

COURSE CONTENT FOR PH4900 (With Final Year Project)

Academic Year	Any	Semester	1, 2 and Special Term I & II
Course Coordinator	Leek Meng Lee		
Course Code	PH4900		
Course Title	Professional Internship I (Co-op)		
Pre-requisites	Approval by the Division of Physics & Applied Physics		
Mutually Exclusive	PH4405 FYP, PH4412 PA, PH4413 PI, PH4415 FYP, PH4416 PA, PH4417 PI, PH4701 OEP12, PH4702 OEP12, PH4703 OEP6, PH4704 OEP6, PH4901 PI I (Co-op)		
No of AUs	15		
Contact Hours	30 weeks		
Proposal Date			

A. Course Aims

This 30-week Professional Internship programme with Final Year Project is offered as a core course for all **Physics and Applied Physics** (Cooperative Education Program) undergraduate students during Year 3 Semester 2+Special Semester I & II or Year 3 Special Semester I & II + Year 4 Semester 1. This is a 15AU-course.

The purpose of this Professional Internship is to enable the application of knowledge and skills you have learned in the university in an authentic work environment. This is such that you can gain relevant exposures and develop practical industry experiences and skills that will facilitate your career decision and future transition into your selected vocation. It allows you to develop professional competencies that will enhance your employability and lifelong learning capabilities to support your career and life endeavours and your readiness for the future of work. In addition, you will have the option of completing an Industrial Final Year Project (IFYP) co-supervised by a company supervisor and an NTU faculty. The IFYP provides an opportunity to apply and integrate the knowledge you have gained through various subjects in your degree programme, and to demonstrate practical research skills through solving real life problems in related field.

B. Intended Learning Outcomes (ILOs)

At the successful completion of the Professional Internship, you (as a student) should be able to:

I. Cognitive

1. Apply knowledge and skills relevantly and appropriately in the workplace. [Apply fundamental physics knowledge, logical reasoning, mathematical and computational skills to analyse, model and solve problems]
2. Identify your own competency gaps at the internship workplace.
3. Evaluate and develop personal learning and development pathways towards bridging competency gaps identified in point (2) above. [Identify technical skills needed to solve problems.]
4. Develop and apply strategies to solve problems effectively (involves critical thinking and creativity, generating questions, resourcing, application and reiteration). [Formulate research question, methodically develop approaches to tackle problems using scientific approach, collect, analyse data to make rigorous and objective deductions.]
5. Evaluate resources and develop insights to make informed judgements and recommendations. [Discuss relevant knowledge through literature review and critically evaluate sources of scientific/non-scientific information.]

II. Context

6. Discuss the internship organisation's nature and context of business.
7. Reflect on the organisational culture at the internship organisation.
8. Appraise the significance and impact of the project/work/assignment undertaken at the internship organisation.
9. Describe the career pathways within the internship organisation as well as the broader industry.
10. Reflect on personal and professional development needs within the internship organisation as well as the broader industry and set strategic goals for advancing along an intended career path.
11. Apply time and task management strategies effectively. [Spend adequate time on the project to ensure rigour, quality and at the same time staying relevant to internship organisation.]

III. Relationship

12. Apply effective written and oral communication skills in professional settings when communicating and connecting with relevant stakeholders. [Communicate (in writing and speaking) scientific and non-scientific ideas effectively to professional scientists and to the general public]
13. Assimilate into the work environment (people, team, hierarchy) and function effectively. [Communicate effectively with team members when working in a group and contribute as a valued team member when working in a group]

IV. Affective/Moral

14. Tolerate ambiguity and handle anxiety.
15. Contribute proactively to the internship organisation.
16. Demonstrate responsibility, integrity and professionalism in the fulfilment of all workplace and internship requirements. [Readily pick up new skills, particularly technology related ones, to tackle new problems.]
17. Demonstrate the persistence to learn, overcome and improve.

