MONASH University

Unit Guide

TRC3600
Modelling and control

Semester 2, 2017

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Unit handbook information

Synopsis

This unit commences with the modeling of various dynamic engineering systems, followed by the analysis of their transient and steady-state responses. More sophisticated analytical methods such as root locus and frequency response will be explored and will build the foundation for controller design in the future. Modeling via state-space methods will also be briefly covered.

Mode of delivery

Malaysia (Day)
Clayton (Day)

Workload requirements

3 hours of lectures, 2 hours of tutorials and 6 hours of private study per week plus two 3-hour laboratories during semester.

Unit relationships

Prerequisites

None

Prohibitions

MAE3408, MEC3457

Co-requisites

TRC3200

Chief Examiner(s)

Professor Chris Davies

Unit Coordinator(s)

Name: Professor Bijan Shirinzadeh
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Name: Dr. Md Abdus Samad Kamal
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Clayton/Malaysia staff contact details

Clayton campus	
Campus Coordinator	Name: Professor Bijan Shirinzadeh Email: bijan.shirinzadeh@monash.edu Building: 31, Room: G27 Consultation hours: TBA
Lecturer(s)	Name: Professor Bijan Shirinzadeh Email: bijan.shirinzadeh@monash.edu Building: 31, Room: G27

Malaysia campus	
Campus Coordinator	Name: Dr. Md Abdus Samad Kamal Email: md.abdus.samad@monash.edu Building: 5, Room: 5-34 Consultation hours: TBA
Lecturer(s)	Name: Dr Md Abdus Samad Kamal Email: md.abdus.samad@monash.edu Building: 5, Room: 5-34 Consultation hours: Wednesday 11:00-13:00 and Friday 9:00-11:00.

Section A: For Clayton students

Academic Overview

Engineers Australia Stage 1 competencies

The Engineers Australia Policy on Accreditation of Professional Engineering Programs requires that all programs ensure that their engineering graduates develop to a substantial degree the stage 1 competencies. Listed below are the activities in this unit that will help you to achieve these competencies.

Note: that not all stage 1 competencies are relevant to each unit.

Element of competency	Indicators of attainment	Learning outcomes
1 Knowledge and skill base		
1.1 Engages with the engineering discipline at a phenomenological level, applying sciences and engineering fundamentals to systematic investigation, interpretation, analysis and innovative solution of complex problems and broader aspects of engineering practice.	**a)** Engages with the engineering discipline at a phenomenological level, applying sciences and engineering fundamentals to systematic investigation, interpretation, analysis and innovative solution of complex problems and broader aspects of engineering practice.	1,2,3,4,5,6
1.2 Develops and fluently applies relevant investigation analysis, interpretation, assessment, characterisation, prediction, evaluation, modelling, decision making, measurement, evaluation, knowledge management and communication tools and techniques pertinent to the engineering discipline.	**a)** Develops and fluently applies relevant investigation analysis, interpretation, assessment, characterisation, prediction, evaluation, modelling, decision making, measurement, evaluation, knowledge management and communication tools and techniques pertinent to the engineering discipline.	1,2,3,4,5,6
1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline.	**a)** Proficiently applies advanced technical knowledge and skills in at least one specialist practice domain of the engineering discipline.	1,2,3,4,5,6
1.4 Discernment of knowledge development and research directions within the engineering discipline.	**a)** Identifies and critically appraises current developments, advanced technologies,emerging issues and interdisciplinary linkages in at least one specialist practice domain of the engineering discipline.	1,2,3,4,5,6
		1,2,3,4,5,6

