Subject Description Form

Subject Code	**BSE1203**
Subject Title	**Thermodynamics and Heat Transfer**
Credit Value	3
Level	1
Pre-requisite Co-requisite Exclusion	BSE1201 Thermofluids Nil Nil
Objectives	This subject is intended to allow students to acquire basic knowledge about thermodynamics and heat transfer related to building and in building services applications. Efforts will be made on the applications of the thermodynamics and heat transfer principles to analysis of the working principles and efficiency of the HVACR equipment and systems. The environmental impacts of refrigerants are also discussed to arouse the awareness of students on sustainability.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a) appreciate the basic principles and fundamentals in engineering thermodynamics and heat transfer; b) understand the heat and work transfer in thermodynamic processes in heat engine cycles and refrigeration cycles; and c) analyze the performance of typical chillers, refrigerators and air conditioners.
Subject Synopsis/ Indicative Syllabus	**Fundamentals of thermodynamics**: the first law of thermodynamics; properties of working fluids; heat and work, potential, kinetic and internal energy; perfect gas equations; properties of pure substances, T-v diagram and P-v diagram; second law of thermodynamics; heat engines; reversed heat engines; thermal efficiency; coefficient of performance COP; entropy as a property. **Heat engine cycles**: Clausius inequality, entropy and irreversibility; entropy as a property; heat engine cycles; Carnot cycle and Rankin cycle. **Refrigeration cycles**: ideal and actual refrigeration cycles; T-s and p-h diagrams; compression, condensation, throttling and evaporation processes and heat and work transfer in the processes;. **Compressors**: various types of compressors and factors affecting compressor performance including compression ratio and clearance volume; reciprocating compressors, rotary compressors, centrifugal compressor; volumetric efficiency, mechanical efficiency and minimum compression work. **Conduction**: Fourier's law of heat conduction; the law of conservation of energy; steady state conduction in/across a slab and cylindrical; electrical analogy to heat transfer. **Convection**: Newton's law of cooling, and surface convective heat transfer coefficients; the concept of boundary layers; use of dimensionless parameters in convective heat transfer (Nu, Re, Pr, etc.). **Radiation**: absorption and emission at solid surfaces; Planck's radiation law; Stefan-Boltzmann law; geometrical problems and configuration factor; radiation between black bodies and non-black bodies at different temperatures. **Related Laboratory Work** Investigation of the Characteristics of a Refrigerant Compressor (A11) Investigation of free and forced convection heat transfer (H1)
Teaching/Learning Methodology	There will be 10 lectures to illustrate the fundamental principles, demonstrate the application of the theory with real-life problems, and explain the relevance to the professional jobs. There will be 9 tutorial sessions in half of the class size, during which students are expected to work on solutions of real-life problems via discussion with lecture and among themselves. Students will be required to do assigned-readings, particularly on the fundamentals, before attending lecturers and tutorials. The assigned readings will be detailed in the teaching scheme to be distributed to students at the beginning of the Semester.

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<tr><td></td><td>In additions there are two lab sessions for students of a group of 4, undertaking a prescribed set of measurements, analyzing the correlations, check against the theories learnt in the class.</td></tr>
<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></td><td></td><td></td></tr>
<tr><td>End-of-semester examination</td><td>60</td><td>✓</td><td>✓</td><td>✓</td><td></td><td></td><td></td></tr>
<tr><td>In class test</td><td>20</td><td>✓</td><td>✓</td><td>✓</td><td></td><td></td><td></td></tr>
<tr><td>Lab experiments and report</td><td>20</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.</td></tr>
<tr><td>Student Study Effort Expected</td><td>
<table>
<tr><td>Class contact:</td><td></td></tr>
<tr><td>▪ Lecture</td><td>20 Hrs.</td></tr>
<tr><td>▪ Tutorial</td><td>9 Hrs.</td></tr>
<tr><td>▪ Tests</td><td>4 Hrs.</td></tr>
<tr><td>▪ Laboratory works</td><td>6 Hrs.</td></tr>
<tr><td>Other student study effort:</td><td></td></tr>
<tr><td>▪ Reading and working on given exercises</td><td>69 Hrs.</td></tr>
<tr><td>▪ Lab Preparation and Report</td><td>12 Hrs.</td></tr>
<tr><td>Total student study effort</td><td>120 Hrs.</td></tr>
</table></td></tr>
<tr><td>Reading List and References</td><td>Michael J. Moran and Howard N. Shapiro. Fundamentals of Engineering Thermodynamics. New York: John Wiley & Sons, Inc. 2008.
Eastop TD and McConkey A, Applied thermodynamics for engineering technologists. New York: Wiley, 1993.
Cengel YA, Turner RH, Fundamentals of Thermo-fluid sciences, McGraw Hill, 2005.
Rogers GFC, Mayhew YR, Thermodynamic and transport properties of fluids, Blackwell, 1995.
Stoecker WF, Jones JW, Refrigeration and air-conditioning. New York: McGraw-Hill, 1982.
McQuiston FC, Parker JD, Spitler JD, Heating, ventilating and air-conditioning analysis and design, 5th ed. New York: John Wiley & Sons, Inc., 2000.
CIBSE Guides.
ASHRAE Handbooks.</td></tr>
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