Taylor's University

School of Engineering

Scheme of Work

SOW/SoE/08/18

Module	Real Time Instrumentation	**Module Code**	ENG60803
Module Status	Core	**Prerequisite**	EEE60303 (Signals and Systems)
Semester/year	EE 5 & 6 / 3	**Date Prepared**	August 2018
Lecturer	Dr. Phang Swee King	**Credit Hours**	Three (3)
Period	14 weeks	**Date(s) of Revision**	N/A
Module Synopsis	This course provides an initial introduction into real-time systems and how they are connected as instrumentation and control devices to other electrical circuits.		
Contact hours	Lecture: 2 hours/week Tutorials: 1.5 hour per week (Average) Labs: 0.6 hour per week (Average)		
Evaluation	25% Laboratory Assessment 15% Test (Moderated) 60% Final Examination (Moderated)		
Learning Outcomes	On completion of this module, students will be able to: 1. Explain the basic concept of instrumentation and measurements, including interrupts and data acquisition. 2. Analyse the phenomenon of sensors, industrial devices including different flow and level measuring techniques. 3. Make use of appropriate software for real time system simulations. 4. Analyse a suitable A/D and D/A converters, for real-time instrumentation systems. 5. Evaluate transfer functions, state-space, and/or block diagrams to describe and manipulate continuous time systems. 6. Design a suitable PID controller for process.		

Assessment Methods

Distribution	(%)	LO 1	LO 2	LO 3	LO 4	LO 5	LO6
Test	15	✓				✓	
Lab Experiments	25			✓			✓
Final Examination	60	✓	✓		✓	✓	✓
Total	100						

Note: All internal assessments with feedback will be made available within 7 days after each assessment submission except Final Exam.

Learning References

1. John Park, Practical Data Acquisition for Instrumentation and Control Systems, Newnes 2003.
2. E.O.Doebelin. "Measuring Systems, Application and Design." McGraw Hill, 2003.
3. B.A.Gregory. "Introduction to Electrical Instrumentation and Measurement Systems." Palgrave Macmillan, 1981.

Additional References

1. R.S. Khandpur, "Handbook of Analytical Instruments", Second Edition, Tata McGraw Hill publishing Co. Ltd., 2006.
2. Klaas B. Klaassen. "Electronic Measurement and Instrumentation." Cambridge University Press, 2003.

Program Outcomes (Electrical and Electronic Engineering)

PO1	Apply the knowledge of mathematics, science, engineering practices, innovation techniques, entrepreneurship and human factors to provide value-adding solutions to complex Electrical and Electronic Engineering challenges.
PO2	Identify, formulate, analyse and document complex engineering challenges to arrive at viable solutions and substantiated conclusions.
PO3	Conceive, Design, Implement and Operate solutions for complex engineering challenges that meet specified requirements with appropriate consideration for public health and safety, cultural, societal, environmental and economical considerations.
PO4	Conduct research and investigation into complex challenges using methods which include experiment design, analysis of data and synthesis of information to provide valid conclusions.
PO5	Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering activities, with an awareness of the accompanying assumptions and limitations.
PO6	Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal, economical and cultural issues and the consequent responsibilities relevant to professional engineering practice.
PO7	Explain the global impact of professional engineering solutions in societal, economical and environmental contexts and demonstrate knowledge of and need for sustainable development.
PO8	Apply professional and ethical responsibilities of engineering practice.
PO9	Effectively communicate complex engineering activities, both orally and in a written form, in both technical & non-technical contexts.
PO10	Function effectively as an individual and in multidisciplinary settings with the capacity to be a leader.
PO11	Recognise the importance of lifelong learning and engaging in continuous professional development activities in accordance with technological change.
PO12	Effectively manage projects in multidisciplinary environments and apply project management tools and techniques to one's own work, as a member and leader in a team to satisfy stakeholder's requirements.