V. Technical

18. Use tools that enable and facilitate effective project/work/assignment undertaken at the internship organisation.

C. Course Content

This internship programme, being a work-integrated education course, has its educational content embedded within the work environment and assignments that students will undertake at each internship organisation. For this reason, the internship job scope will be evaluated by the course instructor/coordinator using the following criteria:

- a. It is relevant to the student's discipline of study;
- b. It provides the required internship duration;
- c. It accommodates NTU's internship periods;
- d. It caters to NTU's internship duration requirement;
- e. It provides sufficient structure and rigour that will enable students to achieve the intended learning outcomes listed above;
- f. It provides the appropriate workload for the stipulated internship period;
- g. It enhanced the career prospects of the student;
- h. The internship workplace is safe and conducive for student learning and development;
- i. The internship workplace is equipped with the necessary tools and resources for the internship work;
- j. The internship organisation has standing policies to safeguard the welfare of interns;

- k. The internship organisation supervisor possesses the competencies, experience, and commitment to provide guidance to the students;
- l. The internship organisation will use NTU's internship assessment scheme for students.

D. Assessments

This is a Letter-Graded course with the final outcome determined collectively by your Faculty Supervisor and your Organisation Supervisor.

The assessments will be based on the intended learning outcomes (ILO) in section (B) above and you should familiarise yourself with them as they will be your focus throughout the internship.

Your Organisation Supervisor will assess your performance at the internship workplace through an evaluation form "Assessment of Work in the Organisation" (AWO). He/She will complete this evaluation at the end of your internship.

Your Faculty Supervisor will facilitate and assess your learning, development, and growth through your e-journal submissions. The e-journals are where you will reflect on your experience, learning, growth and achievement of the relevant ILOs. Keep the ILOs in mind throughout your experience and undertake or seek challenges in the workplace that will provide you with opportunities to generate experience and evidences regarding your competencies.

Each week, in your journal, you are to record the tasks you have accomplished and the skills you have acquired in the e-journal. Your weekly entry should be between 200 – 500 words. You are to work out a Gantt chart with your supervisors by the end of week 2 and track your progress.

Component	Course ILOs assessed	Graduate Attributes assessed	Weighting	Team / Individual	Assessment Rubrics
Assessment of Work in the Organisation (AWO). This component evaluates your performance at the workplace.	1, 4, 5, 11, 12, 13, 14, 15, 16, 17, 18	Competency 4-6 1-3,7 only for selected internship Creativity Communications Character Civic Mindedness	20	Individual	See Annex 1 for rubric. Assessed by Organisation Supervisor.
e-Journal 1, 2, 3	1-10, 12, 18	Competency 4-6 1-3,7 only for selected internship Creativity	20	Individual	See Annex 2 and 3 for rubric. Assessed by NTU Faculty Supervisor.

Final Oral Presentation	1-5, 12, 18	Communications Character Civic Mindedness	30	Individual	See Annex 4 Assessed by Organization Supervisor, NTU Supervisor and NTU examiner
Final Thesis	1,4,5, 12, 18		30	Individual	See Annex 5 Assessed by Organization Supervisor, NTU Supervisor and NTU examiner
Total			100%		

	Company supervisor	NTU supervisor	NTU examiner(s)	total
Assessment of work at organization/E-journals	20 (AWO)	20 (e-journals)	NA	40
Final presentation	10	10	10	30
Final thesis report	10	10	10	30
total	40	40	20	100

Graduate Attributes

Upon the successful completion of the PHY, APHY and PHMA programs, graduates should be able to:

<i>Competency</i>	1	demonstrate a rigorous understanding of the core theories and principles of physics involving (but not limited to) areas such as classical mechanics, electromagnetism, thermal physics and quantum mechanics;
		[PHMA only] demonstrate a rigorous understanding of the core theories and principles of mathematical sciences involving (but not limited to) areas such as analysis, algebra and statistical analysis;
	2	read and understand undergraduate level physics content independently;
	3	make educated guesses / estimations of physical quantities in general;
	4	apply fundamental physics knowledge, logical reasoning, mathematical and computational skills to analyse, model and solve problems;
	5	develop theoretical descriptions of physical phenomena with an understanding of the underlying assumptions and limitations;
	6	critically evaluate and distinguish sources of scientific/non-scientific information and to recommend appropriate decisions and choices when needed;
	7	demonstrate the ability to design and conduct experiments in a Physics laboratory, to make measurements, analyse and interpret data to draw valid conclusions.
<i>Creativity</i>	1	propose valid approaches to tackle open-ended problems in unexplored domains;
	2	offer valid alternative perspectives/approaches to a given situation or problem.
<i>Communication</i>	1	describe physical phenomena with scientifically sound principles;
	2	communicate (in writing and speaking) scientific and non-scientific ideas effectively to professional scientists and to the general public;
	3	communicate effectively with team members when working in a group.
<i>Character</i>	1	uphold absolute integrity when conducting scientific experiments, reporting and using the scientific results;
	2	readily pick up new skills, particularly technology related ones, to tackle new problems;

	3	contribute as a valued team member when working in a group.
<i>Civic Mindedness</i>	1	put together the skills and knowledge into their work in an effective, responsible and ethical manner for the benefits of society.

