Subject Description Form

Subject Code	EIE3123
Subject Title	Dynamic Electronic Systems
Credit Value	3
Level	3
Pre-requisite / Co-requisite / Exclusion	Basic calculus
Objectives	**To enable students to gain knowledge and understanding in the following aspects:** 1. Modelling dynamic electronic systems using Laplace Transform technique. 2. Analysis of the stability, steady-state error, and transient response performances of dynamic electronic systems. 3. Using scientific computing software in control systems design. 4. Application of different feedback compensator design techniques to meet a set of given specifications. 5. Implementation of designed feedback compensator on real electronic systems and verify their performances.
Intended Subject Learning Outcomes	**Upon completion of the subject, students will be able to:** <u>Category A: Professional/academic knowledge and skills</u> 1. Understand the fundamentals of dynamic electronic systems and the importance of feedback control. 2. Design feedback compensator to meet a set of given specifications and constraints. 3. Use scientific computing software to analyse dynamic electronic systems and solve control problems. 4. Implement feedback compensator on real electronic systems. <u>Category B: Attributes for all-roundedness</u> 5. Communicate effectively. 6. Think critically and creatively. 7. Work with others as a team during practical classes.
Subject Synopsis/ Indicative Syllabus	**Syllabus:** 1. <u>Modelling of Dynamic Systems</u> Laplace Transform; transfer functions; examples of modelling dynamic electronic systems. 2. <u>Transient Response</u> Poles and zeros; effect of pole locations; first-order systems; second-order systems; time-domain specifications; effects of zeros and additional poles. 3. <u>Stability</u> Stability of linear time-invariant systems; Routh-Hurwitz stability criterion; Nyquist stability criterion; stability margins. 4. <u>Steady-State Errors</u> Steady-state error for unity feedback systems; system types; static error constants; steady-state error for disturbances; steady-state error for non-unity feedback systems. 5. <u>Design via Root Locus Techniques</u> The root locus concept; properties of root locus; gain adjustment; lag compensation; lead compensation; lead-lag compensation.

	6. <u>Design via Frequency Response Techniques</u> Frequency response; Bode plots; gain adjustment; lag compensation; lead compensation; lead-lag compensation. 7. <u>Tuning PID Controllers</u> Ziegler-Nichols tuning method; Cohen-Coon tuning method. 8. <u>Digital Control Systems</u> Basic structure of digital control system, *z*-Transform, discrete transfer function, stability/steady-state error/transient performances of digital control systems, concept of discrete equivalents, digital compensator design in *z*-plane, implementation of digital compensator. **Laboratory Experiments:** 1. Virtual (software-based) control lab 2. Mini-project
Teaching/Learning Methodology	(see table below)

Teaching and Learning Method	**Intended Subject Learning Outcome**	**Remarks**
Lectures	1, 2, 3, 6	In lectures, students will be introduced to the fundamental knowledge of the subject, and comprehension is strengthened through interactive Q&A. They will be able to explain and generalize knowledge in the analysis and control design of dynamic electronic systems.
Tutorials	1, 2, 3, 5, 6	In tutorials, students will apply the knowledge learned in lectures in analysing the cases and solving the problems given by the tutor. They will analyse the given information, compare and contrast different scenarios and propose solutions or alternatives.
Mini-project (practical works)	1, 2, 3, 4, 5, 6, 7	Students will acquire hands-on skills in using scientific computing software to analyse dynamic electronic systems and design feedback compensator. They will apply the knowledge learned in lectures / tutorials to complete a mini-project on the design and implementation of feedback compensator on real electronic systems.
Take-home assignment	1, 2, 3, 5, 6	By working on take-home assignment, students will develop a firm understanding of the knowledge related to the subject. They will analyse the available information and apply the knowledge learned in solving problem. For some design problems, they will have to synthesize solutions by evaluating different alternatives.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific Assessment Methods/Tasks	% Weighting	Intended Subject Learning Outcomes to be Assessed (Please tick as appropriate)						
		1	2	3	4	5	6	7
1. Continuous Assessment (total 50%)								
• Take-home assignment	5%	✓	✓	✓		✓	✓	
• Mini-project	35%	✓	✓	✓	✓	✓	✓	✓
• Mid-semester test	10%	✓	✓				✓	
2. Examination	50%	✓	✓				✓	
Total	100 %							

The continuous assessment consists of one take-home assignment, one test, and one mini-project.

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

Specific Assessment Methods/Tasks	Remark
Take-home assignment	One take-home assignment will be given to students to assess their competence level of knowledge and comprehension, ability to analyze given information, ability to apply knowledge and skills in different situations, ability to synthesize structure, and ability to evaluate given data to make judgment. The criteria (i.e. what to be demonstrated) and level (i.e. the extent) of achievement will be graded according to six levels: (A+ and A), Good (B+ and B), Satisfactory (C+ and C), Marginal (D) and Failure (F). These will be made known to students before the assignment is handed out. Feedback about their performance will be given promptly to students to help them improve their learning.
Mini-project (practical works)	Students will be required to complete a mini-project and submit a report. The emphasis is on assessing their ability to use scientific computing tools to analyze dynamic electronic systems and design feedback compensator to meet a given set of specifications, and implement the design on real electronic systems. Expectation and grading criteria are similar to the case of take-home assignment.
Mid-semester test	There will be a mid-semester test to evaluate students' understanding and ability to apply all the key concept. Feedback about their performance will be given promptly to students to help them improve their learning. Expectation and grading criteria are similar to the case of take-home assignment.

Student Study Effort Expected	**Class contact (time-tabled):**	
	• Lecture	24 Hours
	• Tutorial/Laboratory/Practice Classes	15 Hours
	Other student study effort:	
	• Lecture: preview/review of notes; homework/assignment; preparation for test/quizzes/examination	36 Hours
	• Tutorial/Laboratory/Practice Classes: preview of materials, revision and/or reports writing	30 Hours
	Total student study effort:	**105 Hours**
Reading List and References	**Reference Books:** 1. Norman S. Nise, *Control Systems Engineering*, 7th ed., John Wiley and Sons, Inc., 2015. 2. Richard C. Dorf and Robert H. Bishop, *Modern Control Systems*, 13th ed., Pearson, 2016. 3. Gene F. Franklin, J. David Powell, and Abbas Emami-Naeini, *Feedback Control of Dynamic Systems*, 8th ed., Pearson, 2019. 4. K. Ogata, *Modern Control Engineering*, 5th ed., Prentice Hall, 2010. 5. Karl J. Astrom and Richard M. Murray, *Feedback Systems: An Introduction for Scientists and Engineers*, Princeton University Press, 2008.	
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