1.5 Identifies and applies systematic principles of engineering design relevant to the engineering discipline.	**a)** Identifies and applies systematic principles of engineering design relevant to the engineering discipline.	
1.6 Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline.	**e)** Appreciates the formal structures and methodologies of systems engineering as a holistic basis for managing complexity and sustainability in engineering practice.	1,2,3,4,5,6
2. Engineering application ability		
2.1 Application of established engineering methods to complex engineering problem solving.	**a)** Identifies, discerns and characterises salient issues, determines and analyses causes and effects, justifies and applies appropriate simplifying assumptions, predicts performance and behaviour, synthesises solution strategies and develops substantiated conclusions.	1,2,3,4,5,6
	b) Ensures that all aspects of an engineering activity are soundly based on fundamental principles - by diagnosing, and taking appropriate action with data, calculations, results, proposals, processes, practices, and documented information that may be ill-founded, illogical, erroneous, unreliable or unrealistic.	1,2,3,4,5,6
	c) Competently addresses engineering problems involving uncertainty, ambiguity, imprecise information and wide-ranging and sometimes conflicting technical and non-technical factors.	1,2,3,4,5,6
	e) Partitions problems, processes or systems into manageable elements for the purposes of analysis,modelling or design and then re-combines to form a whole, with the integrity and performance of the overall system as the paramount consideration.	2,3,4,5,6
2.2 Fluent application of engineering techniques, tools and resources.	**b)** Constructs or selects and applies from a qualitative description of a phenomenon, process, system, component or device a mathematical, physical or computational model based on fundamental scientific principles and justifiable simplifying assumptions.	1,2,3,4,5,6
	c) Determines properties, performance, safe working limits, failure modes, and other inherent	1,2,3,3,4,5,6

	parameters of materials, components and systems relevant to the engineering discipline.	
	d) Applies a wide range of engineering tools for analysis, simulation, visualisation, synthesis and design, including assessing the accuracy and limitations of such tools, and validation of their results.	1,2,4,5,6
	e) Applies formal systems engineering methods to address the planning and execution of complex, problem solving and engineering projects.	1,2,3,4,5,6
2.3 Application of systematic engineering synthesis and design processes.	**a)** Proficiently applies technical knowledge and open ended problem solving skills as well as appropriate tools and resources to design components, elements, systems, plant, facilities and/or processes to satisfy user requirements.	1,2,3,4,5,6
2.4 Application of systematic approaches to the conduct and management of engineering projects.	**a)** Contributes to and/or manages complex engineering project activity, as a member and/or as the leader of an engineering team.	1,2,3,4,5,6
3. Professional and personal attributes		
3.1 Ethical conduct and professional accountability.	**c)** Understands the accountabilities of the professional engineer and the broader engineering team for the safety of other people and for protection of the environment.	1
3.2 Effective oral and written communication in professional and lay domains.	**b)** Prepares high quality engineering documents such as progress and project reports, reports of investigations and feasibility studies, proposals, specifications, design records, drawings, technical descriptions and presentations pertinent to the engineering discipline.	2,4
3.3 Creative, innovative and pro-active demeanour.	**a)** Applies creative approaches to identify and develop alternative concepts, solutions and procedures, appropriately challenges engineering practices from technical and non-technical viewpoints; identifies new technological opportunities.	1,2,4
3.4 Professional use and management of information.	**b)** Critically assesses the accuracy, reliability and authenticity of information.	2,3,4
3.5 Orderly management of self, and professional conduct.	**a)** Demonstrates commitment to critical self-review and performance	1,2,3,4,5,6

	evaluation against appropriatecriteria as a primary means of tracking personal development needs and achievements.	
3.6 Effective team membership and team leadership.	**c)** Earns the trust and confidence of colleagues through competent and timely completion of tasks.	6

Teaching and learning method

Lecture and tutorials or problem classes; problem-based learning.

Learning outcomes

At the end of this unit, students are expected to:

- value the significance and relevance of systems and associated control in engineering
- formulate linear dynamic mathematical models of various systems (mechanical, electrical, fluid, hydraulic and pneumatic) as well as graphical models (such as block diagrams and signal flow graphs) using time-domain, frequency-domain and state-space techniques together with the unified concept of resistance, capacitance and inertia/inductance
- calculate the response of systems as a function of time using classical differential equation solution, Laplace transforms and state-space method
- analyse the stability and dynamic performance of a system using root locus and Bode plot methods, and calculate system parameters to achieve the desired dynamic response
- recognise the effects of non-linearity in systems and accept the limitations of the use of linear models as approximations
- formulate solutions using computer-based techniques (such as Matlab).

Your feedback to us

One of the formal ways students have to provide feedback on teaching and their learning experience is through the Student Evaluation of Teaching and Units (SETU) survey. The feedback is anonymous and provides the Faculty with evidence of aspects that students are satisfied with and areas for improvement.

