

Academic Year	Any	Semester	2
Course Coordinator	Ho Shen Yong		
Course Code	PS9886		
Course Title	Making and Tinkering (Lite 1)		
Pre-requisites	-		
No of AUs	2 AUs		
Contact Hours	3 hours per week and 6 hours of workshop in total		
Proposal Date	10 December 2019		

Course Aims

The course aims to equip you with basic technological awareness, particularly computer- controlled electronics and 3D printing, and hands-on skills required for building basic equipment and products related to Science and Technology. Through this course, you will develop creativity as you are encouraged to explore different approaches to a given problem, and resilience when facing the need to acquire new technological skills in a limited time in order to solve a given problem.

Intended Learning Outcomes (ILO)

Upon the successful completion of this course, you (as a student) would be able to:

Project (PROJ)

1. solve a given problem by applying the knowledge and skills associated with
 - computer-controlled electronics,
 - 3D printing, and
 - basic mechanical and electrical works.

Computer Controlled Electronics (CCE)

2. use programming logic to control basic electronic components;
3. control output of an electronic component based on the input of a sensor;
4. control electronic systems with both digital and analogue input;

3D Printing (3DP)

5. use a 3D drawing software to create 3d objects made up of two or more distinct parts and to create assemblies of well-tolerant 3d components;
6. operate a 3D printer, do a simple 3D print job and perform basic trouble shooting; and
7. post-process a 3D print job

Electrical Workshop (EW)

8. assemble and test electrical components onto Printed Circuit Board;
9. perform simple circuit design using a design and simulation software;

Course Content

Computer Controlled Electronics

Micro-controller basics
Introduction to Arduinos and Arduinos programming
Introduction to other computer-controlled electronics systems
Digital Input / Output
Analog Input
Analog to digital conversion
Pulse Width Modulation
Types of motors, LED and sensors
Arduino Shields

3D Printing (3DP)

Theory and History of 3D Printing
3D printing technology
Sketching using 3D design software
Post processing techniques

Electrical Workshop (EW)

Workshop Safety
Printed Circuit Board: Assembly and testing
Circuit design and simulation software

Project (PROJ)

Project that involves building a physical object or solving a problem using 3D printing and computer-controlled electronics. Instructor will help suggest possible topics.

Assessment (includes both continuous and summative assessment)

This is a pass / fail course. There is a checklist of ALL the skills that you need to demonstrate in order to pass the course. The course instructor will check the quality of your works/understanding, provide a rating and approve with their signatures. See Appendix 1 for more details.

Component	Course LO Tested	Related Programme LO or Graduate Attributes	Weighting	Team / Individual	Assessment Rubrics
Continuous Assessment	All	Competence, Creativity, Communications Character	100%	Individual / Pair (See Appendix 1)	See Appendix 1
Total			100%		

Formative feedback

At the end of teaching each topic / skill, the students will be given time to complete a given task. After that, the instructor will assess students on their understanding and feedback to the quality of their work.

The students will have to make improvements until satisfaction before the instructor will sign on the checklist for the students. (See Appendix 1)

Learning and Teaching approach

Approach	How does this approach support students in achieving the learning outcomes?
Master-Apprentice	Develop competence in 3D printing, computer-controlled electronics and basic mechanical and electrical works. The instructor will provide feedback to the students on their work each session. This will also help develop perseverance and resilience as students will have to improve continually until the desired quality of work is achieved.
Pair Work (Hands-on)	Develop communication skills while doing collaborative learning. The students also have an opportunity to work as a team and do group presentation.
Project	Develop physical intuition and competence in solving scientific / technological problems. The designing of a solution to an open-ended problem also allow the students to be creative.

Reading and References

1. Autodesk Fusion 360: <http://www.autodesk.com/products/fusion-360>
2. Arduino IDE - <https://www.arduino.cc/en/Guide/Environment>
3. Arduino tutorial for beginners - <http://forefront.io/a/beginners-guide-to-arduino/>
4. RAMPS

Course Policies and Student Responsibilities

Absence Due to Medical or Other Reasons

If you are sick and unable to attend your class, you have to:

1. Send an email to the instructor regarding the absence and request for a replacement class.
2. Submit the original Medical Certificate* to administrator.
3. Attend the assigned replacement class (*subject to availability*).

* The medical certificate mentioned above should be issued in Singapore by a medical practitioner registered with the Singapore Medical Association.

