Subject Description Form

Subject Code	**BSE3226**
Subject Title	**HVACR II**
Credit Value	3
Level	3
Pre-requisite Co-requisite Exclusion	BSE3225 HVACR I, or equivalent. Nil Nil
Objectives	This subject aims at: 1. equipping students with the abilities required in designing water systems in providing heating and air conditioning for buildings, taking into consideration the part-load performance of the systems and their environmental impacts; and 2. developing their competence in making relevant decision that complies to requirement on energy efficiency of buildings and air conditioning systems.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a) design HVAC water systems for providing air conditioning in buildings, taking into consideration the characteristics of the building and energy efficiency; b) analyse and quantify the impact of the heat rejection medium on the coefficient of performance and energy use of chiller systems; c) evaluate the performance of cooling towers on the basis of heat and mass transfer theories; d) select appropriate refrigeration and control systems; e) explain the key design concerns and compare the performance of heating systems and equipments in buildings; and f) practice application of theories and acquire a basic competence in system commissioning skills.
Subject Synopsis/ Indicative Syllabus	**HVAC plants**: Packaged units, chillers, heat pumps, boilers. **HVAC water supply and distribution**: Flow requirements; basic chilled water and heating water pumping systems; single-loop pumping system with differential pressure bypass control; two-loop pumping system; variable speed pumping and control; control valve characteristics; energy considerations, building energy code requirements on chiller performance; chiller sequencing control; district cooling. **Refrigeration systems**: Expansion devices and capacity control, safety devices, system options, part load operation; VRV system; condenser and heat rejection methods, direct air-cooled systems, direct and indirect water-cooled systems; cooling towers, operating principles and applications, heat and mass transfer performance of cooling towers, legionnaires diseases and mitigation measures; territory wide condenser water supply for heat rejection. **Heating systems and equipment**: Major equipments in heating systems; heat pump technology; radiators and their selection; heating water system designs; district heating.
Teaching/Learning Methodology	Students will be required to do assigned-readings, particularly on the fundamentals, before attending lecturers and tutorials. The assigned readings are detailed in the reading list to be distributed to students at the beginning of the Semester. Lecture to explain the theories and to deliver the main thrust of materials on HVAC plants, water supply systems, refrigeration systems, heat rejection methods and heating systems. Tutorial – tutorial problem sheets issued for students to solve numerical problems. Selected problems from the tutorial problem sheets will be discussed in tutorial sessions. Students are required to tackle those problems as homework before attending the tutorial sessions. Mini design project – to allow students to practice design of chilled water pumping system, chiller

capacity and heat rejection options, through a student-centered learning approach.

The subject includes two 3-hour laboratory sessions. Related laboratory work are:

- Water system balancing
- Expansion device performance test
- Cooling tower performance test

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	f
Coursework							
- Laboratory work	10	✓		✓	✓		✓
- Test	18	✓	✓	✓	✓		
- Mini design project	12	✓	✓		✓		
End-of-semester examination	60	✓	✓	✓	✓	✓	
Total	100						

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

Design project assignment is to enable students to develop design skills, appraise energy code requirement on air conditioning systems and present their design decisions through drawing, written report and quiz.

In-class test is to assess students' abilities of various aspects that can be measured through written test.

Laboratory work is to allow students to practice application of the theories and acquire a basic competence in system commissioning.

The end-of-semester examination assesses students' ability in solving real problems by applying their knowledge of waterside systems, heat rejection systems, refrigeration systems and heating systems.

Student Study Effort Expected

Class contact:	
▪ Lectures	22 Hrs.
▪ Tutorials	6 Hrs.
▪ Mini design project quiz	3 Hrs.
▪ Laboratory	6 Hrs.
▪ In-class test	2 Hrs.
Other student study effort:	
▪ Assigned reading	8 Hrs.
▪ Preparing tutorial problems	20 Hrs.
▪ Design project assignment	16 Hrs.
▪ Preparing laboratory work	8 Hrs.

	▪ Test preparation	9 Hrs.
	▪ Examination preparation	20 Hrs.
	Total student study effort	120 Hrs.
Reading List and References	McQuiston FC, Parker JD, Spitler JD, Heating, ventilating and air-conditioning analysis and design, 6th ed. New York: John Wiley & Sons, Inc., 2005. Wang SK, Handbook of air conditioning and refrigeration, 2nd ed. NY: McGraw-Hill, 2001. Haines RW, Hittle DC, Control systems for heating, ventilating and air conditioning, 6th ed. NY: Chapman & Hall, 2003. Kreider J.F., Curtiss P.S. and Rabl A. Heating and cooling of buildings: Design for efficiency, CRC Press/Taylor & Francis, 2010. Oughton DR, Hodkinson SL, Faber and Kell's heating and air-conditioning of buildings, 10th Ed. London: Butterworth-Heinemann, 2008.	