Previous student evaluations of this unit

In response to previous SETU results of this unit, the following changes have been made:

- Improve slides

Student feedback has highlighted the following strength(s) in this unit:

Feedback provided with assignments

If you wish to view how previous students rated this unit, please go to:
https://unitevaluations.connect.monash.edu.au/unitevaluations/index.jsp

Unit schedule - Clayton campus

Unit schedule

Week	Activities	Assessment
0		No formal assessment is undertaken in week 0
1	**Introduction. Modelling of dynamic systems**	
2	**Systems (physical) modelling. Transfer function. Block diagrams.**	
3	**Predicting system response**	
4	**System response**	
5	**Routh Hurwitz stability criterion, dynamic performance**	Assignment (TBC)
6	**Polar plot, frequency response**	
7	**Frequency response**	Assignment (TBC)
8	**Frequency response. State variable models**	
9	**State-space model –physical modelling**	Assignment (TBC)
10	**Solution to state-space. Signal flow graph**	
11	**Root locus**	Assignment (TBC)
12	**Introduction to controller design: P, PI, PD, PID. Review**	
	SWOT	
	Examination period	LINK to Assessment Policy: www.policy.monash.edu /policybank/acad emic/education /assessment/assessment- in-coursework-policy.html

The assignments are expected to be issued/uploaded onto the moodle site one week before the due date. Late assignments will not be accepted.

Assessment requirements

Assessment summary

Continuous assessment: 40%
Final Examination (3 hours): 60%
Students are required to achieve at least 45% in the total continuous assessment component and at least 45% in the final examination component and an overall mark of 50% to achieve a pass grade in the unit. Students failing to achieve this requirement will be given a maximum of 45% in the unit.

Assessment task	Value	Due date
Assignment 1	15 (`9%)	Week 5
Assignment 2	15 (~9%)	Week 7
Assignment 3	15 (~9%)	Week
Assignment 4	15 (~9%)	Week 11
Laboratory Experiment	4 (~4%)	Week 6-9

Hurdle requirements

Students are required to achieve at least 45% in the total continuous assessment component and at least 45% in the final examination component and an overall mark of 50% to achieve a pass grade in the unit. Students failing to achieve this requirement will be given a maximum of 45% in the unit.

Assessment tasks

Assessment title: Assignment 1
Mode of delivery: Moodle
Details of task: Assignment on systems modeling and analysis
Release dates (where applicable): Week 3
Word limit (where applicable): N/A
Due date: Week 5
Value: 15 (`9%)
Presentation requirements: Written
Hurdle requirements (where applicable): N/A
Individual assessment in group tasks (where applicable): N/A
Criteria for marking: Problem solving related to systems modelling, system response, stability analysis, state space, etc.

These will be provided at the time of assignment is provided.

Please note that indicative grades/marks only will be used for the marking of assignments, where appropriate.
High Distinction
All problems solved correctly
Distinction

Almost all problems solved correctly
Credit
More than half of the problems solved correctly
Pass

At least half of the problems done correctly

Additional remarks: N/A

Assessment title: Assignment 2
Mode of delivery: Moodle
Details of task: System modeling, response prediction and analytical solution

Release dates (where applicable): Week 5
Word limit (where applicable): N/A
Due date: Week 7
Value: 15 (~9%)
Presentation requirements: Written
Hurdle requirements (where applicable): N/A
Individual assessment in group tasks (where applicable): N/A
Criteria for marking: Problem solving related to systems modelling, system response, stability analysis, state space, etc.

These will be provided at the time of assignment is provided.

Please note that indicative grades/marks only will be used for the marking of assignments, where appropriate.

High Distinction
All problems solved correctly
Distinction
Almost all problems solved correctly
Credit
More than half of the problems solved correctly
Pass

At least half of the problems done correctly

Additional remarks: N/A

Assessment title: Assignment 3
Mode of delivery: Moodle
Details of task: System response prediction, characteristics, and stability analysis

Release dates (where applicable): Week 7
Word limit (where applicable): N/A
Due date: Week

Value: 15 (~9%)
Presentation requirements: Written
Hurdle requirements (where applicable): N/A
Individual assessment in group tasks (where applicable): N/A
Criteria for marking: Problem solving related to systems modelling, system response, stability analysis, state space, etc.

These will be provided at the time of assignment is provided.

Please note that indicative grades/marks only will be used for the marking of assignments, where appropriate.