E. Formative Feedback

Continuous feedback on progress and performance can be expected from student's internship organisation supervisor.

Student's faculty supervisor will also provide feedback through the student's internship e-journal submissions and/or site visits.

F. Learning and Teaching Approach

An internship is an experiential learning programme done in a professional setting. Students will be placed in an organisation for the entire internship period and will undertake work assignments and/or projects in the organisation. It is through such work in the real-world environment where students learn and develop the competencies and experiences relevant to the intended learning outcomes of this course.

Each student will be supervised by (1) an Organisation Supervisor at the internship organisation, and (2) a Faculty Supervisor in NTU.

The Organisation Supervisor will be the key person working with and interacting with the student on a day-to-day basis. The Organisation Supervisor will be one providing guidance and feedback to the student on a regular basis.

The Faculty Supervisor from NTU will serve to facilitate student's learning and progress through interactions via e-journal submissions, email, phone, and/or visits. The Faculty Supervisor will also be each student's first point of contact for any matters arising from the internship. Student can also contact the respective Internship Programme Manager at NTU's Career and Attachment Office as an alternative.

G. Reading and References

NTU Student Internship Handbook

Please refer to the respective Professional Internship/Attachment Teamsites via NTU Studentlink for the Internship Handbook.

NTU Work-Integrated Education Blog – WIE ARISE

<https://blogs.ntu.edu.sg/wie-arise/>

Harvard Business Review: 6 Ways to Make the Most of Your Internship

<http://bit.ly/2J81BU2>

Huffington Post: 21 Ways to Make the Most of Your Internship

<http://bit.ly/2kK6Fz5>

Vault: How to Successfully Manage your Assignments:

<http://bit.ly/2LNfrlX>

H. Course Policies and Student Responsibilities

Please refer to the respective Professional Internship/Attachment Teamsites via NTU Studentlink for detailed Internship Policy and Procedures.

Further information can be obtained from NTU's Career and Attachment Office (CAO) via cao_internship@ntu.edu.sg.

I. Professional and Academic Integrity

An internship concerns work in a professional setting. As with good academic work, good professional work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of professional and 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. Refer to this link for details: <http://www.ntu.edu.sg/ai/Pages/shared-values-honour-code.aspx>

As a student, it is important that you recognize your responsibilities in understanding and applying the principles of integrity in all the work you do as a student of NTU. Not knowing what is involved in maintaining integrity does not excuse professional and academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of professional and academic dishonesty, including and not limited to, plagiarism, 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 faculty supervisor if you need any clarification about the requirements of professional and academic integrity in the course.

J. Course Instructors

Your Faculty Supervisor for the period of your internship will be allocated to you after the placement process is completed.

This internship course is managed and administered by your school's internship course coordinator as well as NTU's Career & Attachment Office.

K. Planned Weekly Schedule

Your detail internship work schedule will follow that provided by your Internship Organisation with the following check points with your NTU supervisor.

Week	Key Meetings (with NTU supervisors)	Readings/ Activities
1-4	-	Weekly updating e-Journal
5	Completion of Gantt chart. Review of e-journal and performance in first 5 weeks.	
6-9	-	
10	Review of e-journal and performance in first 10 weeks. First review of progress of FYP project.	
11-19	-	
20	Review of e-journal and performance in first 20 weeks. Second review of progress of FYP project.	
21-28	-	
29	Submission of Final Report.	