Chapter	Topic	Week	Topic Outcomes (TO)	LO	PO	Delivery Methods
1	Introduction to real-time concepts	Week 1	• Briefing on LO and POs • Introduction to Real-time concepts and Data Acquisition.	LO 1	PO 1	Lecture, Tutorial
			• Definitions of real-time. Types of Interrupts.	LO 1	PO 1	Lecture, Tutorial
2	Data acquisition	Week 2	• Instruments accuracy, percentage error, noise, sensitivity, calibration.	LO 1	PO 1	Lecture, Tutorial
			• Signal state, signal rate	LO 1	PO 1	Lecture, Tutorial
3	Systems	Week 3	• Block diagram, electrical and mechanical systems, transfer functions.	LO 5	PO 2	Lecture, Tutorial
		Week 4-5	• Concepts of poles and zeros, first and second order systems	LO 5	PO 2	Lecture, Tutorial
		Week 6	• Closed-loop systems, stability criteria	LO 5	PO 2	Lecture, Tutorial
		Week 7	Test	LO 1 LO 5	PO 1 PO 2	Written Exam
		Week 8	**Lab 1:** ABB robotic arm programming	LO 3	PO 4	Lab experiment
4	Controllers	Week 8	• Basic control action, ON-OFF Control, composite control modes- P+I, P+D, P+I+D.	LO 6	PO 5	Lecture, Tutorial
		Week 9	• Characteristics of controllers, Simple PID control and its implementation. TES Briefing (15 min.) (Week 9)	LO 6	PO 5	Lecture, Tutorial
		Week 10	**Lab 2:** Tuning of Controllers (Matlab Simulink)	LO 3	PO 4	Lab experiment
5	Instrumentation interfaces	Week 10	• Analog-digital converter • Sampling and scaling. • Analog circuits for instrumentation. *Fill up TES student evaluation (15 min). Students are required to bring their own devices to complete the evaluation (Week 10)*	LO 4	PO 2	Lecture, Tutorial
6		Week 11	• Types of linear displacement sensors *E-learning week	LO 2	PO 2	Lecture, Tutorial
		Week 12	**Lab 3:** PID controller (Matlab Simulink)	LO 3 LO 6	PO 4 PO 5	Lab experiment

	Sensors and Industrial Devices	Week 12	• Types of angular displacement sensors	LO 2	PO 2	Lecture, Tutorial
		Week 13	**Lab 4:** Lab assessment (ABB robotic arm programming)	LO 6	PO 5	Lab experiment
		Week 13	• Types of level measurements	LO 2	PO 2	Lecture, Tutorial
		Week 14	• Types of flow measurements	LO 2	PO 2	Lecture, Tutorial

Assessment Details:

Assessment Details			
Type	Details	Learning Domain	Mark
Test	Individual	Cognitive	15%
Lab Experiments	Group	Psychomotor	25%
Final Examination	Individual	Cognitive	60%
Total			100%

Assessment schedule:

		Week Nº.												
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Assessment Methods	Test							✓							
	Lab Experiments								✓		✓		✓	✓	
	Final Examination (After Week 14)														

For all assessment, TURNITIN similarity limit: 30%
Student is not allowed to transcribe directly (cut and paste) any material from another source into their submission.

LO-PO (TGC) mapping:

		Programme Outcomes (POs) and Taylor's Graduate Capabilities (TGC)											
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
Learning Outcomes LOs	LO 1	✓											
	LO 2		✓										
	LO 3				✓								
	LO 4		✓										
	LO 5		✓										
	LO 6					✓							

Prepared by:	Checked by:	Approved by:
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Remarks:

1. The Scheme of Work is to be distributed to the students in the first week of the semester.
2. Module coordinators may set a more stringent similarity percentage (minimum 20%) for their respective modules pertaining to students' submissions with the approval of the Programme Director.
3. Any changes to the Scheme of Work shall be communicated (in writing) to the Program Director and the approved revised version must be communicated to the students.