Additional remarks: N/A

Assessment title: Assignment 4
Mode of delivery: Moodle
Details of task: State variable modelling and Bode plot development
Release dates (where applicable): Week 9
Word limit (where applicable): N/A
Due date: Week 11
Value: 15 (~9%)
Presentation requirements: Written
Hurdle requirements (where applicable): N/A
Individual assessment in group tasks (where applicable): N/A
Criteria for marking: Problem solving related to systems modelling, system response, stability analysis, state space, etc.

These will be provided at the time of assignment is provided.

Please note that indicative grades/marks only will be used for the marking of assignments, where appropriate.

Additional remarks: N/A

Assessment title: Laboratory Experiment
Mode of delivery: Laboratory
Details of task: Digital simulation laboratory
Release dates (where applicable): Week 6-9
Word limit (where applicable): N/A
Due date: Week 6-9
Value: 4 (~4%)
Presentation requirements: Computer based
Hurdle requirements (where applicable): Yes
Individual assessment in group tasks (where applicable): N/A
Criteria for marking: problem solving related to systems modelling, system response, stability analysis, state space, etc.

These will be provided at the time of assignment is provided.

Please note that indicative grades/marks only will be used for the marking of assignments, where appropriate.

Additional remarks: N/A

Examination(s)

Calculators
A list of the Faculty of Engineering approved calculators and the process for obtaining a sticker is available online at:
http://www.eng.monash.edu.au/current-students/calculators.html

IMPORTANT: Only these listed calculators with the **authorised Monash University-Science or Monash University-Engineering STICKER** will be allowed into the examination by the invigilators.

Approved faculty calculators permitted

Section B: For Malaysia students

Academic Overview

Program Education Objectives
The Mechatronics engineering discipline expects to produce graduates, who are:
1. competent in Mechatronics engineering
2. responsible and effective global citizens
3. leaders in their chosen profession or society at large.

Program Outcomes
The Mechatronics engineering discipline has developed a set of Program Outcomes (POs) for all of its graduates based on the competencies required by the Malaysian Engineering Accreditation Council.

Program Outcomes (POs)	Activities used in this unit to develop POs, achievement of Bloom's domains and complex problem solving
PO1 **Mechatronics Engineering Knowledge:** Apply knowledge of mathematics, natural science, engineering fundamentals and specialisation in Mechatronics engineering to the solution of complex engineering problems	Cognitive:
PO2 **Problem Analysis:** Identify, formulate, survey research literature and analyse complex Mechatronics engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences	Cognitive:
PO3 **Design/Development of Solutions:** Design solutions for complex Mechatronics engineering problems and design systems, components or processes that meet specified needs.	Cognitive: Psychomotor:
PO4 **Research-based Investigation:** Conduct investigations of complex Mechatronics engineering problems using research-based knowledge and research methods including design of experiments, (analysis and interpretation of data, and synthesis of information to provide valid conclusions.	Cognitive:
PO5 **Modern Tool Usage:** Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex Mechatronics engineering problems, with an understanding of the limitations	Cognitive: Psychomotor:
PO6 **Engineer and Society:** Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice	Affective:

Program Outcomes (POs)	Activities used in this unit to develop POs, achievement of Bloom's domains and complex problem solving
and solutions to complex Mechatronics engineering problems	
PO7 **Environment and Sustainability:** Understand and evaluate the sustainability and impact of professional engineering work in the solution of complex Mechatronics engineering problems in environmental contexts.	Cognitive: Affective:
PO8 **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.	Affective:
PO9 **Communication:** Communicate effectively on complex Mechatronics engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions	Affective:
PO10 **Individual and Team work:** Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings	Affective:
PO11 **Lifelong Learning:** Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change	Affective:
PO12 **Project Management and Finance:** Demonstrate knowledge and understanding of engineering management principles and economic decision-making and apply these to manage projects	Cognitive: Affective:

Teaching and learning method

Lecture and tutorials or problem classes; problem-based learning.

