Nanyang Technological University
Division of Physics and Applied Physics

Academic Year	2022-23	**Semester**	Special Terms & Semester 1
Course Coordinator	Ho Shen Yong		
Course Code	PS5888		
Course Title	Making and Tinkering		
Pre-requisites	Subject to School's Approval		
Mutually Exclusive	CY2003 Research Attachment 3		
No of AUs	4 AU		
Contact Hours	PS5888 (Project-based course, about 12 - 16 hours a week).		
Proposal Date	09 February 2023		

Course Aims

This course aims to create an environment that allows students to apply their scientific knowledge to identify and solve open-ended, real-life problems together with their peers from different disciplines. You will have the opportunities to freely explore, take risks and even if you fail, you will be able to learn from your failures. The end-product of the investigation will be a (possibly novel) prototype designed and created by you and your team to solve the problem you identified. You will also be required to do presentations of your project.

Intended Learning Outcomes (ILO)

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

1. Design a systematic plan to explore ways of solving an identified problem related to Science, Technology, Engineering or Mathematics.
2. Identify the areas of expertise and purchase the raw materials needed for investigation of a problem or construction of the prototype.
3. Work together as a team and pick up the necessary skills to produce prototypes for testing.
4. Design and construct a prototype.
5. Test, critique and improve the prototype design iteratively.
6. Perform progress update presentations.
7. Present and market your work to an audience and a panel of judges.

Course Content

The content is dependent on the project. It will be related to Science, Technology, Engineering and Mathematics. Students will most likely be dealing with computer-controlled electronics, 3D printing, computer simulation and working in a mechanical / electronics workshop to produce a prototype.

Assessment (includes both continuous and summative assessment)

Component	Course LO Tested	Related Programme LO or Graduate Attributes	Weighting	Team / Individual	Assessment Rubrics
1. Assessment of final prototype	1-5	Competence, Cognitive Agility, Character	50%	Team (weighted for each individual, see component 5)	See Appendix 1
2. Teamwork and Individual Contributions to the Team	1-3	Competence, Character	15%	Individual	See Appendix 2
3. Technical Knowledge (Participation during fortnight progress meetings and viva)	5-6	Competence, Character and Cognitive Agility,	15%	Individual	See Appendix 3
4. Final Presentation and Blog	5-7	Competence,	20%	Team	See Appendix 4
5. Peer assessment of individual team members' contribution	1-5	Competence, Character	Determines fraction of component 1 to be awarded.	Individual	See Appendix 5
Total			100%		

Formative feedback

You will receive feedback on your project from your supervisors and course coordinator from time to time. Your fellow course mates and instructors will also provide feedback to you during the fortnightly progress update meeting.

Learning and Teaching approach

Approach	How does this approach support students in achieving the learning outcomes?
Problem solving	Develop competence and perseverance in solving Science, Technology, Engineering and Mathematics problems
Developing of a prototype in a group	Develop physical intuition and competence in solving real-life problems. Students learn to work in a group, delegate responsibilities, manage time and resolve conflicting ideas related to the project.
Peer Instruction (during fortnightly sharing and final presentation)	Develop communication and presentation skills related to Science, Technology, Engineering and Mathematics. Students are encouraged to provide feedback for each other's projects.

Reading and References

This is project dependent. Resources related to Science, Technology, Engineering and Mathematics.

Course Policies and Student Responsibilities

Absence Due to Medical or Other Reasons

If you need to be away from the course for an extended period (exceeding one week), you need to seek the approval of the co-ordinator and supervisor.

Students are required to attend all fortnight progress meeting. If they are unable to make it, they are supposed to take leave from the coordinator before the meeting or produce official letter of excuse (including medical certificates).

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
Ho Shen Yong	SPMS PAP 03-07	65927816	hosy@ntu.edu.sg
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Planned Weekly Schedule

Stage / Week	Activity	Course LO	Readings/ Activities
Pre-course (about 2 months ahead)	Identification of problem and forming of teams to bid for projects	1-2	Research and purchase related to project.
Preparation (about 1 month ahead)	Purchase of material and learning of relevant skills for projects. Theoretical and hands-on exploration of solutions to problems identified.	1-3	
Stage 1 (Week 1 – 4)	The teams will attend relevant workshops on safety, use of machinery, entrepreneurship etc. Theoretical and hands-on exploration of solutions to problems identified.	1-4	Project updates meeting on Week 3, 5, 7, 9 and final presentation on week 13 onwards till end of Semester 1.
Stage 2 (Week 3-13)	Designing / creating / making of prototype.	3-6	
Stage 3 (Week 9 – 20)	Continual test-trial and enhancement to prototype.	3-6	
Stage 4	Work on Poster and Video presentation.	6-7	

