Subject Description Form

Subject Code	**BSE4413**
Subject Title	**Indoor Air Quality Engineering**
Credit Value	3
Level	4
Pre-requisite Co-requisite Exclusion	BSE3223Air-Conditioning and Ventilation or BSE3225 HVACR I or equivalent Nil Nil
Objectives	In modern society, people spend most of their time in indoors. Since 1990s indoor air quality (IAQ) engineering has become a multidisciplinary practice, and IAQ has become one of the key objectives of a healthy building design. IAQ is a complex issue. There are multiply factors that affect IAQ, and multidisciplinary approach is involved to solve IAQ problems. In this subject, lectures and student-centred learning, including seminars, laboratory and field tests, video-taped real cases will be used in combination, allowing the student to explore the multidisciplinary nature of IAQ Engineering.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a) understand the major factors affecting IAQ and to be aware of the associated health impact and health risks of indoor air pollution; b) identify good IAQ as the major design objective and bring the best practice into building environment design; c) examine design, operation and maintenance practices in relation with IAQ objectives; d) work as IAQ practitioners to investigate problematic buildings and recommend mitigation measures; e) incorporate IAQ management in an overall facility management scheme; and f) work in a multidisciplinary team to cope with emerging IAQ problems.
Subject Synopsis/ Indicative Syllabus	**Indoor environment:** Historic perspective of IAQ and its health impacts. Factors affecting indoor air quality, thermal comfort, lighting and noise aspects. Human psychological and physiological aspects. Building related illness (BRI), Sick Building Syndrome (SBS). Children Allergy / asthma. **Indoor air quality:** Legislation and standards. World Organisation review of indoor air pollutants of concern. Rationales of Hong Kong Outdoor Air Quality Objective, Hong Kong IAQ certification scheme, and National Ambient Air Quality of US EPA. Health effects and risks of air pollutants. Occupational pollutant exposure standard vs. ambient air quality standard. **Indoor air pollutants:** Gaseous pollutants, Volatile Organic Compounds (VOCs), formaldehyde, radon, airborne particulates and biological contaminants. Modelling analysis of indoor air pollutants. Sources and emission strengths. Airborne pollutant decay/deposition mechanisms. Aerosol dynamics and infectious disease transmission in indoor environments. **Moisture control and mould/fungi growth indoors:** Introduction to microbiology, life cycle of moulds and mould spore, moisture and humidity dynamics in building space and materials. **Ventilation and indoor air movement:** ASHRAE standard of ventilation, air flow inside and around buildings, ventilation effectiveness, air flow pattern and inhaled air quality, short circuiting of fresh air supply, draft and cold air dumping problems in air-conditioned spaces. **Use of Instrumentation and measurement techniques in IAQ Management:** Air change rate measurement, ventilation effectiveness measurement and indoor air pollutant concentration measurement. Emission strength measurement using chamber technique. Procedures of IAQ Audit. Diagnosis of problem buildings.

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Air cleaners: Principle of air disinfection in air and on surfaces by various techniques and their pros and cons, health impacts – photo-catalytic oxidation, ozone, ultra violet radiation, filtration, herbal extracts, plasma and etc.

Control measures: Regulatory control, control techniques, improved IAQ by air-conditioning system design, indoor fitting out and material selection. Removal of indoor contaminants at sources, improved maintenance management.

Smart management: Deployment of state of the arts technology in for knowledge based IAQ management, cross infection control management against communicable disease.

Analytic tools: Introduction of computational fluid dynamics (FLUENT) and CONTAM.
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<tr><td>Teaching/Learning Methodology</td><td>
In this subject, lectures serve to introduce the students into this multi-disciplinary field, and the major mass-balance and transport models are introduced. Written assignments are used to engage the students to undertake independent analysis, literature review and problem solving.

Video-taped real cases are used to give the student a large picture of IAQ, laboratory visit and instrument demonstration by technicians let the students experience the capabilities of state of the art instruments. Student-led seminars, covering a wide range topics prescribed by the subject examiner, allow the student to explore the multidisciplinary nature of IAQ Engineering.
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<tr><td>Assessment Methods in Alignment with Intended Learning Outcomes</td><td>
<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="6">Intended subject learning outcomes to be assessed (Please tick as appropriate)</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td><td>f</td></tr>
<tr><td>Test</td><td>20</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td></td><td></td></tr>
<tr><td>Seminar presentation and report</td><td>20</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Coursework*</td><td>60</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Total</td><td>100</td><td colspan="6"></td></tr>
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* For details, please refer to the 2020/21 Semester 1 Subject teaching scheme/schedule.

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:
1. Test serves the learning outcome in the first 4 aspects;
2. While the seminar serves best to encourage students' involvement in questions and discussions, addressing the multi-disciplinary nature of the subject.
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Student Study Effort Expected	Class contact:	
	▪ Lectures	24 Hrs.
	▪ Seminars	9 Hrs.
	▪ Tutorials	4 Hrs.
	▪ Lab visit	2 Hrs.
	Other student study effort:	
	▪ Reading	31 Hrs.
	▪ Literature Review, Seminar Presentation and Report	50 Hrs.
	Total student study effort	120 Hrs.
Reading List and References	ASHRAE Standard 62.1-2010 (2010), Ventilation for Acceptable Indoor Air Quality. Environmental Protection Agency (1991). Building Air Quality: A Guide for Building Owners & Facility Managers. Diane Pub. World Health Organization, WHO/UNEP (2000). Guidelines for Air Quality, Geneva, World Health Organization. HKEPD Indoor Air Quality Information Centre (2003). Indoor air quality certification scheme for offices and public places. Hong Kong Environmental Protection Department, the Government of the Hong Kong Special Administrative Region, China. Environmental Protection Agency (1994). Indoor Air Pollution - An Introduction for Health Professionals, EPA. WHO/UNEP (1990). Indoor environment - Health aspects of air quality, thermal environment, light and noise. Geneva, World Health Organization.	