Reg. No. 200604393R

COURSE OUTLINE FOR STUDENTS AT NTU

Academic Year	2020/21	**Semester**	1
Course Coordinator	Associate Professor Ang Wei Tech		
Course Code	MA2012		
Course Title	Introduction to Mechatronics Systems Design		
Pre-requisites	Nil		
No of AUs	3		
Contact Hours	Lectures: 31 hours Lab: 24 hours		
Proposal Date	April 2020		

Course Aims

The objectives of this course are to:
a) introduce you to the basic principle of a mechatronics system or product, the working principles of these elements and the integration of the various elements into a mechatronics system
b) teach you how to design a mechatronics product through bread boarding of an integrated mechatronics product.

Intended Learning Outcomes (ILO)

Upon successful completion of the course, you will be able to:
1) distinguish various elements of a mechatronics system, and explain how they work
2) assemble a mechatronics system that has a microcontroller, and various sensors and actuators
3) develop and program mechatronics systems
4) deduce viable solutions for problems pertaining to mechatronics systems
5) Interpret the specifications of the components via their data sheets
6) manage, organize and plan projects
7) communicate technical contents effectively

Course Content

	Topic	Hours
1.	**Introduction to mechatronics system** Elements of mechatronics systems and the integration; bread boarding and design and prototyping tools e.g. sketching, wood works etc.	2
2.	**Embedded systems** Introduction to an embedded processor, programming tool and software development system.	5 (2h lecture and 3h lab)
3.	**Sensors** Overview of digital and analog sensors, and their interface with the microcontroller. Reading and understanding the data specifications of these devices. Important concepts such as the Shannon sampling theorem and Nyquisit frequency will be introduced.	5 (2h lecture and 3h lab)

4	**Actuators** Overview of servos, DC motors, stepper motors, and their interface with the microcontroller and drive circuits. Reading and understanding the data specifications of these devices and how to design the interfacing circuits.	5 (2h lecture and 3h lab)
5.	**Interfacing to input and output devices** Introduction to various types of contact switches, push buttons, and types of contacts pull-up resistors, remote control using IR; interfacing to LED displays, LCD display panels.	5 (2h lecture and 3h lab)
6.	**Communication protocols** Introduction to serial and parallel communication. Two serial communication protocols, I2C Bus and SPI Bus, will be introduced.	5 (2h lecture and 3h lab)
7.	**Case study: Hexapod robot** Using the case study to understand how to select appropriate elements, and how to integrate them into a functional mechatronics system.	2
8.	**Review** A review will be given at the end of this course.	2

Project Work

1.	**Mechatronics System Project** Design and develop a mechatronics product that demonstrates the effective integration of mechanical elements, drive system, sensors, and an embedded processor. Report documentation of the whole mechatronics system design process.	24

Assessment (includes both continuous and summative assessment)

Component	Course LO Tested	Related Programme LO or Graduate Attributes	Weighting	Team/ Individual	Assessment rubrics
1. Continuous Assessment1 – Lab assessment	LO 1-7	*EAB SLO a, b, c, e, i, j, k, l*	20%	Team	
2. Continuous Assessment2 – Project	LO 1-7	*EAB SLO a, b, c, e, i, j, k, l*	30%	Team	
3. Final Examination – Closed Book; 2 hrs	LO 1-7	*EAB SLO a, b, c, e, j*	50%	Individual	
Total			100%		

* EAB SLO stands for the Engineering Accreditation Board Student Learning Outcomes. The list is below:

a) **Engineering knowledge:** Apply the knowledge of mathematics, natural science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems

b) **Problem Analysis:** Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c) **Design/development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

d) **Investigation:** Conduct investigations of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

e) **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f) **The engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g) **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for the sustainable development.

h) **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i) **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings.

j) **Communication:** Communicate effectively on complex 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.

k) **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and economic decision-making, and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

l) **Life-long 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

Formative feedback

We will provide:

1. constant verbal feedbacks to the students
2. regular feedbacks on their progress in the project

Learning and Teaching approach

Approach	**How does this approach support students in achieving the learning outcomes?**
TEL	A general introduction to the specific topics
Lab sessions	1. A briefing before the session

	2. The lab session will provide hands on experience

Reading and References

Textbook

1. Introduction to Mechatronics, and Measurement Systems 3rd Ed. D G Alciatore and M B Histand, McGraw Hill, 2007

2. Exploring Arduino, J. Blum, Wiley, 2013

References

1. Lab handouts

Course Policies and Student Responsibilities

As a student of the course, you are required to abide by both the University Code of Conduct and the Student Code of Conduct. The Codes provide information on the responsibilities of all NTU students, as well as examples of misconduct and details about how students can report suspected misconduct.

The university also has the Student Mental Health Policy. The Policy states the University's commitment to providing a supportive environment for the holistic development of students, including the improvement of mental health and wellbeing. These policies and codes concerning students can be found in the following link.
http://www.ntu.edu.sg/SAO/Pages/Policies-concerning-students.aspx

Academic Integrity

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values.

As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the academic integrity website for more information. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Course Instructors

Instructor	Office Location	Phone	Email
Ang Wei Tech	N3.2-02-83	6790 4911	WTANG@ntu.edu.sg

Planned Weekly Schedule

Week	Topic	Course LO	Readings/ Activities
1	Introduction to mechatronics system	1-7	Lecture slides and lab handouts

2	Embedded systems	1-7	Lecture slides and lab handouts
3	Sensors	1-7	Lecture slides and lab handouts
4	Actuators	1-7	Lecture slides and lab handouts
5	Interfacing to input and output devices	1-7	Lecture slides and lab handouts
6	Communication protocols	1-7	Lecture slides and lab handouts
8-13	Project	1-7	N.A.