Appendix 1

Assessment of final prototype

	5	4	3	2	1	Score
How original is the design of the project? (LO 1, 4) [Where did you get the idea from? Did you make any modifications for this project?]	Absolutely original.	Not totally original but had made non-trivial improvements on existing ideas.	Not totally original but had made some minor improvements on existing ideas.	Not totally original but had made modifications (not necessarily improvements) on existing ideas.	The project was a direct copy of existing ideas without the slightest modifications or improvements.	**/ 5**
Does this project involve some clever use of Science? (LO 1, 4) [Explain the Scientific principles behind your project.]	Involves the novel application of existing scientific principles and/or discovery of new scientific principles.	The project was designed based on sound scientific principles.	The project was designed based on some scientific principles and involved some trial and error.	The project was designed based loosely on scientific principles and involved mainly uneducated guesses.	No Science or Mathematics involved in this project.	**/ 10**
Was the prototype designed and built from scratch? (LO 2, 3, 4) [Evidence needed.]	Prototype was designed and built from scratch with basic components.	Prototype was designed and built from assembly of basic components and some ready-made parts.	Prototype was designed and built from assembly of ready-made parts but with some modifications.	Prototype was built by merely assembling ready-made parts (or simple modifications of stl files.)	Close to no effort was required to build the prototype (or just printed of existing stl files.)	**/ 10**
Did the team go through the cycle of test, critique and re-design? (LO 5) [Evidence needed.]	Yes, rigorous testing, evaluation and re-designing were involved in the design (e.g. using computer simulation and / or optimization).	Yes, thorough testing, evaluation and re-designing were involved in the design (e.g. using computer simulation and/or data collection).	Yes, some testing, evaluation and re-designing were involved in the design. (e.g. data collection and analysis.)	Yes, minimal testing, evaluation and re-designing were involved in the design.	Only very simple testing, evaluation and re-designing were involved in the design.	**/ 10**
How much effort was needed to make the prototype? (LO 2, 3, 5)	Project was technically very demanding and the team put in a lot of effort.	Project was technically demanding and the team put in significant amount of effort.	Project has some technical demands and the team put in some effort.	Project has little technical demands and the team only put in minimal effort.	Close to no effort.	**/ 5**
How do you rate the design and craftsmanship of the end product? (LO 4, 5) [What's so special about your design? Is there anything difficult in the building of the end-product?]]	Some ingenuity in the design with attention paid to all the details. The end product was robust and the team overcame technical challenges.	Careful considerations were made in the design with attention paid to some details. The end product was well made and the skills required were non-trivial.	Some considerations were made and alternatives explored but there is room for improvements. The end product was well made but the skills required were not demanding.	Project has some design flaws with obvious room for improvements. The end product was not well made and the skills required were not demanding.	The end product was poorly designed with severe flaws. The skills involved were trivial. It could be done by anyone with no training.	**/ 5**
Is the project operating as intended? (LO 1, 5) [Please demonstrate your end product (twice)]	Operating as intended and the end product was robust (works all the time).	Operating as intended and the end product worked most of the time.	Nearly all parts of project were working individually but the integrated whole was not working yet.	Some parts of project were working but the integrated whole was not working yet.	No part of the project was working yet.	**/ 5**
					Total:	**/ 50**

Appendix 2

Assessment Rubric for Teamwork

	Exceptional (5)	Effective (4)	Acceptable (3)	Developing (2)	Unsatisfactory (1)	Score
Project Management (LO 1, 2)	The team followed a well-planned time-line, catering to different scenarios and was able to adhere to most of it.	The team followed a realistically planned time-line and was able to adhere to most of it.	The team followed a time-line and was able to adhere to some of it.	The team followed a basic time-line, was behind schedule most of the time but managed to complete the project on time (possibly by simplifying the intended outcomes).	The team did not plan a time-line and was not able to complete the project on time.	**/ 10**
Teamwork (LO 2, 3)	Responsibilities were well-distributed and coordinated.	Responsibilities were distributed and coordinated.	Responsibilities were distributed but shows lack of coordination.	Responsibilities were not well-distributed or coordinated.	Responsibilities were not distributed or coordinated.	**/ 5**
					Total:	**/ 15**

