The Hong Kong Polytechnic University

Subject Description Form

Subject Code	ABCT4635
Subject Title	Laboratory Quality Management Systems and Automation for Analytical Sciences
Credit Value	3
Level	4
~~Pre-requisite~~/ Co-requisite/ ~~Exclusion~~	ABCT4708 Principle of Quality Assurances / ABCT4633 Quality Management and Laboratory Accreditation.
Objectives	This subject aims to equip students with a comprehensive understanding of laboratory automation within the framework of laboratory quality management systems. Students will gain proficiency in utilizing Laboratory Information Management Systems (LIMS) and related software to enhance laboratory operations, including sample tracking, data management, and quality control. The subject covers regulatory compliance, data integrity, and best practices for reporting, while emphasizing workflow optimization and resource utilization through LIMS integration. Learners will develop skills in troubleshooting, report and dashboard customization, and ensuring data security and confidentiality. Additionally, students will be prepared to train laboratory staff on LIMS functionalities and evaluate suitable LIMS solutions based on organizational needs, budget, and scalability, fostering efficient and effective laboratory management.
Intended Learning Outcomes	Upon completing this subject, students will be able to: (a) Demonstrate comprehension of fundamental principles of laboratory information [quality] management systems; (b) Create and implement protocols for laboratory workflows and processes through integration of LIMS; (c) Analyze/interpret analytical laboratory informatics obtained by automated data-collection systems effectively toward improved productivity and resources utilization; (d) Integrate and critically review the analytical data and informatics through machine learning methods; (e) Identify and solve real-world laboratory informatics and automation challenges.

Subject Synopsis/ Indicative Syllabus	**Fundamental Principles of Laboratory Information Management Systems (LIMS) and Laboratory Automation** • Overview of LIMS and automation • Historical development & components of LIMS • Benefits of implementing LIMS and automation **Core components of LIMS and Laboratory Automation** • Protocols for laboratory workflows • Sensors, actuators and controllers in laboratory automation • Basics of robotic systems • Common communication protocols **Digital Transformation and Internet of Things (IoT) Fundamentals for LIMS and Laboratory Automation** • IoT architecture: sensors, gateways, cloud platforms, etc • Cloud-based solutions on laboratories • Data security in IoT-enabled laboratories **Quality Assurance and Compliance with International Standards** • Quality Assurance and Control • ISO/IEC 17025 • ISO 15189 **LIMS Integration and Data Management** • Inventory Management • Personnel and Training • Equipment Management and Maintenance • Data Management, Analysis, Decision Making and Reporting **Integrating Artificial Intelligence (AI) in solving real-world LIMS and Laboratory Automation** • Introduction to AI/ Machine Learning • Automated data collection • Use of progamming language such as Python and GenAI in setting up laboratory automation • Integration with various instrumentation • Application of AI in data analysis and visualization for compliance in real-world cases
Teaching/Learning Methodology	The subject will be delivered mainly through lectures and tutorials. The lectures will be conducted to introduce the basic concepts of the topics in the syllabus which are then reinforced by learning activities involving demonstration and tutorial exercise. Students should complete exercises and hands-on activities using a range of AI, data analytics, and generative AI tools. The e-learning materials consisting of readings, exercises and assessment will be designed and delivered to introduce students to the basic concept and practice of LIMS. *Lectures* will provide fundamental knowledge (i.e., the concepts, technologies, and methods) of data analytics. W*orkshops* will be arranged for students to apply the learned knowledge and principles into students' own data analytics trials.

	Group/individual projects will be assigned to students to develop students' ability to define problems; students will have hands-on experience to acquire essential techniques to identify and solve real-world laboratory informatics and automation challenges. To promote student engagement, *in-class participation* is essential in discussions during lectures and workshops.
Assessment Methods in Alignment with Intended Learning Outcomes	

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)				
		a	b	c	d	e
1. Class participation	10%	✓	✓			
2. Pre-workshop Quizzes	30%	✓	✓	✓		
3. Project report	20%	✓	✓	✓	✓	✓
4. Project presentation	40%	✓	✓	✓	✓	✓
Total	100%					

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

In-class participation: Students are expected to attend face-to-face classes and complete in-class exercises assigned during the lectures. To engage students' learning, in-class discussion during the lectures and workshops will be used to assess students' comprehension of the topics and readiness for the practical training of workshop.

Pre-workshop Quizzes: Students are expected to study the online materials and pre-reading before attending the face-to-face workshops. The students' readiness will be assessed by on-site quizzes. Students who are unable to have satisfactory performance in the quizzes may be disqualified for workshop attendance.

Group/individual projects: Students will be assessed throughout the duration of the project. The project is assessed by the approach of work, achievement of proposed objectives, planning and execution of work, quantity and quality of the research and information reviewed, interpretation and analysis of results and presentation of findings. The student's ability to write a comprehensive essay report and present results in an effective, skillful and professional manner will be evaluated. The assessment will be based on the final written report as well as the oral presentation.

Student Study Effort Required	Class contact:	
	▪ Lecture	18 Hrs.
	▪ Tutorial	3 Hrs.
	▪ Workshops	18 Hrs.
	Other student study effort:	
	▪ Projects	80 Hrs.
	Total student study effort	119 Hrs.

Reading List and References

Textbook:

Paszko C, Elizabeth Turner, E., Paszko, P.,	Laboratory Information - Management Systems, 2nd - Edition	New York: Marcel Dekker 2002

References:

Moumtzoglou, Anastasius, Kastania, Anastasia, Archondakis	Laboratory Management -Information Systems Current Requirements and Future Perspectives (Advances in Healthcare Information Systems and Administration)	IGI Global 2014
郭华	疾病预防控制中心实验室信息管理系统 - Laboratory information management system of the centers for disease control and prevention	清华大学出版社 2020
ISO	ISO 15189:2022 Medical laboratories — Requirements for quality and competence	2022
ISO/IEC	ISO/IEC 17025:2017 General requirements for the competence of testing and calibration laboratories	2017