

Subject Description Form

Subject Code	EE3005 / EE3005A / EE3005B
Subject Title	Systems and Control
Credit Value	3
Level	3
Pre-requisite/ Co-requisite/ Exclusion	Pre-requisite: AMA2111
Objectives	<ol style="list-style-type: none"> 1. To introduce the principles and techniques used in the analysis and design of control systems. 2. To provide the foundation for the later subjects in the areas of power systems, drives and control.
Subject Intended Learning Outcomes	<p>Upon completion of the subject, students will be able to:</p> <ol style="list-style-type: none"> a. Analyse the stability, transient response and steady-state response of continuous time systems. b. Design compensators and controllers for control systems. c. Model systems using block diagram and signal flow graph and evaluate the properties of the overall systems. d. Write technical reports and present the findings.
Subject Synopsis/ Indicative Syllabus	<ol style="list-style-type: none"> 1. Introduction to control system analysis: Open-loop control systems, Closed-loop control systems, Effects of feedback, Examples of control systems. 2. Mathematical modelling of dynamic systems: Electrical and electro-mechanical system components, Transducers and actuators, Laplace transform, Transfer functions. Differential equation, State space, Transfer functions, Block diagram, Signal flow graphs, Mason's formula 3. Time domain analysis of linear systems: First-order systems, Second-order systems, Transient response, Steady-state response, Routh-Hurwitz stability criterion. Root-locus analysis 4. Frequency domain analysis of linear systems: Frequency response, Bode Diagrams, Gain margin and phase margin, Polar plots, Nyquist stability criterion, Nichols plots. 5. Compensators and PID controllers: Compensators, PID controllers, Controller tuning. Ziegler-Nichols tuning, Model-based tuning, internal mode control. Sensitivities and Design Tradeoffs 6. Common Challenges: Fuzzy control, neural network control, AI control. <p>Laboratory Experiment:</p> <p>PID control Fuzzy controller</p>

Teaching/Learning Methodology	<p>Lectures and tutorials are the primary means of conveying the basic concepts and theories. Experiments are designed to supplement the lecturing materials. The students are encouraged to take extra readings and to look for relevant information.</p> <table border="1" data-bbox="432 248 1455 544"> <thead> <tr> <th data-bbox="432 248 927 365" rowspan="2">Teaching/Learning Methodology</th> <th colspan="4" data-bbox="927 248 1455 304">Outcomes</th> </tr> <tr> <th data-bbox="927 304 1062 365">a</th> <th data-bbox="1062 304 1198 365">b</th> <th data-bbox="1198 304 1334 365">c</th> <th data-bbox="1334 304 1455 365">d</th> </tr> </thead> <tbody> <tr> <td data-bbox="432 365 927 427">Lectures</td> <td data-bbox="927 365 1062 427">✓</td> <td data-bbox="1062 365 1198 427">✓</td> <td data-bbox="1198 365 1334 427">✓</td> <td data-bbox="1334 365 1455 427"></td> </tr> <tr> <td data-bbox="432 427 927 490">Tutorials</td> <td data-bbox="927 427 1062 490">✓</td> <td data-bbox="1062 427 1198 490">✓</td> <td data-bbox="1198 427 1334 490">✓</td> <td data-bbox="1334 427 1455 490"></td> </tr> <tr> <td data-bbox="432 490 927 544">Experiments</td> <td data-bbox="927 490 1062 544">✓</td> <td data-bbox="1062 490 1198 544">✓</td> <td data-bbox="1198 490 1334 544"></td> <td data-bbox="1334 490 1455 544">✓</td> </tr> </tbody> </table>					Teaching/Learning Methodology	Outcomes				a	b	c	d	Lectures	✓	✓	✓		Tutorials	✓	✓	✓		Experiments	✓	✓		✓																
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Assessment Methods in Alignment with Intended Learning Outcomes	<table border="1" data-bbox="432 636 1455 1137"> <thead> <tr> <th data-bbox="432 636 762 801" rowspan="2">Specific assessment methods/tasks</th> <th data-bbox="762 636 927 801" rowspan="2">% weighting</th> <th colspan="4" data-bbox="927 636 1455 734">Intended subject learning outcomes to be assessed</th> </tr> <tr> <th data-bbox="927 734 1062 801">a</th> <th data-bbox="1062 734 1198 801">b</th> <th data-bbox="1198 734 1334 801">c</th> <th data-bbox="1334 734 1455 801">d</th> </tr> </thead> <tbody> <tr> <td data-bbox="432 801 762 869">1. Examination</td> <td data-bbox="762 801 927 869">60%</td> <td data-bbox="927 801 1062 869">✓</td> <td data-bbox="1062 801 1198 869">✓</td> <td data-bbox="1198 801 1334 869">✓</td> <td data-bbox="1334 801 1455 869"></td> </tr> <tr> <td data-bbox="432 869 762 936">2. Class test</td> <td data-bbox="762 869 927 936">15%</td> <td data-bbox="927 869 1062 936">✓</td> <td data-bbox="1062 869 1198 936">✓</td> <td data-bbox="1198 869 1334 936">✓</td> <td data-bbox="1334 869 1455 936"></td> </tr> <tr> <td data-bbox="432 936 762 1003">3. Laboratory reports</td> <td data-bbox="762 936 927 1003">15%</td> <td data-bbox="927 936 1062 1003">✓</td> <td data-bbox="1062 936 1198 1003">✓</td> <td data-bbox="1198 936 1334 1003"></td> <td data-bbox="1334 936 1455 1003">✓</td> </tr> <tr> <td data-bbox="432 1003 762 1070">4. Assignment</td> <td data-bbox="762 1003 927 1070">10%</td> <td data-bbox="927 1003 1062 1070">✓</td> <td data-bbox="1062 1003 1198 1070">✓</td> <td data-bbox="1198 1003 1334 1070">✓</td> <td data-bbox="1334 1003 1455 1070"></td> </tr> <tr> <td data-bbox="432 1070 762 1137">Total</td> <td data-bbox="762 1070 927 1137">100%</td> <td colspan="4" data-bbox="927 1070 1455 1137"></td> </tr> </tbody> </table> <p>The outcomes on analysis and design are assessed by the usual means of examination and tests whilst those on technical reporting and presentation are evaluated by the experiments and reports.</p>					Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed				a	b	c	d	1. Examination	60%	✓	✓	✓		2. Class test	15%	✓	✓	✓		3. Laboratory reports	15%	✓	✓		✓	4. Assignment	10%	✓	✓	✓		Total	100%				
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Student Study Effort Expected	Class contact:																																												
	▪ Lecture/Tutorial		33 Hrs.																																										
	▪ Laboratory		6 Hrs.																																										
	Other student study effort:																																												
	▪ Laboratory preparation/report		12 Hrs.																																										
	▪ Self-study, revision and assignment		49 Hrs.																																										
	Total student study effort		100 Hrs.																																										
Reading List and References	<p>Reference books:</p> <ol style="list-style-type: none"> 1. M.F. Golnaraghi and B.C. Kuo, Automatic Control Systems, 10th Edition, Prentice-Hall, 2017 2. R.C. Dorf and R.H. Bishop, Modern Control Systems, 14th Edition, Pearson, 2022 3. M. Gopal, Control Systems: Principles and Design, 4th Edition, McGraw-Hill, 2012 																																												