Subject Description Form

Subject Code	AAE3004
Subject Title	Dynamical Systems and Control
Credit Value	3
Level	3
Pre-requisite/ Co-requisite/ Exclusion	**Pre-requisite:** AMA2111 Mathematics I **OR** AMA2112 Mathematics II
Objectives	1. To introduce basic concepts and methods of feedback control and automatic control systems; and 2. To introduce the mathematical modeling of physical elements in dynamic systems; and 3. To provide with a basic understanding of behaviour of first- and second-order systems due to typical inputs, and concepts of time-domain specifications; and 4. To introduce the basic concepts of frequency response and frequency domain specifications; and 5. To introduce feedback control and its application to improve the overall system behaviour; and 6. To present the basic concepts of proportional-and-integral-and-derivative control, and the setting of control parameters to meet the system goals.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Identify, formulate and solve problems in aviation engineering by applying knowledge of dynamical system and control (including transfer function and response of a first- or second-order system both in time and frequency domains); and b. Design and conduct experiments, as well as to analyze the system dynamic behavior is related to system specifications and its improvements according to the specifications (including Routh-Hurwitz stability criterion); and c. Have knowledge of contemporary issues of dynamical system and control (including applications of proportional, integral and derivative feedbacks in control systems) to understand the impact of engineering solutions in a global and societal context.
Subject Synopsis/ Indicative Syllabus	**Dynamic Responses of First-Order and Second-Order Systems -** Mathematical modeling of dynamic systems (elements or interconnection of elements) by differential equations, critical parameters of first-order and second-order systems, system response analysis due to step, ramp and impulse inputs using Laplace transform. **Frequency Response of First-Order and Second-Order Systems -** Harmonic response, Bode diagrams, frequency domain specifications, frequency response applications. **Fundamental Methods of Feedback Control -** Analysis of open-loop and closed-loop systems, transfer functions, block diagrams, time-domain specifications, time-domain analysis of control systems, system stability, Routh-Hurwitz stability

criterion.

Basic Feedback Controller- Automatic controllers, P, PD, PID controllers, Steady state error.

Lab sessions:

There are two 2-hour lab sessions. Typical tasks:

1. Control systems analysis and design using time-domain method
2. Control systems analysis and design using frequency-response method
3. Control systems design using PID

Teaching/Learning Methodology

The teaching and learning methods include lectures, tutorials and laboratory experiments.

The lectures aim at providing students with an integrated knowledge required for understanding and analyzing dynamic systems and fundamental feedback control.

The tutorials aim at enhancing the analytical skills of the students. Examples on system modelling, dynamic response of linear 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.

The experiments will provide the students with hand-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.

Teaching/Learning Methodology	Intended subject learning outcomes to be cover		
	a	b	c
1. Lecture	✓	✓	✓
2. Laboratory	✓	✓	✓

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed		
		a	b	c
1. Home work	25%	✓	✓	
2. Class tests and reports	25%	✓	✓	✓
3. Examination	50%	✓	✓	✓
Total	100%			

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

Overall Assessment:

0.50 x End of Subject Examination + 0.50 x Continuous Assessment

	Assessment: Assignments, laboratory reports, and tests are adopted in continuous assessment on students' timely feedback to and on-going understanding of the course. The 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	35 Hrs.
	▪ Laboratory	4 Hrs.
	Other student study effort:	
	▪ Self-study	42 Hrs.
	▪ Homework assignment	15 Hrs.
	▪ Laboratory report	6 Hrs.
	Total student study effort	**102 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.	

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