Subject Description Form

Subject Code	AAE1001
Subject Title	Introduction to Artificial Intelligence and Data Analytics in Aerospace and Aviation Engineering
Credit Value	2
Level	1
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	The subject will provide students with 1. An overview and introduction of the basic concepts and techniques of intelligent automation and artificial intelligence in aerospace, aeronautical and aviation engineering; 2. The applications of data analytics in intelligent automation and artificial intelligence in the domain; and 3. Operational challenges, technological limitations, emerging technologies and future directions.
Intended Learning Outcomes *(Note 1)*	Upon completion of the subject, students will be able to: (i) Demonstrate an understanding of the foundational concepts of Artificial Intelligence and Data Analytics (AIDA); (ii) Acquire basic skills in using AIDA technologies and applications; (iii) Articulate examples of how the adoption AIDA could enhance their understanding on aeronautical and aviation engineering; and (iv) Demonstrate an awareness of global contemporary ethical issues and impact from AIDA applications in daily life.
Subject Synopsis/ Indicative Syllabus *(Note 2)*	The subject covers the following topics. Fundamental and the elements of statistical learning – variable types, terminology, statistical decision theory, statistical models. Introduction to model nature and selections in aerospace, aeronautical and aviation engineering – regression, classification, smoothing methods, model assessment and selection, model inference and averaging, decision trees, neural networks, prototype methods, nearest-neighbours. Overview of supervised learning in aerospace, aeronautical and aviation engineering – linear models, least squares, nearest-neighbour methods, structured regression models..

	Overview of unsupervised learning in aerospace, aeronautical and aviation engineering – association rules, cluster analysis, independent component analysis, random forests. Case studies on aeronautical engineering with AI technologies – UAS concept, UAV path planning, brief introduction of autonomous flights, brief introduction of AI in aircraft system and their global impact and contributions to social sustainability and urban air mobility and smart city. Case studies on aviation engineering with AI technologies – delay and delay propagation prediction, air route network analysis, safety analysis, and understanding the importance of aviation safety and airline social responsibility. Data compliances, ethical issue in data analytics, handling sensitive data, corporate data and customer profile – importance of non-disclosure agreement, protection against unintended or intended consequences of the use of data and results of the data analytics, human rights and privacy (e.g. aerial photography, leakage of airline customer data, unauthorised use of passengers' behaviour data for promotion). Legal and ethical consideration in artificial intelligence in aerospace and aviation engineering – Global legislations and safety considerations from ICAO, civil aviation authority and airworthiness, human equality in space exploration, responsibility of unexpected events, incidents and accident, and bias in the use of AI.
Teaching/Learning Methodology *(Note 3)*	**1. e-Learning Module** The e-learning module is developed and delivered by the Department of Computing at PolyU, consisting of readings, exercises and assessments that are designed to introduce students to the basic concept and practice of AIDA. The e-learning module will provide basic foundation concepts about AIDA, as well as their potential global and societal context impacts. A brief understanding about the technology and applications will also be provided. Students are required to successfully complete the e-learning module (including video watching, an after-class exercise, and a lab with the AIDA interactive playground) within the first seven weeks of the semester in which they are taking the subject. **2. Lectures and Laboratories** Lectures are used to deliver the fundamental knowledge in relation to various aspects of machine learning, data mining, data analytics, data-driven optimisation and artificial intelligence in airline and airport operations.

Several laboratories will be made available to equip students with the basic knowledge of data mining, soft computing, optimisation and artificial intelligence in solving aerospace, aeronautical and aviation engineering problems.

Given the basic knowledge of data science, a group mini project will be used to help students deepen their knowledge of a specific topic through literature study, methodology study, analysis of data, dissemination of research findings and report writing.

Teaching/Learning Methodology	Intended subject learning outcomes to be covered			
	(i)	(ii)	(iii)	(iv)
1. E-Learning module	✓	✓	✓	
2. Lecture	✓	✓	✓	✓
3. Laboratory	✓	✓	✓	✓

Assessment Methods in Alignment with Intended Learning Outcomes

(Note 4)

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed			
		(i)	(ii)	(iii)	(iv)
1. e-Learning module	15%	✓	✓	✓	
2. Assignment	25%	✓	✓	✓	✓
3. Laboratory	35%	✓	✓	✓	
4. Group project and presentation	25%	✓	✓	✓	✓
Total	100%				

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

The continuous assessment (100%) is aimed at enhancing the students' comprehension and assimilation of various topics of the syllabus via assignment, several laboratory teaching and laboratory report, numerical analysis, reading assignment. In particular, group projects are used to assess the students' capacities of self-study and problem-solving and effective communication skills in English so as to fulfil the requirements of working in the aviation industry. Assignment and laboratory will be conducted to evaluate the students' performance in problem selection, artificial intelligence design for satellite, aerospace and aviation engineering. E-Learning

	module aims to equip students with the basic concept and practice of AIDA.	
Student Study Effort Expected	**e-Learning module**	3 Hrs.
	Class contact	
	▪ Lecture	26 Hrs.
	Other student study effort	
	▪ A Literature review / Scientific finding and analysis / final report writing preparation / presentation material preparation	24 Hrs.
	▪ Self-study	24 Hrs.
	Total student study effort	77 Hrs.
Reading List and References	Barber, D. (2012). *Bayesian reasoning and machine learning*. Cambridge University Press. Cormen, T. H., Leiserson, C. E., Rivest, R. L., & Stein, C. (2009). Introduction to algorithms: MIT press. De Neufville, R., & Odoni, A. (2003). Airport systems. planning, design and management. New York: McGraw-Hill. Guido, S., & Müller, A. (2016). *Introduction to machine learning with python* (Vol. 282). O'Reilly Media. Marsland, S. (2015). *Machine learning: an algorithmic perspective*. CRC press. Wallwork, A. (2016). English for writing research papers: Springer. Wells, A. T. (2007). *Air transportation: A management perspective*: Ashgate Publishing, Ltd. Wu, C.-L. (2016). *Airline operations and delay management: insights from airline economics, networks and strategic schedule planning*: Routledge.	

June 2023