# 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**<br>AMA2112 Mathematics II |
| **Objectives** | 1. To introduce basic concepts and methods of feedback control and automatic control systems; and<br>2. To introduce the mathematical modeling of physical elements in dynamic systems; and<br>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<br>4. To introduce the basic concepts of frequency response and frequency domain specifications; and<br>5. To introduce feedback control and its application to improve the overall system behaviour; and<br>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:<br>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<br>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<br>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.<br>**Frequency Response of First-Order and Second-Order Systems -** Harmonic response, root locus, Bode diagrams, frequency domain specifications, frequency response applications, Nyquist criterion and Nyquist plots.<br>**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.

**Teaching/Learning Methodology**

The teaching and learning methods include lectures and tutorials.

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

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

**Assessment Methods in Alignment with Intended Learning Outcomes**

| Specific assessment methods/tasks | % weighting | Intended subject learning outcomes to be assessed | | |
|---|---|---|---|---|
| | | a | b | c |
| 1. Assignment | 40% | ✓ | ✓ | ✓ |
| 2. Mid-term test | 10% | ✓ | ✓ | |
| 5. 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:

Assignment and mid-term test 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 the final examination.

**Student Study Effort Expected**

| | |
|---|---|
| Class contact: | |
| ▪ Lecture | 39 Hrs. |
| Other student study effort: | |
| ▪ Self-study | 45 Hrs. |
| ▪ Assignment | 21 Hrs. |

| | | |
|---|---|---|
| | Total student study effort | **105 Hrs.** |
| **Reading List and References** | 1. K. Ogata, Modern Control Engineering, Prentice Hall, latest edition.<br>2. N.S. Nise, Control Systems Engineering, John Wiley, latest edition. | |

Aug 2024