Academic Year	Any	**Semester**	Special Semester 1 and 2
Course Coordinator	Director-CN Yang Scholars Programme, and Dr Koh Teck Seng		
Course Code	CY2003		
Course Title	Research Attachment 3		
Pre-requisites	NA		
Mutually Exclusive	PS9888 Making and Tinkering		
No of AUs	4 AU		
Contact Hours	Project-based course, about 12 - 16 hours a week		
Proposal Date	23 April 2019		

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 friends 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, Creativity, Character	60%	Team	See Appendix 1
2. Teamwork and Individual Contributions to the Team	1-3	Competence, Communication, Character	15%	Individual	See Appendix 2
3. Technical Knowledge (Participation during fortnight progress meetings and viva)	5-6	Competence, Communication, Character and creativity	15%	Individual	See Appendix 3
4. Final Presentation	5-7	Competence, Communication	10%	Team	See Appendix 4
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 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
Prof Tan Choon Hong	SPMS-CBC-04-18	63168761	choonhong@ntu.edu.sg
Dr Koh Teck Seng	SPMS-PAP-03-08	65141066	kohteckseng@ntu.edu.sg

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.
Stage 2 (Week 3-9)	Designing / creating / making of prototype.	3-6	
Stage 3 (Week 7 – 12)	Continual test-trial and enhancement to prototype.	3-6	
Stage 4 (Week 11-13)	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 of the end product? (LO 4, 5) [What's so special about your design?]	Some ingenuity in the design with attention paid to all the details.	Careful considerations were made in the design with attention paid to some details.	Some considerations were made and alternatives explored but there is room for improvements.	Project has some design flaws with obvious room for improvements.	The end product was poorly designed with severe flaws.	**/ 5**
How do you rate the craftsmanship? (LO 4, 5) [Is there anything difficult in the building of the end-product?]	The end product was robust and the team overcame technical challenges.	The end product was well made and the skills required were non-trivial.	The end product was well made but the skills required were not demanding.	The end product was not well made and the skills required were not demanding.	The skills involved were trivial. It could be done by anyone with no training.	**/ 10**
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:	**/ 60**

Appendix 2

Assessment Rubric for Teamwork and Individual Contributions to the Team*

	Exceptional (5)	Effective (4)	Acceptable (3)	Developing (2)	Unsatisfactory (1)	Score
Project Management / Individual Contribution (LO 1, 2) (Team)	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.	**/ 5**
Teamwork (LO 2, 3) (Team)	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**
Individual Contributions (LO 2, 3) (Individual)	Contributed significantly in both ideas and the technical aspects of the project.	Contributed in both ideas and the technical aspects of the project.	Made some contributions to the project.	Made only little contributions to the project.	Made minimal contributions to the project.	**/ 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 Project Presentation

	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.	**/ 5**
Presentation Skills (LO 6 – 7)	Ideas were presented very clearly and visuals were very helpful to audience.	Ideas were presented clearly and visuals were helpful to audience.	Ideas were presented somewhat clearly (i.e. generally able to follow but could be more precise, concise) and visuals were somewhat helpful to audience.	Ideas were mostly unclear and visuals were mostly unhelpful to audience.	Ideas were not presented clearly and visuals were not helpful to audience.	**/ 5**
					Total:	**/ 10**