

Subject Description Form

Subject Code	BSE5522
Subject Title	Commissioning and Reliability of Facilities
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Basic knowledge in probability, statistics and calculus needed and knowledge in building services engineering preferable
Objectives	<p>The subject comprises two parts: commissioning and reliability, with emphasis on engineering facilities in modern buildings. Commissioning ensures plants will perform as designed while ensuring the plants will continue to perform reliably requires well managed and executed operation and maintenance that are based firmly on reliability concept.</p> <p>The subject aims to provide students with a clear understanding of contemporary practices of testing and commissioning and relevant standards and guidelines; and reliability concepts and their application to maintenance planning and management.</p>
Intended Learning Outcomes	<p>Upon completion of the subject, students will be able to:</p> <ol style="list-style-type: none"> a. understand the purpose of testing and commissioning and basic measurement methods for plant performance verification; b. identify relevant standards and guidelines for testing and commissioning of major services systems in buildings, the responsibilities of the involved parties and the provisions needed for the works; c. analyze the impacts of measuring instruments and measurement methods on uncertainties of measurement; d. evaluate component and system reliability and availability from failure and repair statistics; e. investigate the mode, effect and criticality of component and system failures and means for enhancing system reliability; and f. appreciate the application of reliability concepts to maintenance management.
Subject Synopsis/ Indicative Syllabus	<p>The subject comprises two parts:</p> <p>Part 1 – Commissioning</p> <ul style="list-style-type: none"> • Purpose of testing and commission (T&C); T&C standards and guidelines; parties responsible for T&C and their roles; T&C records; re-commissioning; • Instrumentations and methods for performance measurement and verification (M&V) for major building services equipment and systems; • T&C methods for major building services systems;

	<ul style="list-style-type: none"> • Methods for quantification of uncertainties in measurements and their implications to planning of T&C and M&V processes. <p>Part 2 – Reliability</p> <ul style="list-style-type: none"> • Basic mathematical concepts and tools; failure and repair rates; reliability and availability; mean time between failures; • Reliability and availability models for components in series and in parallel with and without standby components; • Reliability block diagram, failure tree and failure mode, effect and criticality analyses for systems; • Introduction to reliability-centered maintenance; practical limitations.
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Teaching/Learning Methodology	<p>The subject will be covered by a range of teaching and learning (T&L) activities, which include interactive lectures, tutorials, a workshop and student-led seminar, and an in-class test. All topics in the syllabus will be covered in the lectures, which will emphasize on fundamental principles and their applications. A study guide will be issued to each student to provide them with a concise summary of the materials covered by the subject and relevant references from which to find more detailed and in-depth materials.</p> <p>The workshop is for students to work in groups to develop a topic on testing and commissioning practices, and to develop the approach for exploring into the topic, including a collaboration plan for sharing the work among the group members, which will yield the needed materials for a seminar presentation. At the end of the workshop, each group shall submit a brief work plan that describes the chosen topic, the key issues to be explored and how the work would be shared among group members. They should then proceed with their work and present their findings to the class in the session reserved for the seminar.</p> <p>For the part on reliability, tutorial problem sheets will be issued and some of the problems will be solved in the tutorial sessions as worked examples to supplement the lectures and reinforce understanding. Other tutorial problems are for students to tackle during the tutorial sessions and at home. The in-class test will be used to obtain feedback on students' progress in this part, especially on their ability to handle the mathematical analysis techniques.</p>
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Assessment Methods in Alignment with Intended Learning Outcomes	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2" style="width: 25%;">Specific assessment methods/tasks</th> <th rowspan="2" style="width: 10%;">% weighting</th> <th colspan="6">Intended subject learning outcomes to be assessed (Please tick as appropriate)</th> </tr> <tr> <th style="width: 5%;">a.</th> <th style="width: 5%;">b.</th> <th style="width: 5%;">c.</th> <th style="width: 5%;">d.</th> <th style="width: 5%;">e.</th> <th style="width: 5%;">f.</th> </tr> </thead> <tbody> <tr> <td>1. Workshop and seminar</td> <td>30%</td> <td style="text-align: center;">✓</td> <td style="text-align: center;">✓</td> <td style="text-align: center;">✓</td> <td></td> <td></td> <td></td> </tr> <tr> <td>2. In-class test</td> <td>20%</td> <td></td> <td></td> <td></td> <td style="text-align: center;">✓</td> <td style="text-align: center;">✓</td> <td></td> </tr> <tr> <td>3. Examination</td> <td>50%</td> <td style="text-align: center;">✓</td> <td style="text-align: center;">✓</td> <td style="text-align: center;">✓</td> <td style="text-align: center;">✓</td> <td style="text-align: center;">✓</td> <td style="text-align: center;">✓</td> </tr> <tr> <td>Total</td> <td>100%</td> <td colspan="6"></td> </tr> </tbody> </table> <p>Explanation of the appropriateness of the assessment methods in assessing</p>							Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)						a.	b.	c.	d.	e.	f.	1. Workshop and seminar	30%	✓	✓	✓				2. In-class test	20%				✓	✓		3. Examination	50%	✓	✓	✓	✓	✓	✓	Total	100%						
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	<p>the intended learning outcomes:</p> <ul style="list-style-type: none"> i) The workshop and seminar provide students with flexibility to explore into a specific T&C topic and to share their experience, which is considered the most appropriate T&L approach for the part on T&C that require sourcing for a wide range of reference and formulation of critical comments on current practices; ii) The in-class test is for obtaining feedback on individual students' understanding of the mathematical methods and their ability to apply the methods to analyses of reliability problems; iii) The examination is for testing comprehensively how well the students have achieved the intended learning outcomes of the whole subject as listed above.
<p>Reading List and References</p>	<p>Energy Design Resources. Building Commissioning Guidelines. Pacific Gas and Electric Company [Available from http://www.energydesignresources.com].</p> <p>EVO. <i>International Performance Measurement and Verification Protocol</i>. Efficiency Valuation Organization, 2012.</p> <p>Lewis EE. (1996). <i>Introduction to reliability engineering</i>, 2nd Ed. New York: John Wiley & Sons, Inc.</p> <p>Lyonnet P. (2012). <i>Maintenance Planning Methods and Mathematics</i>. Springer.</p> <p>O'Connor PDT, Newton D, Bromley R. (2012). <i>Practical Reliability Engineering</i>, 5th Ed. NJ: John Wiley & Sons, Inc.</p> <p>PECI (2017). <i>Functional testing and design guide</i>, Portland Energy Conservation Inc. (Available from http://www.peci.org/ftguide/)</p> <p>Relevant ASHRAE, BSRIA & CIBSE publications on commissioning.</p> <p>Sundararajan C. (1991). <i>Guide to Reliability Engineering – Data, Analysis, Applications, Implementation, and Management</i>. New York: Van Nostrand Reinhold.</p> <p>Testing and commissioning procedures for various building services system in government buildings, published by Architectural Services Department, The Hong Kong SAR Government.</p> <p>Yik FWH (2010). <i>A Study Guide on Commissioning & Reliability of Facilities</i>. Department of Building Services Engineering, The Hong Kong Polytechnic University.</p>