Learning outcomes

At the end of this unit, students are expected to:

- value the significance and relevance of systems and associated control in engineering

- formulate linear dynamic mathematical models of various systems (mechanical, electrical, fluid, hydraulic and pneumatic) as well as graphical models (such as block diagrams and signal flow graphs) using time-domain, frequency-domain and state-space techniques together with the unified concept of resistance, capacitance and inertia/inductance
- calculate the response of systems as a function of time using classical differential equation solution, Laplace transforms and state-space method
- analyse the stability and dynamic performance of a system using root locus and Bode plot methods, and calculate system parameters to achieve the desired dynamic response
- recognise the effects of non-linearity in systems and accept the limitations of the use of linear models as approximations
- formulate solutions using computer-based techniques (such as Matlab).

OBE requirements to learning outcomes (LOs)

Learning Outcomes (LOs) for Outcome Based Education (OBE) requirements	Handbook Learning Outcomes (LOs)
LO1 Relate the fundamental principles of the control systems to real life engineering applications.	LO1 Value the significance and relevance of systems and associated control in engineering.
LO2 Study physical systems (linear or nonlinear), formulate their linear mathematical models (in time-domain, frequency domain and using state-space technique) and obtain graphical representations of the models.	LO2 Formulate linear dynamic mathematical models of various systems (mechanical, electrical, fluid, hydraulic and pneumatic) as well as graphical models (such as block diagrams and signal flow graphs) using time-domain, frequency-domain and state-space techniques together with the unified concept of resistance, capacitance and inertia /inductance.
LO3 Calculate the response of dynamical systems as a function of time for various inputs, and interpret the meaning of the solutions.	LO3 Calculate the response of systems as a function of time using classical differential equation solution, Laplace transforms and state-space method.
LO4 Analyze the stability and performance of a system using different methods (root locus and Bode plot methods), design controller to achieve the desired dynamic performance, evaluate controller considering effect of model linearization.	LO4 Analyze the stability and dynamic performance of a system using root locus and Bode plot methods, and calculate system parameters to achieve the desired dynamic response. LO5 Recognize the effects of non-linearity in systems and accept the limitations of the user of linear models as approximations.
LO5 Formulate, evaluate and compare the performance of the systems and controller using MATLAB.	LO6 Formulate solutions using computer-based techniques (such as Matlab).

Relationship between unit learning outcomes and program outcomes

No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
LO1	√	-	-	-	-	-	-	-	-	-	-	-
LO2	√	-	-	-	-	-	-	-	-	-	-	-
LO3	-	√	-	-	-	-	-	-	-	-	-	-
LO4	-	-	√	-	-	-	-	-	-	-	-	-
LO5	-	-	-	-	√	-	-	-	-	-	-	-

Key

	No emphasis

√	Emphasised and assessed in the unit

Your feedback to us

One of the formal ways students have to provide feedback on teaching and their learning experience is through the Student Evaluation of Teaching and Units (SETU) survey. The feedback is anonymous and provides the Faculty with evidence of aspects that students are satisfied with and areas for improvement.

Previous student evaluations of this unit

In response to previous SETU results of this unit, the following changes have been made:

As encouraged by the students, practice quizzes will be offered every week.

Student feedback has highlighted the following strength(s) in this unit:

Feedback provided with assignments

If you wish to view how previous students rated this unit, please go to:
https://emuapps.monash.edu.au/unitevaluations/index.jsp

Unit schedule - Malaysia campus

Week	Lecture	Tutorial	Lab	Assignment
1	Introduction. Modelling of dynamic systems	Modelling (2 hrs)	-	-
2	Systems (physical) modelling. Transfer function	Modelling (2 hrs)	-	-
3	Block diagrams, Signal flow graphs. Calculate response,	Calculate output (2 hrs)		Assignment 1 issued
4	Transient response	Transient response (2 hrs)		Assignment 1 due
5	Steady state response, Routh Hurwitz	Steady-state response, Routh Hurwitz, (2 hrs)		Assignment 2 issued
6	Root locus	Root locus (2 hrs)	Lab 1: QET (3 hrs)	
7	Root locus	Root locus (2 hrs)	Lab 1 report due	Assignment 2 due
8	Polar plot, Frequency response	Frequency response (2 hrs)		Assignment 3 issued
9	Frequency response	Frequency response (2 hrs)	Lab 2: QET (3 hrs)	Assignment 3 due
10	Frequency response	Frequency response (2 hrs)	Lab 2 report due	Assignment 4 issued
11	State space	State space (2 hrs)		Assignment 4 due
12	Introduction to controller design: P, PI, PD, PID	PID Controller (2 hrs)		

The assignments are expected to be issued/uploaded onto the moodle site. Late submission of assignments will not be accepted.

