ Laboratory preparation/report	12 Hrs.
▪ Case study preparation/report	14 Hrs.
▪ Self-study	40 Hrs.
Total student study effort	105 Hrs.

Reading List and References

Reference books:

1. D.E. Seborg, Process Dynamics and Control, Hoboken, N.J.: Wiley, 2011
2. C.A. Smith, Automated Continuous Process Control, New York, John Wiley & Sons, 2002
3. J.R. Leigh, Applied Digital Control: Theory, Design, and Implementation, New York, Prentice-Hall, 1992
4. P.E. Wellstead and W. Zarrop, Self-tuning Systems: Control and Signal Processing, Wiley, 1991
5. R. Isermann, Adaptive Control Systems, New York, Prentice Hall, 1992