

## The Hong Kong Polytechnic University

### Subject Description Form

<b>Subject Code</b>	AAE3S01
<b>Subject Title</b>	Mitigating the STEM Divide through Providing Early Aviation Experiences to Youths
<b>Credit Value</b>	3
<b>Level</b>	3
<b>Pre-requisite/Co-requisite/Exclusion</b>	Undergraduate students under FENG except COMP, who have passed: <ol style="list-style-type: none"> <li>1. AP10001 Introduction to Physics OR AP10005 Physics I; AND</li> <li>2. AMA1110 Basic Mathematics I – Calculus and Probability &amp; Statistics</li> </ol>
<b>Objectives</b>	The objectives of this subject are to: <ol style="list-style-type: none"> <li>1. Introduce to students the concept and practice of service-learning;</li> <li>2. Raise students' awareness of STEM-related learning hurdles faced by youths in underprivileged communities;</li> <li>3. Develop students' scientific thinking and literacy through providing aviation-themed STEM education to youths in underprivileged communities;</li> <li>4. Enhance students' generic competencies of innovative problem solving, communication and teamwork; and</li> <li>5. Nurture students' sense of social awareness, responsibility and engagement through the provision of STEM education services.</li> </ol>
<b>Intended Learning Outcomes</b>	Upon completion of the subject, students will be able to: <ol style="list-style-type: none"> <li>a. Explain the concepts of STEM divide and the hurdles and challenges faced by underprivileged students;</li> <li>b. Apply aviation-related STEM concepts and theories acquired in class to design innovative STEM programmes to mitigate the STEM divide;</li> <li>c. Reflect on their role and responsibilities as a professional in STEM-related fields and as a responsible citizen;</li> <li>d. Demonstrate empathy for the underprivileged students facing STEM divide, and a strong sense of social responsibility; and</li> <li>e. Demonstrate an understanding of the linkage between the service-learning and their understanding of STEM knowledge.</li> </ol>
<b>Subject Synopsis/ Indicative Syllabus</b>	The topics in the course syllabus cover three major areas: <ol style="list-style-type: none"> <li>1. Concept and practice of service-learning <ol style="list-style-type: none"> <li>(i) Understand the social responsibility</li> <li>(ii) Proper attitude and behaviours in service delivery</li> <li>(iii) Reflection as a tool for learning</li> </ol> </li> </ol>

	<ul style="list-style-type: none"> <li>(iv) Ethical issues in service-learning</li> </ul> <ol style="list-style-type: none"> <li>2. Discipline-specific concepts, issues, and skills <ul style="list-style-type: none"> <li>(i) Financial, cultural and socioeconomic challenges in aviation and STEM learning of underprivileged students</li> <li>(ii) Aviation-related concepts in Mathematics and Applied Physics</li> <li>(iii) STEM-pilot ground theory material preparation and delivery</li> <li>(iv) Engineering design knowledge in aviation</li> <li>(v) Ergonomics and safety awareness in flight simulator experiences</li> <li>(vi) Understanding and appreciation of basic flight operations and the theorem</li> </ul> </li> <li>3. Project-specific concepts, issues and skills <ul style="list-style-type: none"> <li>(i) Skills in communicating and facilitating adolescents' learning</li> <li>(ii) Skills in STEM workshop planning and management</li> <li>(iii) Skills in instructional material development for innovative STEM workshops</li> <li>(iv) Moral and ethical concerns specific to the service project and beneficiaries</li> </ul> </li> </ol>
<p><b>Teaching/Learning Methodology</b></p>	<p>The following teaching and learning methodology will be used:</p> <ol style="list-style-type: none"> <li><b>1. E-learning of service-learning</b> <p>The e-learning module is developed and delivered by the Service-Learning and Leadership Office at PolyU, consisting of readings, exercises and assessments that are designed to introduce students to the basic concept and practice of service-learning.</p> <p>Students are required to successfully complete the e-learning module within the first three weeks of the semester in which they are taking the subject.</p> </li> <li><b>2. E-learning of aviation-related knowledge</b> <p>The e-learning module is developed and delivered by the academic staff of the Department of Aeronautical and Aviation Engineering, consisting of readings and assessments that are designed to introduce students to the basic background and principles related to aviation.</p> <p>Students are required to successfully complete the e-learning module within the first 3 or 4 weeks of the semester (refer to the teaching plan of each semester) in which they are taking the subject.</p> </li> <li><b>3. Discipline-specific lectures</b> <p>The lectures and seminars will be designed and conducted by the academic staff of the Department of Aeronautical and Aviation Engineering. They are designed to illustrate the STEM education contents, scientific thinking and the impact of scientific literacy on society.</p> </li> </ol>

#### **4. Project-specific workshop and seminars**

The workshops and seminars will be designed and conducted by the academic staff of the Department of Aeronautical and Aviation Engineering, and domain experts (e.g., pilots, training instructors and licensed trainers and engineers in aviation and social workers). They are designed to develop students' understanding of the background and challenges in aviation-themed STEM education, pilot ground theory and service beneficiaries. Students will also be equipped with skills in workshop planning and management, and instructional material development.