Assessment Summary

Continuous assessment: 40%
Final Examination (3 hours): 60%
Students are required to achieve at least 45% in the total continuous assessment component and at least 45% in the final examination component and an overall mark of 50% to achieve a pass grade in the unit. Students failing to achieve this requirement will be given a maximum of 45% in the unit.

Assessment task	Value	Due date
Assignment 1	8%	Week 4
Assignment 2	8%	Week 7
Assignment 3	8%	Week 9
Assignment 4	8%	Week 11
Laboratory experiments	8%	Week 6-9
Total continuous assessment	40%	Week 4-12
Examination (3 hours)	60%	Date will be provided later.

Hurdle requirements

Students are required to achieve at least 45% in the total continuous assessment component and at least 45% in the final examination component and an overall mark of 50% to achieve a pass grade in the unit. Students failing to achieve this requirement will be given a maximum of 45% in the unit.

Bloom's Taxonomy:
Three domains of educational activities have been identified under the general taxonomy known as Bloom's.

- **Cognitive**: mental skills (*Head*)
- **Affective**: growth in feelings or emotional areas (*Heart*)
- **Psychomotor**: manual or physical skills (*Hand*)

The *cognitive* domain involves knowledge and the development of intellectual skills. This includes the recall or recognition of specific facts, procedural patterns, and concepts that serve in the development of intellectual abilities and skills.

The *affective* domain includes the attitudes with which someone deals with things emotionally, such as feelings, values, appreciation, enthusiasms and motivations.

The *psychomotor* domain includes physical movement, coordination, and use of the motor-skill areas. Development of these skills requires practice and is measured in terms of speed, precision, distance, procedures, or techniques in execution.

Key for the LO-assessment relationship table above:

Cognitive

C1	C2	C3	C4	C5	C6
Knowledge: Remembers previously learned material	**Comprehension:** Grasps the meaning of material (lowest level of understanding)	**Application:** Uses learning in new and concrete situations (higher level of understanding)	**Analysis:** Understands both the content and structure of material	**Synthesis:** Formulates new structures from existing knowledge and skills	**Evaluation:** Judges the value of material for a given purpose

Psychomotor

P1	P2	P3	P4	P5	P6	P7
Perception: Senses cues that guide motor activity	**Set:** Is mentally, emotionally and physically ready to act	**Guided Response:** Imitates and practices skills, often in discrete steps	**Mechanism:** Performs acts with increasing efficiency, confidence and proficiency	**Complete Overt Response:** Performs automatically	**Adaption:** Adapts skill sets to meet a problem situation	**Organisation:** Creates new patterns for specific situations

Affective

A1	A2	A3	A4	A5
Receiving: Selectively attends to stimuli	**Responding:** Responds to stimuli	**Valuing:** Attaches value or worth to something	**Organisation:** Conceptualises the value and resolves conflict between it and other values	**Internalising:** Integrates the value into a value system that controls behaviour

Relationship between Assessments and OBE Learning Outcomes (LOs)

No.	Learning Outcomes	Assignment	Laboratory	Final Exam
1	Relate the fundamental principles of the control systems to real life engineering applications.	C5		
2	Study physical systems (linear or nonlinear), formulate their linear mathematical models (in time domain, frequency domain and using state-space technique) and obtain graphical representations of the models.	C6		C6
3		C6		C6

	Calculate the response of dynamical systems as a function of time for various inputs, and interpret the meaning of the solutions.			
4	Analyze the stability and performance of a system using root locus and Bode plot methods, design controller to achieve the desired dynamic performance, evaluate controller considering model linearization.	C6		C6
5	Formulate, evaluate and compare the performance of the systems and controller using MATLAB.		C6	

Relationship between Assessments and Complex Problems /Activities

Assessment	Complex Problems							Complex Activities					
	Depth of Knowledge	Range of Requirements	Depth of Analysis	Infrequent Issues	Extent of Codes	Stakeholder Involvement	Components or Sub-problems	Range of Resources	Level of Interactions	Innovation	Consequences to Society and Environment	Unfamiliarity	
1	Assignments	WP1											
2	Laboratory	WP1											
3	Exam	WP1											