30	Presentation of FYP Project / Viva.	
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This internship course outline template is drafted by:

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Annex 1:

Assessment Rubrics for Assessment of Work in the Organisation (AWO)

Criteria for the assessment of student performance in the internship organisation by the organisation supervisor:

ILOs	Focus	Criteria
1	Knowledge and Skills [Scientific approach to problem solving]	Able to apply knowledge and skills (whether prior or newly learned) appropriately in the workplace and/or projects/tasks. [Able to put together analytical, mathematical and/or computational skills to solve quantitative problems.]
4	Problem-solving	Able to solve problems systematically and effectively.
5	Resourcefulness [Awareness of relevant knowledge, skills needed]	Able to source for relevant information to make informed judgement, decisions and/or recommendations. [Able to handle information critically and propose systematic approaches to handling problems.]
11	Time and Task Management	Able to plan, organise, manage and complete assignments effectively and in a timely manner.
12	Written and Oral Communication	Able to communicate effectively and appropriately in writing and verbally
13	Team Work	Able to function effectively with other colleagues/stakeholders in the work environment.
14	Adaptability	Able to function effectively under ambiguity and/or change.
15	Initiative	Able to remain consistently pro-active towards contributing to the work and/or organisation.
16	Responsibility	Consistently demonstrates commitment, responsibility, integrity, professionalism and ethical behaviour at the workplace.
17	Persistence to Learn and Improve [Particularly technological tools.]	Consistently demonstrates persistence and grit to overcome challenges, to learn and improve continuously at the workplace.

18	Fluency with Tools	Able to use tools, whether software or hardware tools, (and learn new ones where necessary) proficiently to accomplish tasks and assignments.
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Annex 2:

Assessment Rubrics for E-Journal 1 and E-Journal 2

You are required to submit a total of two (2) e-journals and one (1) Final e-Journal/Report documenting and reflecting on your internship experience in relation to the relevant intended learning outcomes of this course.

The first two (2) e-journals (E-Journal and E-Journal) will be assessed in week 3 and week 7 during the internship. These are purposed to be formative assessments where you will receive feedback on your progress.

For each of these e-journal submissions, you are to choose three (3) ILOs from the list provided (see the 10 ILOs in section D above) and present evidences and reflections on each one. The e-journal submission link will be provided to you by CAO:

- Evidences can be provided in the form of text descriptions, photographs, or drawings (ensure you seek clearance from your internship organisation should sensitive information be involved).
- Reflect critically on the evidences and the experience producing them, relating them to how they demonstrated your achievement of the specific ILO (or how they helped you to do so): Particularly but should not be limited to - what were the tasks (or observations) and their contexts, actions taken (or lessons drawn) by you and their reasons, and results achieved? What did you learn (e.g. information, knowledge, skills)? Evaluate your own capabilities and attitude where appropriate.
- E-Journal 2 should focus on another 3 ILOs not already covered in E-Journal 1.
- If you wish to provide further evidences and reflections on ILOs which you have covered in an earlier e-journal submission, you are encouraged to do so. Such new evidence(s) and reflection(s) should demonstrate your development and growth.

Criteria for E-Journal 1 (Week 5)

ILOs	Focus	Criteria
1	Knowledge and Skills [Scientific approach to problem solving]	Able to apply knowledge and skills (whether prior or newly learned) appropriately in the workplace and/or projects/tasks. [Able to put together analytical, mathematical and/or computational skills to solve quantitative problems.]

2	Self-awareness and reflection	Able to critically assess one's competency gaps with that required to get the job done.
3	Planning for self-improvement	Able to self-evaluate and develop personal learning and development pathways towards bridging competency gaps identified in point (2) above.
6	Understanding relevance of skills	Able to contextualize skills to work requirements

Criteria for E-Journal 2 (Week 10) - progress update

ILOs	Focus	Criteria
4	Problem-solving	Able to solve problems systematically and effectively.
5	Resourcefulness [Awareness of relevant knowledge, skills needed]	Able to source for relevant information to make informed judgement, decisions and/or recommendations. [Able to handle information critically and propose systematic approaches to handling problems.]
7	Understanding of work environment and culture	Able to observe and understand the organisational culture at the internship organisation.

Focus	Criteria
Evidence for each ILO	Evidence provided is relevant to and supports the ILO.
Reflection on each ILO	Critical and thoughtful reflection on the experience of achieving the ILO. Clear and concise articulation of thoughts.
Achievement of ILO	Conclusive achievement of ILO.

Annex 3:

Assessment Rubrics for Final E-Journal (Week 20)

Your Final E-Journal will be assessed at the end of your internship.

