Subject Description Form

Subject Code	BSE542
Subject Title	Energy Efficient Buildings
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Students who had previously taken the subject of BSE4417 are excluded. Students with background knowledge about building physics and building energy systems, such as thermal properties of building envelops and air condition systems, are preferred.
Objectives	To provide students with an overall view of energy use patterns in buildings, particularly large air-conditioned buildings, taking into account environmental and economic factors. To enable students to achieve low-energy buildings or zero energy buildings via sustainable active and passive design technologies, and to understand the applications of smart green nanomaterials and renewable energy technologies in building envelope. To enable students to understand the process of building retro-commissioning, including the use of various measurement data and data analytics, in order to identify energy saving opportunities and demand limitation in existing buildings and in new designs. To enable students to integrate and to apply their knowledge of efficient operation of building services systems, to upgrade existing buildings and improve designs for new buildings.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. understand the energy use patterns in various types of buildings and the major energy end-uses; b. design low energy buildings via sustainable active and passive design technologies; c. carry out building energy performance based on established guideline, identifying energy saving opportunities (ESO) and implementing retro-commissioning on major energy end-users in buildings; d. predict the energy consumption of building HVAC systems using simplified steady-state model and evaluate the amount of energy that may be recovered from HVAC systems; e. apply building energy management principle to achieve highest possible building energy use performance; f. apply demand side management principle to achieve both energy and cost saving in operating buildings
Subject Synopsis/ Indicative Syllabus	**Overall building energy use:** Overall view of energy use, energy source, supply and distribution; energy requirement and consumption in buildings, source, energy tariffs, usage pattern, maximum demand, seasonal variation; Hong Kong energy use data and statistics in building sector.

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Building sustainable design technologies: Active design, passive design, building green nanomaterials (passive radiative cooling, functional coatings for thermal blocking and self-cleaning, etc.) for building envelope, and building-integrated renewable energy technologies.

Building retro-commissioning: Objectives and methodologies, analysis of energy use data, building energy modeling and evaluation methods, identification of areas for potential energy saving, optimisation and diagnosis.

Building energy management: Energy management approaches, good housekeeping practice, plan for energy conservation programme, barriers to achieving building energy efficient operation, energy policies.

Retrofitting and upgrading buildings for energy conservation: Identifying opportunity for retrofitting, building structure and services systems upgrade for energy conservation, projection of results of proposed retrofitting programme using modelling and computer simulation, economic analysis. 'Energy Star', 'Green Lights'.

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<tr><td>Teaching/Learning Methodology</td><td>

The subject teaching will be realized through lecture, student based seminar and tutorial sessions. The intended subject outcomes will be mostly covered in lecture sessions, and reinforced by seminar sessions and tutorial sessions. For student seminar sessions, they will be required to prepare course work around these intended learning outcomes, although individual students may select a specific topic which is only relevant to one of the intended learning objectives.

Industrial speakers who are experienced in improving energy efficiency in buildings will be invited to deliver special talks, presenting case studies and highlighting both the technical and managerial approaches to solving a practical problem.

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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>1. Coursework</td><td>40%</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td></td></tr>
<tr><td>2. Examination</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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Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

- Open book examination format is adopted. Therefore, students are expected to place efforts more on analysis and problem solving. This is preferable for Level 5 subjects; The intended learning outcomes will be embedded in setting examination questions.
- Course work will be assessed via student presentation during seminar sessions and report submission. Students will have to go through Q and A sessions to test their understandings of fundamentals and demonstrate their masters of the intended learning outcomes.

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Reading List and References	2020 ASHRAE Handbook—HVAC Systems and Equipment 2019 ASHRAE Handbook—HVAC Applications 2017 ASHRAE Handbook—Fundamentals *Technical Guidelines on Retro-commissioning*. Electrical and Mechanical Services Department (EMSD), HK SAR, 2018. *Hong Kong Energy End-use Data*. Electrical and Mechanical Services Department (EMSD), HK SAR. *Code of Practice for Energy Efficiency of Building Services Installation,* Electrical and Mechanical Services Department (EMSD), HK SAR, 2018. Intelligent Buildings and Building Automation, Wang, Shengwei, Spon Press (Taylor & Francis), London, 2010. Eastop, T. D. & Croft, D. R. (1990). *Energy Efficiency for Engineers and Technologists*, Longman Scientific & Technical. Kreider, J. & Rabl, A. (1994). *Heating and Cooling of Buildings -- Design for Efficiency*, McGraw-Hill, Inc. Meckler, M. (1994). *Retrofitting Buildings for Energy Conservation*, The Fairmont Press Inc. Roaf, S & Hancock, M. (1992). *Energy Efficient Buildings*, Blackwell Scientific Publication Ltd. Selected papers from CIBSE Journal, ASHRAE publications, etc.