Assessment requirements

Assessment tasks

Assessment title: Assignment 1
Mode of delivery: Moodle
Details of task: You will be given a problem to solve, which will require all the skills that you have learnt before the release of the assignment.
Release dates (where applicable): Tutorial session of week 3
Word limit (where applicable): N/A
Due date: Tutorial session of week 4
Value: 8% of entire unit
Presentation requirements: N/A
Hurdle requirements (where applicable): N/A

Individual assessment in group tasks (where applicable): A mark will be given to the entire group
Criteria for marking: Marking scheme will be provided along assignment questions.
Additional remarks: N/A

Assessment title: Assignment 2
Mode of delivery: Moodle
Details of task: You will be given a problem to solve, which will require all the skills that you have learnt before the release of the assignment
Release dates (where applicable): Tutorial session of week 6
Word limit (where applicable): N/A
Due date: Tutorial session of week 7
Value: 8% of entire unit
Presentation requirements: N/A
Hurdle requirements (where applicable): N/A
Individual assessment in group tasks (where applicable): A mark will be given to the entire group
Criteria for marking: Marking scheme will be provided along assignment questions.

Additional remarks: N/A

Assessment title: Assignment 3
Mode of delivery: Moodle
Details of task: You will be given a problem to solve, which will require all the skills that you have learnt before the release of the assignment.
Release dates (where applicable): Tutorial session of week 8
Word limit (where applicable): N/A
Due date: Tutorial session of week 11
Value: 8% of entire unit
Presentation requirements: N/A
Hurdle requirements (where applicable): N/A
Individual assessment in group tasks (where applicable): A mark will be given to the entire group
Criteria for marking: Marking scheme will be provided along assignment questions.
Additional remarks: N/A

Assessment title: Assignment 4
Mode of delivery: Moodle
Details of task: You will be given a problem to solve, which will require all the skills that you have learnt before the release of the assignment.

Release dates (where applicable): Week 10
Word limit (where applicable): N/A
Due date: Week 11 Tutorial Class
Value: 8%
Presentation requirements: N/A
Hurdle requirements (where applicable): N/A
Individual assessment in group tasks (where applicable): Mark will be given to the entire group
Criteria for marking: Marking scheme will be provided along assignment questions.
Additional remarks: N/A

Assessment title: Laboratory
Mode of delivery: Laboratory Experiment
Details of task: You will be given an experiment to conduct, and will be required to submit a report based on your findings
Release dates (where applicable): Week 6,9
Word limit (where applicable): N/A
Due date: Tutorial session of week 7
Value: 8% of entire unit
Presentation requirements: N/A
Hurdle requirements (where applicable): N/A
Individual assessment in group tasks (where applicable): A mark will be given to the entire group
Criteria for marking: Marking scheme will be provided along assignment questions.
Additional remarks: N/A

Examination(s)

Exam title: Examination
Weighting: 60%
Length: 3 hours
Type (Open/closed book): closed book
Hurdle requirements (where applicable): Student must have 45% from the final exam to pass the unit.
Electronic devices allowed: N/A
Remarks (where applicable): N/A

Calculators

A list of the Faculty of Engineering approved calculators and the process for obtaining a sticker is available online at:
http://www.eng.monash.edu.au/current-students/calculators.html

IMPORTANT: Only these listed calculators with the **authorised Monash University-Science or Monash University-Engineering STICKER** will be allowed into the examination by the invigilators.

Approved faculty calculators permitted

Section C: All students

Extensions and penalties

All assignments are to be submitted via the MAE3408/TRC3600 assignment box located in the foyer Ground Level of Building 31, next to Mechanical Engineering Office. The assignments must be submitted in hardcopy (paper-based).

Returning assignments

Assignments will be returned during Tutorial/practical classes.

Students can expect assignments to be returned no more than four weeks from the submission date or after receipt, whichever is later.

Plagiarism and collusion

Intentional plagiarism or collusion amounts to cheating under Part 7 of the Monash University (Council) Regulations.

Plagiarism: Plagiarism means taking and using another person's ideas or manner of expressing them and passing them off as one's own. For example, by failing to give appropriate acknowledgement. The material used can be from any source (staff, students or the internet, published and unpublished works).