#### **5. Service-learning project**

To help mitigate the STEM divide, students will work in small groups and provide STEM education through aviation-themed activities in the respective service recipients' schools.

The service-learning project consists of four main components.

- (i) Tutoring on STEM knowledge using aviation-related knowledge as a vehicle: The focus of the project will be on teaching and learning STEM concepts and theories while cultivating knowledge transfer and scientific thinking.
- (ii) Flight simulator experience using the simulators in Aviation Engineering Laboratory, Department of Aeronautical and Aviation Engineering, or other virtual reality (VR) tools: It emphasises on students' practice and hand-on experience using the flight simulator.
- (iii) Project competition in small aircraft design: The student project competition emphasises on students' engineering practices and design skills, and nurtures future younger generation interests in STEM via aviation-themed activities and develops students' sense of knowledge transfer.
- (iv) Reflection and/or debriefing sessions are held after each service day. Students are required to reflect and consolidate their experiences during the service deliveries in these sessions.

#### **6. Reflective journal and group presentation**

Reflective assessment is essential and appropriate for service-learning subjects. Therefore, upon completion of the service-learning project, students will be required to submit reflective journals to demonstrate their reflection from the service. The students shall review and discuss how the service inspires them as a lifelong learner, and their role on societal issues with regard to their profession. Documentary reflections help students to

	<p>organise their thoughts and identify their learning gains, areas for improvement and future action plans.</p> <p>Other than the reflective journal, students shall also make a presentation on a group basis. The presentation requires the students to summarise their work prepared for the service, the deliverables provided to the students, and the personal growth gained through the service. There are four key items that students shall present, including (1) what they have done in the service project, (2) what they have learnt in the service project, (3) what they have accomplished in the service project, and (4) how the service project could be improved. Like a usual academic presentation, this component will be assessed in terms of both the content and delivery. A group presentation presents their work beyond the individual reflective journal. It is emphasised on the group effort as a whole: not only individual reflection but a forum for learning through their peers as well.</p> <p>Remarks: Students are required to attend all of the lectures, seminars and workshops, and complete all of the required assignments and learning tasks before the service-learning project.</p>
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**Assessment Methods in Alignment with Intended Learning Outcomes**

(Note 4)

Students' performance in this subject will be assessed using a letter-grading system in accordance with the University's convention from grade F (failure) to A+. The relative weighting of the different assessment components are as follows:

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)				
		a	b	c	d	e
1. E-learning module on service-learning (individual)	Pass/Fail			✓	✓	
2. E-learning module on aviation-related knowledge (individual)	Pass/Fail		✓			
3. Service proposal and teaching material preparation (group)	20%	✓	✓		✓	✓

4. Service preparation performance (individual)	10%		✓			
5. Service performance (individual)	40%	✓	✓	✓	✓	✓
6. Reflective journal (individual)	20%			✓	✓	✓
7. Presentation (group)	10%		✓	✓	✓	✓
Total	100 %					

Students must obtain a pass in all of the components in order to pass the subject.

*Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:*

E-learning module on service-learning

The E-Learning Module on Service-Learning will include learning tasks that are designed to assess students' ability to link service-learning with the academic content of the subject through serve-to-learn and learn-to-serve (ILO c and d).

E-learning module on aviation-related knowledge

The E-learning Module on aviation-related STEM knowledge is designed to let students understand more on the principles and background of airport services in different areas in terms of design and engineering. In addition to the knowledge acquired in the lectures, the E-Learning module will further deepen students' understanding of the necessary concepts to design and create a set of teaching materials that can help mitigate the STEM divide (ILO b).

Service proposal and teaching materials preparation

Students will be asked to write service proposals for the workshop and design their own set of teaching materials for their STEM tutoring sessions in accordance with the proposal. These proposals and teaching materials will be assessed based on how well students demonstrate their understanding of the learning hurdles of underprivileged youths in Hong Kong (ILO a), their understanding of aviation-related STEM knowledge (ILO b), and their ability to use different teaching methodologies to engage students who face learning hurdles in STEM (ILO d and e).