Appendix 3

Assessment Rubric for Participation during Fortnight Progress Meetings and Viva*

	Exceptional (5)	**Effective (4)**	**Acceptable (3)**	**Developing (2)**	**Unsatisfactory (1)**	**Score**
Discussions & Contributions (LO 5)	Very productive discussions and deep analyses; critique extends beyond the requirements of the project into new scenarios.	Productive discussions and analyses; critique of how different aspects of the project interact with each other and their impact on the project.	Adequate discussions and analyses; critique of more than one aspect of the project, but unable to connect them.	Little discussions and analyses; critique involved only a single aspect of the project.	Minimal discussions, analyses or critique.	**/5**
Demonstration of Technical Knowledge and Skills (LO 1,2,4,5)	Demonstrated expert technical knowledge and skills related to the project. Able to answer technical queries confidently and correctly.	Demonstrated very good technical knowledge and skills related to the project. Able to answer most technical queries confidently and correctly.	Demonstrated some technical knowledge and skills related to the project. Able to handle some technical queries.	Demonstrated little technical knowledge and skills related to the project. Able to handle some technical queries with help.	Demonstrated minimal technical knowledge and skills related to the project. Have difficulties handling technical queries even with help.	**/10**
					Total:	**/ 15**

Appendix 4

Assessment Rubrics for Final Project Presentation and Course Blog

	Exceptional (5)	Effective (4)	Acceptable (3)	Developing (2)	Unsatisfactory (1)	Score
Content (LO 5)	Provided more than the required information about the project; completely accurate.	Provided required information about the project; mostly accurate.	Provided most of the required information about the project; mostly accurate.	Provided some of the required information about the project; some major errors.	Provided little to none of the required information about the project; major errors.	**Blog:** **/ 5** **Presentation:** **/ 5**
Presentation (LO 6 – 7)	Ideas were presented very clearly and visuals were very helpful.	Ideas were presented clearly and visuals were helpful.	Ideas were presented somewhat clearly (i.e. generally able to follow but could be more precise, concise) and visuals were somewhat helpful.	Ideas were mostly unclear and visuals were mostly unhelpful.	Ideas were not presented clearly and visuals were not helpful.	**Blog:** **/ 5** **Presentation:** **/ 5**
					Total:	**/ 20**

Appendix 5

Online survey for evaluation of individual contribution during teamwork (Conducted in Confidence)

Self and peer evaluation for individual contribution during teamwork:
Please rate the contribution of yourself and all of your team members for the criteria below by highlighting the level you find best describes each individual's performance.

	Contribution to workload and co-operation				
	Always cooperative and works extremely well with others. Is highly productive and routinely comes up with useful ideas. (4 points)	Usually cooperative and works well with others. Does his/her share and usually comes up with useful ideas. (3 points)	Sometimes cooperative. Requires directions. Could have shared more of the workload. Sometimes offers useful ideas. (2 points)	Does not contribute or work much. Does not work well with others. Difficulty focusing on task. (1 point)	Did not contribute to the work at all. (0 points)
You					
TM 1					
TM 2					
TM 3					
Other comments (for each member):					
	Contribution to team spirit and positive interdependence				
	Participates in nearly all group meetings. Always listens to, shares with, and supports the efforts of others. Provides effective feedback. Relays a lot of relevant information. (4 points)	Participates in most group meetings. Usually listens to, shares with, and supports the efforts of others. Provides some effective feedback. Relays some basic information that relates to the topic. (3 points)	Participates in some group meetings. Often listens to, shares with, and supports the efforts of others. Rarely listens to others. Provides little feedback. Relays very little information that relates to the topic. (2 points)	Participates in few or no group meetings. Rarely listens to, shares with, or supports the efforts of others. Provides no feedback. Does not relay any information to teammates. (1 point)	Did not participate in the work at all. (0 points)
You					
TM 1					
TM 2					
TM 3					
Other comments (for each member):					

The average score from the inputs of all team members will be taken and the score in group Appendix 1 will be awarded in accordance to the distribution below.

Average pts (AP)	% of group score in Appendix 1
$\mathrm{AP} \geq 3.50$	100
$3.25 \leq AP < 3.50$	90
$3.00 \leq AP < 3.25$	85
$2.75 \leq AP < 3.00$	80
$2.50 \leq AP < 2.75$	75
$2.25 \leq AP < 2.50$	70
$2.00 \leq AP < 2.25$	65
$1.75 \leq AP < 2.00$	60
$1.50 \leq AP < 1.75$	55
$1.25 \leq AP < 1.50$	50
$1.00 \leq AP < 1.25$	45
$0.75 \leq AP < 1.00$	40
$0.50 \leq AP < 0.75$	35
$AP < 0.50$	0