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

	Name	Office Location	Email Address
Coordinator	Dr Ho Shen Yong	SPMS-PAP-03-07	hosy@ntu.edu.sg
Computer Controlled Electronics Instructor	Mr Gan Eng Swee (Tony)	SPMS-PAP-02-07	esgan@ntu.edu.sg
3D Printing Instructor	Mr Leong Han Yang	SPMS-PAP-02-07	HYLEong@ntu.edu.sg

Planned Weekly Schedule

Week	Topic	Course LO	Readings/ Activities
1	Introduction Theory and History of 3D Printing; 3D printing technology; Computer Controlled Electronics and Arduinos	PROJ 1	
2	Computer-controlled Electronics I Basic programming for controlling electronic components 1	CCE 2	* start Electronics Workshop
3	Computer-controlled Electronics II Basic programming for controlling electronic components 2	CCE 2	
4	Computer-controlled Electronics III Sensors; controlling systems with different types of inputs	CCE 3, 4	
5	Computer-controlled Electronics IV Output control	CCE 3, 4	
6	Project I Discussion and development of project.	ALL LOs	
7	3D drawing and 3D printing I Sketching using 3D design software. Post processing techniques.	3DP 5, 6	
8	3D printing II Complex geometries and designing multi-part 3D projects;	3DP 6, 7	
9	Computer-controlled Electronics V Applications	CCE 2, 3, 4	
10	Project II Designing and construction of project.	ALL LOs	
11	Progress Report Presentation of project progress.	ALL LOs	
12	Project Discussion and Consultations Construction of project and finalizing design	ALL LOs	
13	Final Presentation Presentation by the all groups	ALL LOs	

Students can book the Mechanical Workshop (MW) training will start after the lesson in week 2.
(LO: MW8-11)

*Students can book the Electronics Workshop (EW) training will start after the lesson in week 6.
(LO: EW 12-13)

Name: _____

Sample Learning Outcome Checklist page 1
(Items will vary according to the hardware used)

		Rating*	Sign / Date
	3D Printing [Individual]	1 2 3 4 5	
1.	Basic overall knowledge about 3D printing and applications (Quiz)		
2.	Able to use a 3D drawing software:		
	to sketch, scale, position basic 2d sketches		
	to sketch, scale, position basic geometrical 3d objects		
	to combine 2 or more geometrical 3d objects into complex objects		
	to create assemblies of well-tolerant 3d components		
3.	Basic understanding of settings/parameters for 3d printing:		
	Layer Height and Resolution		
	Optimizing Orientation and Strength		
	Overhangs and Supports		
	Generation of 3D Print File from STL File		
4.	Post processing		
	Combining separate parts into single piece		
	Surface finishing techniques		
	Paint or colour application		
	Part duplication		
5.	Basic troubleshooting skills		
	Adjustments to increase load strength		
	Adjustments to improve print quality		
	Adjustments to reduce print time		
	Computer Controlled Electronics [Individual / Pair]		
1.	Arduino programming language		
	if/then/else, while/for, setup/loop		
	DigitalWrite, AnalogWrite, DigitalRead, AnalogRead, delay		
	Debugging using Serial I/O		
2.	Digital input/output		
	Able to control LED lights (turn on/off, to blink, to light up in a certain sequence)		
3.	Analog input		
	Measure temperature using temperature sensor TMP36		
	Measure distance with ultrasonic sensor		
4.	Pulse Width Modulation (PWM)		
	Working with photoresistor and control LED brightness		
	Control speed of motor		

* 5 – Done perfectly; 4 – Done a very good job but still have some room for improvement;
 3 – Completed the job but some improvements can be made;
 2 – Completed the job but some major improvements can be made; 1 – Unsatisfactory;

Name: _____

Learning Outcome Checklist page 2

		Rating*	Sign / Date
		1 2 3 4 5	
	Electronics Workshop [Individual]		
1.	Demonstrate understanding and awareness of the safety in an electronics workshop.		
2.	To be able to assembly electrical components onto PCB.		
3.	To be able to test and trouble system assembled on PCB.		
4.	Demonstrate understanding of the functionalities of circuit design and simulation software.		
5.	Demonstrate understanding of the functionalities and basic operational principles of PCB machine.		
	Project [Pair]		
	Project Presentation [Pair]		

* 5 – Done perfectly; 4 – Done a very good job but still have some room for improvement;
 3 – Completed the job but some improvements can be made;
 2 – Completed the job but some major improvements can be made; 1 – Unsatisfactory;