### Service preparation performance

Before the service provision, students shall demonstrate their awareness in identifying the learning hurdles of youths in underprivileged communities so that they can prepare adequate teaching materials for the service beneficiaries (ILO b). While students will be assessed individually, they need to work in groups to deliver their service. Hence, they shall show their ability to work in teams with innovative problem-solving skills and effective communication.

### Service performance

Students will form groups and work with our service recipients together in the small aircraft design project. To stimulate the service recipients' interests in STEM using aviation as a vehicle, the project aims to develop their knowledge in engineering. Students are expected to understand their service beneficiaries' learning hurdles (ILO a), then to apply knowledge of design, mathematics, physics, technology, and engineering in the project (ILO b). Students are expected to lead the service recipients to achieve the learning goals together (ILO c).

The students' attitude and performance in the rendering of services, the degree of engagement with service recipients, collaboration with other students and service recipients, leadership skills and communication skills, professional ethics and their empathy for people in need are the key indicators of the service performance (ILO c and d). Throughout the project, students shall actively serve-to-learn and learn-to-serve, linking service-learning and the academic content of the subject (ILO e).

### Reflective journal

In addition to those outcomes fulfilled by the service proposal, teaching content preparation and engineering design project in a group effort, an individual reflective journal is one of the key personal records of students' learning experiences. Students shall reflect on their position and role as a future young professional in STEM-related fields (ILO c and d), as well as how they practiced empathy during the service. The writing should highlight the relationship between aviation, STEM, the problems they are addressing through the service project, and most importantly, demonstrate a sense of social awareness and engagement with the importance of societal responsibility and knowledge transfer (ILO c and d). Under the concept of service-learning, students are not only expected to learn how to serve the community, they also need to gain novel insights to their whole person development via the serve-to-learn approach (ILO e). The reflective journal shall be concise in 2-3 pages for clear illustration of deep reflection.

### Presentation

The presentation requires the students to summarise their work prepared for the service, the deliverables, and the personal growth gained through the service. There are four key items that students shall present, including (1) what they have done in the service project, (2) what they have learnt

	in the service project, (3) what they have accomplished in the service project, and (4) how the service project could be improved. The key focus of the presentation is to require students to reflect and review their experience in the project (ILO b and c), so sharing with case examples rendered during the service delivery shall be present (ILO d and e).	
<b>Student Study Effort Expected</b>	E-learning module on service-learning	10 Hrs.
	E-learning module on aviation-related knowledge	10 Hrs.
	Class contact:	
	▪ Discipline-specific lectures	9 Hrs.
	▪ Project-specific workshop and seminars	12 Hrs.
	▪ Reflection, review tutorials, and consultation sessions	6 Hrs.
	Other student study effort:	
	▪ Planning and preparation for the service project	20 Hrs.
	▪ Direct rendering of service	40 Hrs.
	▪ Reflection and review	27 Hrs.
	Total student study effort	134 Hrs.
<b>Reading List and References</b>	<ol style="list-style-type: none"> <li>1. Cress, C.M., Collier, P.J. &amp; Reitenauer, V.L., 2005, <i>Learning Through Serving: A Student Guidebook for Service-Learning Across the Disciplines</i>, Stylus Publishing.</li> <li>2. Hazen, R., Trefil, J., 2009, <i>Science Matters: Achieving Scientific Literacy</i>, Anchor.</li> <li>3. Education Bureau. (2016). Report on promotion of STEM education.</li> <li>4. Hong Kong Federation of Education Workers. (2017). STEM teacher support policy analysis.</li> <li>5. Oxford ATPL Manual 9 - Meteorology – EASA, Latest Edition, Oxford Publishing.</li> <li>6. Oxford ATPL Manual 8 - Human Performance &amp; Limitations - EASA, Latest Edition, Oxford Publishing.</li> <li>7. Paul E, Illman, <i>The Pilot's Handbook of Aeronautical Knowledge</i>, latest edition, Latest Edition, McGraw-Hill, New York.</li> <li>8. Helfrick, A., <i>Principles of Avionics</i>, 9th Edition, Avionics Communications, 2015.</li> <li>9. Kermode, A.C., Philpott, D.R., &amp; Barnard, R.H. (2012). <i>Mechanic of Flight</i>, 12th Edition, Pearson Education Limited.</li> </ol>	