Subject Description Form

Subject Code	ME44004
Subject Title	Heat and Mass Transfer
Credit Value	3
Level	4
Pre-requisite/ Co-requisite/ Exclusion	Pre-requisite: ME34002 Engineering Thermodynamics; and ME34004 Fluid Mechanics
Objectives	To provide students with the fundamental knowledge of heat and mass transfer.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Apply the fundamental knowledge of heat transfer mechanisms, namely conduction, convection and radiation. b. Evaluate different types of heat exchangers. c. Apply the numerical techniques in heat transfer applications. d. Apply the fundamental knowledge of mass transfer.
Subject Synopsis/ Indicative Syllabus	***Introduction*** - Conduction, convection and radiation. Fourier's law. Newton's law of cooling. ***Conduction*** - The plane wall. Insulation and thermal resistance. Radial systems. The overall heat transfer coefficient. Critical thickness of insulation. Heat-Source systems. Cylinder with heat sources. Heat transfer from extended surfaces. Unsteady conduction in slab or cylinder, Lumped-heat-capacity method. ***Forced and Free Convection*** - Governing equation for the boundary layer. Fluid and thermal boundary layer. The relation between fluid friction and heat transfer. Flow over a flat plate. Flow across cylinders/tubes and spheres. Heat transfer in laminar tube flow with constant temperature and constant heat flux. Heat transfer coefficients for free convection of plates and cylinders. ***Numerical Simulation*** - General differential equations for heat conduction. Energy balance method. Finite-difference solutions for differential equations of heat conduction. Explicit and implicit methods. Grid shape and size. Gauss-Seidel iteration. Accuracy and stability. ***Heat Exchanger*** - Heat exchanger types. The overall heat transfer coefficient. Heat exchanger analysis: Log mean temperature difference, parallel and counterflow heat exchangers. Heat exchanger analysis: The Effectiveness-NTU Method. ***Radiation*** - Black body and grey body. Absorptivity and emissivity. View factors. Irradiation and radiosity. Radiation exchange between surfaces and its network approach. ***Mass Transfer*** - Basic equations in mass transfer. Analogy between heat and mass transfer. Mass diffusion. Boundary conditions. Steady mass diffusion through a wall.

<table>
<tr><td></td><td>Water vapour migration in buildings. Simultaneous heat and mass transfer.</td></tr>
<tr><td>Teaching/Learning Methodology</td><td>Lectures are used to deliver the fundamental knowledge in relation to heat transfer and mass transfer (outcomes a to d).

Tutorials will be conducted to facilitate discussions of typical examples and coursework assignments (outcomes a to d).

<table>
<tr><td rowspan="2">Teaching/Learning Methodology</td><td colspan="4">Outcomes</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td></tr>
<tr><td>Lecture</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>Assignment/Tutorial</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
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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="4">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></tr>
<tr><td>1. Assignment</td><td>30%</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>2. Test</td><td>20%</td><td>√</td><td>√</td><td></td><td></td></tr>
<tr><td>3. Examination</td><td>50%</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>Total</td><td>100%</td><td colspan="4"></td></tr>
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Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Overall Assessment:
0.50 × End of Subject Examination + 0.50 × Continuous Assessment

1. The continuous assessment will comprise two components: assignments (30%) and tests (20%). The assignments are aimed at evaluating the progress of students study, assisting them in fulfilling the respective intended subject learning outcomes, and enhancing the integration of their knowledge learnt. The mid-term test(s) covers the first half of the subject material and provides useful feedback to both the lecturer and students on the learnt topics.

2. The examination (50%) will be used to assess the knowledge acquired by the students for understanding and analyzing the problems critically and independently; as well as to determine the degree of achieving the intended subject learning outcomes.</td></tr>
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Student Study Effort Expected	Class contact:	
	▪ Lecture	33 Hrs.
	▪ Tutorial	6 Hrs.
	Other student study effort:	
	▪ Self-study/Coursework	67 Hrs.
	Total student study effort	106 Hrs.
Reading List and References	1. Y.A. Cengel and A.J. Ghajar, Heat and Mass Transfer: Fundamentals and Applications, McGraw-Hill, latest edition. 2. J.P. Holman, Heat Transfer, McGraw Hill, latest edition. 3. F.P. Incropera, D.P. Dewitt, T.L. Bergman and A.S. Lavine, Principles of Heat and Mass Transfer, John Wiley & Sons, Inc., latest edition.	

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