For this final submission, your focus is to cover the remaining 4 ILOs and present evidences and reflections on them. In addition, an overall reflection on your internship experience as a whole is expected:

- Evidences can be in the form of text descriptions, photographs, or drawings (ensure you seek clearance from your internship organisation should sensitive information be involved).
- Reflect critically on the evidences and the experience producing them, relating them to how they demonstrated your achievement of each ILO (or how they helped you to do so): Particularly but should not be limited to - what were the tasks (or observations) and their contexts, actions taken (or lessons drawn) by you and their reasons, and results achieved? How are the achievements validated (by supervisor, colleagues, stakeholders, etc.)? What did you learn (e.g. knowledge, skills)? How will you do things differently and better?
- If you wish to provide further evidences and reflections on ILOs which you have covered in E-Journal 1 and E-Journal 2, you are encouraged to do so. Such new evidence(s) and reflection(s) should demonstrate your development and growth.
- Your overall internship reflection will include but not limited to: Your overall experience in the internship, what are your strengths and weaknesses? Did the experience affirm or revealed them? How will you build up your strengths and reduce your weaknesses? How do you now view this industry and this sort of work? What alternatives will you consider? Knowing what you now know, what are your tentative career plans after graduation? What will you do from this point onwards to put those plans in act?

ILOs	Focus	Criteria
7	Understanding of work environment and culture	Able to observe and understand the organisational culture at the internship organisation.
8	Self-assessment of significance of project in internship organization	Appraise the significance and impact of the project/work/assignment undertaken at the internship organisation.
9	Reflection on Career Options	Describe the career pathways within the internship organisation as well as the broader industry.
10	Self-appraisal of developmental needs	Reflect on personal and professional development needs within the internship organisation as well as the broader industry and set strategic goals for advancing along an intended career path.

Criteria for Final E-Journal submission

Focus	Criteria
Evidence for each ILO	Evidence provided is relevant to and supports the ILO.
Reflection on each ILO	Critical and thoughtful reflection on the experience of achieving the ILO. Clear and concise articulation of thoughts.
Achievement of ILO	Conclusive achievement of ILO.

Overall Internship Reflection	Clear and critical reflection on the internship experience as a whole.

Annex 4: Assessment Rubrics for Final Presentation

Category	Scoring Criteria
Organization	The presentation is appropriate for the topic and audience.
	Information is presented in a logical sequence.
	Presentation appropriately cites references used.
Content	Introduction captures attention; the problem is well defined and establishes a framework for the rest of the presentation.
	Technical terms are well-defined in language appropriate for the target audience.
	Presentation contains accurate information.
	Material included is relevant to the overall message/purpose.
	Appropriate amount of material is prepared and points made reflect well their relative importance.
	There is an obvious conclusion summarizing the presentation.
Presentation	Speaker maintains good eye contact with the audience and is appropriately animated (e.g., gestures, moving around, etc.).
	Speaker uses a clear and audible voice.
	Delivery is poised, controlled, and smooth.
	Good language skills and pronunciation.
	Visual aids are well prepared, informative, effective, and not distracting.
	Length of presentation is within the assigned time limits.
	Content is presented in a clear and concise way.
Q & A	Able to answer questions in a way that reflects a good understanding of the project.

Annex 5: Assessment Rubrics for Final Thesis Report

Category	Scoring Criteria
Organization	Content is organized and presented in a clear, coherent and logical sequence.
	Correct use of referencing throughout, formatted in the correct scientific specification.
	Proper literature review was done and references were properly cited.
	Appropriate use of figures, tables and graphs to communicate data and information.
Content	Clear description of project's objectives, motivations, interpretation and explanation of research approach, process and findings.
	Technical terms are well-defined in language appropriate for the subject area.
	Report contains accurate information.
	Material included is relevant to the overall message/purpose.
	Appropriate amount of material is prepared, and points made reflect well their relative importance.
	Shows clear understanding of key concepts/theories, and interpretation of wider context issues.
	Strong links made between problem statement, claims made, tools used and results.
Difficulty / Originality	Is the project a new initiative, or is it similar to a previous or ongoing project?
	Does the project involve very sophisticated theory or does it require heavy and challenging code development?
	Has the student developed original models or original results, novel and creative application of existing techniques/discovery of new principles?

	Clarity and distinct originality of thought, with clear link to major topics from research materials, as well as important linked topics.	
Effort	The project involves substantial work and intellectual demand befitting of a university final year project.	