Collusion: Collusion means unauthorised collaboration with another person on assessable written, oral or practical work and includes paying another person to complete all or part of the work. Where there are reasonable grounds for believing that intentional plagiarism or collusion has occurred, this will be reported to the Associate Dean (Education) or delegate,

Referencing requirements

Referencing may be required in some circumstances – students should utilise any acceptable referencing styles such as Oxford.

To build your skills in citing and referencing, and using different referencing styles, see the online tutorial Academic Integrity: Demystifying Citing and Referencing at http://www.lib.monash.edu.au/tutorials/citing/

Assignment submission

Hard Copy Submission:

Assignments must include a cover sheet. The coversheet is accessible via the Monash portal page located at http://my.monash.edu.au under the heading 'Learning and teaching tools'. Please keep a copy of tasks completed for your records.

All assignments are to be submitted via the TRC3600/MAE3408 assignment box located in the foyer Ground Level of Building 31, next to Mechanical Engineering Office. The assignments must be submitted in hardcopy (paper-based).

Students: You must keep a copy of your assignment in electronic format. We suggest you keep a print out also.

Online Submission: If Electronic Submission has been approved for your unit, please submit your work via the Moodle site or other; as directed by your demonstator for this unit.
Please keep a copy of tasks completed for your records.

Feedback to you

Feedback given to students in this unit include written comments on assignments graded, verbal comments, feedback to the whole class, to groups, and to individuals during lectures and practice classes.

Learning resources

Prescribed textbooks

Course Notes – will be available on Moodle

Recommended textbooks

Lecture notes provided by academic. Links on the web page.

Nise, N. S., Control Systems Engineering, 5th, Wiley, 2000

Kuo, B. C., *Automatic Control Systems*, Seventh Edition, Prentice Hall

K. Dutton, et. al., *The Art of Control Engineering*, 1997

Philips, C. L. and Harbor, R. D., *Feedback Control Systems*, 1988

Monash Library Unit Reading List (if applicable to the unit):
http://readinglists.lib.monash.edu/index.html

Required resources

Students generally must be able to complete the requirements of their course without the imposition of fees that are additional to the student contribution amount or tuition fees. However, students may be charged certain incidental fees or be expected to make certain purchases to support their study. For more information about this, go to Administrative Information for Higher Education Providers: Student Support, Chapter 21, Incidental Fees at: http://www.innovation.gov.au/HigherEducation/TertiaryEducation/ResourcesAndPublications/Pages/default.aspx

Other information

Policies

Monash has educational policies, procedures and guidelines, which are designed to ensure that staff and students are aware of the University's academic standards, and to provide advice on how they might uphold them. You can find Monash's Education Policies at: http://www.policy.monash.edu/policy-bank/academic/education/index.html

Graduate Attributes Policy

http://www.monash.edu/policy-bank/academic/education/course-governance-and-design/course-design-policy

Student Charter

http://www.monash.edu/students/policies/student-charter.html

Student Services

The University provides many different kinds of services to help you gain the most from your studies. Contact your tutor if you need advice and see the range of services available at http://www.monash.edu/students.

Malaysia students go to: http://www.monash.edu.my/Student-services/.

Monash University Library

The Monash University Library provides a range of services, resources and programs that enable you to save time and be more effective in your learning and research.
Go to http://www.monash.edu/library or the library tab in http://my.monash.edu.au portal for more information.

For Malaysia students the Library and Learning Commons, Monash University Malaysia Campus, provides a range of services and resources that enable you to save time and be more effective in your learning and research.
Go to http://www.lib.monash.edu.my or the library tab in my.monash portal for more information.

Disability Support Services

Students who have a disability, ongoing medical or mental health condition are welcome to contact Disability Support Services.

Disability Support Services also support students who are carers of a person who is aged and frail or has a disability, medical condition or mental health condition.

Disability Advisers visit all Victorian campuses on a regular basis.

- Website: monash.edu/disability
- Telephone: 03 9905 5704 to book an appointment with an Adviser;
- Email: disabilitysupportservices@monash.edu
- Drop In: Level 1, Western Annexe, 21 Chancellors Walk (Campus Centre) Clayton Campus

At Malaysia campus, for information and referral, telephone: Student Adviser, Student Community Services at 03 55146018 or, drop in at Student Community Services Department, Level 2 Building 2, Monash University Malaysia Campus.