Subject Description Form

Subject Code	ME31002
Subject Title	Linear Systems and Control
Credit Value	3
Level	3
Pre-requisite/ Co-requisite/ Exclusion	Pre-requisite: ME31001 Dynamics and Vibrations
Objectives	To teach students time and frequency responses of dynamic systems to different inputs and the feedback control of such systems using PID controllers
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Model physical elements in dynamic systems and find the transfer function of a system comprising mechanical and other physical components. b. Predict the output response of a first- or second-order system both in time and frequency domains subject to typical input signals. c. Complete a given task in linear system control, such as an assignment or a project, by applying concepts in dynamics and control systems. d. Analyze and interpret the data obtained from a control experiment. e. Design a first-order and second-order system with suitable parameters and/or PID controller that will be stable and has the required system performance.
Subject Synopsis/ Indicative Syllabus	***Dynamic Responses of First-Order and Second-Order Systems*** **-** Mathematical modelling of system elements, interconnection of elements in systems by differential equations, parameters of first-order and second-order systems, system response analysis due to step, ramp and impulse inputs using Laplace transform, simulation of dynamic systems using Matlab. ***Frequency Response of First-Order and Second-Order Systems*** **-** Harmonic response, Bode diagrams, frequency domain specifications, frequency response applications. ***Introduction to Feedback Control*** **-** Analysis of open-loop and closed-loop systems, transfer functions and block diagrams, time-domain specifications, system stability analysis, time-domain analysis of control systems. ***Feedback Control Systems*** **-** Automatic controllers, basic P, PD, PID controllers, Routh-Hurwitz stability criterion, numerical computations for the frequency-domain analysis of dynamical systems. **Laboratory Experiment** There are two 2-hour laboratory sessions. Typical Experiments: 1. Digital simulation of feedback control systems 2. DC servomechanism 3. Water level control

Teaching/Learning Methodology

Lectures aim at providing students with an integrated knowledge required for understanding and analyzing feedback control systems. (Outcomes a, b, c and e)

Tutorials aim at enhancing analytical skills of students. Examples on system modeling, transient and frequency response of dynamic systems, and performance and stability of control systems will be involved. Students will be able to solve real-world problems using the knowledge they acquired in the class. (Outcomes a, b, c and e)

Experiments will provide students with hands-on experience on the instrumentation and measurement of physical variables such as motor speed and water level, and their control. It also trains students in the analysis and presentation of experimental data. (Outcome d)

Teaching/Learning Methodology	Outcomes				
	a	b	c	d	e
Lecture	√	√	√		√
Tutorial	√	√	√		√
Experiment				√	

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)				
		a	b	c	d	e
1. Class test	25%	√	√	√		√
2. Homework	15%	√	√	√		√
3. Laboratory report	10%				√	
4. Examination	50%	√	√	√		√
Total	100%					

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Overall Assessment:

$0.50 \times$ End of Subject Examination + $0.50 \times$ Continuous Assessment

Assignments, laboratory reports, and tests are adopted in continuous assessment on students' timely feedback to and on-going understanding of the course. Students' overall understanding of the course and ability in applying the delivered knowledge are further assessed through a formal examination.

Student Study Effort Expected	Class contact:	
	▪ Lecture	31 Hrs.
	▪ Laboratory/Tutorial	8 Hrs.
	Other student study effort:	
	▪ Self-study	45 Hrs.
	▪ Homework assignment	20 Hrs.
	▪ Laboratory report	8 Hrs.
	Total student study effort	112 Hrs.
Reading List and References	1. K. Ogata, Modern Control Engineering, Prentice Hall, latest edition. 2. N.S. Nise, Control Systems Engineering, John Wiley, latest edition. 3. C.L. Phillips and R.D. Harbor, Feedback Control Systems, Prentice-Hall, latest edition. 4. M.R. Driels, Linear Control Systems Engineering, McGraw-Hill, latest edition.	

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