

## Tamkang University Academic Year 106, 1st Semester Course Syllabus

|   |  |            |  |
|---|--|------------|--|
| Course Title  | HEAT CONVECTION  | Instructor | KANG SHUNG-WEN   |
| Course Class  | TEBBM1A<br>MASTER'S PROGRAM, DIVISION OF PRECISION<br>MECHANICAL ENGINEERING, DEPARTMENT OF<br>MECHANICAL AND ELECTRO-MECHANICAL<br>ENGINEERING,   | Details    | <ul style="list-style-type: none"> <li>◆ Selective</li> <li>◆ One Semester</li> <li>◆ 3 Credits</li> </ul> |
| Departmental Aim of Education   |  |            |  |
| <p>I. To prepare students who have a comprehensive understanding of the principles of applied sciences and engineering to be innovators in the field of mechanical and electromechanical engineering.</p> <p>II. To train emerging professionals who possess a high level of expertise and ethical standards who will become independent research and development leaders in the industry.</p> <p>III. To motivate students who will pursue continuing education as a means to stay on the cutting edge of global competitiveness and meet changes in their careers and the workplace with confidence and ease.</p> |  |            |  |
| Departmental core competences   |  |            |  |
| <p>A. Head: Knowledge of mechanical and electromechanical engineering.</p> <p>B. Hand: Hands-on skills and practical realization.</p> <p>C. Heart: Love of learning and innovation.</p> <p>D. Eye: Vision of progress and improvements.</p>   |  |            |  |
| Course Introduction   | <p>The course will cover the following topics:</p> <p>PART 1.: Conservation equations, viscosity and stress terms, boundary layer equations for momentum, heat and mass transfer.</p> <p>PART 2: Momentum and heat transfer for laminar boundary layers, laminar flow in pipes/ducts, turbulent boundary layers, turbulent flow in pipes/ducts, heat transfer by natural convection, influence of temperature-dependent fluid properties on convective heat transfer and friction.</p> |            |  |
|   |  |            |  |

### The Relevance among Teaching Objectives, Objective Levels and Departmental core competences

I. Objective Levels (select applicable ones) :

- |                         |                                     |                           |
|-------------------------|-------------------------------------|---------------------------|
| (i) Cognitive Domain    | : C1-Remembering, C2-Understanding, | C3-Applying,              |
|                         | C4-Analyzing, C5-Evaluating,        | C6-Creating               |
| (ii) Psychomotor Domain | : P1-Imitation, P2-Mechanism,       | P3-Independent Operation, |
|                         | P4-Linked Operation, P5-Automation, | P6-Origination            |
| (iii) Affective Domain  | : A1-Receiving, A2-Responding,      | A3-Valuing,               |
|                         | A4-Organizing, A5-Characterizing,   | A6-Implementing           |

II. The Relevance among Teaching Objectives, Objective Levels and Departmental core competences :

- (i) Determine the objective level(s) in any one of the three learning domains (cognitive, psychomotor, and affective) corresponding to the teaching objective. Each objective should correspond to the objective level(s) of ONLY ONE of the three domains.
- (ii) If more than one objective levels are applicable for each learning domain, select the highest one only. (For example, if the objective levels for Cognitive Domain include C3, C5, and C6, select C6 only and fill it in the boxes below. The same rule applies to Psychomotor Domain and Affective Domain.)
- (iii) Determine the Departmental core competences that correspond to each teaching objective. Each objective may correspond to one or more Departmental core competences at a time. (For example, if one objective corresponds to three Departmental core competences: A, AD, and BEF, list all of the three in the box.)

| No. | Teaching Objectives  | Relevance        |                               |
|-----|--|------------------|-------------------------------|
|     |  | Objective Levels | Departmental core competences |
| 1   | The objectives of the course is to provide students a standard understanding on thermal convection. Students who may have taken this course as his or her graduate work will be able to master these advanced topics through self study. | C6               | ABCD                          |

### Teaching Objectives, Teaching Methods and Assessment

| No. | Teaching Objectives  | Teaching Methods                     | Assessment                          |
|-----|--|--------------------------------------|-------------------------------------|
| 1   | The objectives of the course is to provide students a standard understanding on thermal convection. Students who may have taken this course as his or her graduate work will be able to master these advanced topics through self study. | Lecture, Discussion, Problem solving | Written test, Report, Participation |
|     |  |                                      |                                     |

This course has been designed to cultivate the following essential qualities in TKU students

| Essential Qualities of TKU Students         | Description   |
|---|---|
| ◆ A global perspective                      | Helping students develop a broader perspective from which to understand international affairs and global development.                                   |
| ◆ Information literacy                      | Becoming adept at using information technology and learning the proper way to process information.  |
| ◆ A vision for the future                   | Understanding self-growth, social change, and technological development so as to gain the skills necessary to bring about one's future vision.          |
| ◇ Moral integrity                           | Learning how to interact with others, practicing empathy and caring for others, and constructing moral principles with which to solve ethical problems. |
| ◆ Independent thinking                      | Encouraging students to keenly observe and seek out the source of their problems, and to think logically and critically.                                |
| ◇ A cheerful attitude and healthy lifestyle | Raising an awareness of the fine balance between one's body and soul and the environment; helping students live a meaningful life.                      |
| ◆ A spirit of teamwork and dedication       | Improving one's ability to communicate and cooperate so as to integrate resources, collaborate with others, and solve problems.                         |
| ◇ A sense of aesthetic appreciation         | Equipping students with the ability to sense and appreciate aesthetic beauty, to express themselves clearly, and to enjoy the creative process.         |

#### Course Schedule

| Week | Date                     | Subject/Topics  | Note |
|------|--------------------------|---|------|
| 1    | 106/09/18 ~<br>106/09/24 | Fundamentals of heat convection   |      |
| 2    | 106/09/25 ~<br>106/10/01 | Boundary Layer Fundamentals   |      |
| 3    | 106/10/02 ~<br>106/10/08 | Conservation Equations of Mass, Momentum, and Energy for Laminar Flow Over a Flat Plate |      |
| 4    | 106/10/09 ~<br>106/10/15 | Approximate Integral Boundary Layer Analysis  |      |
| 5    | 106/10/16 ~<br>106/10/22 | Analogy Between Momentum and Heat Transfer in Turbulent Flow Over a Flat Surface        |      |
| 6    | 106/10/23 ~<br>106/10/29 | Mixed Boundary Layer  |      |
| 7    | 106/10/30 ~<br>106/11/05 | Introduction of Natural Convection  |      |
| 8    | 106/11/06 ~<br>106/11/12 | Combined Forced and Natural Convection  |      |
| 9    | 106/11/13 ~<br>106/11/19 | Forced Convection Inside Tubes and Ducts  |      |
| 10   | 106/11/20 ~<br>106/11/26 | Mid-term test   |      |
| 11   | 106/11/27 ~<br>106/12/03 | Analogy Between Momentum and Heat Transfer in Turbulent Flow                            |      |

|                         |  |   |  |
|-------------------------|--|---|--|
| 12                      | 106/12/04 ~<br>106/12/10   | Heat Transfer Enhancement and Electronic-Device Cooling |  |
| 13                      | 106/12/11 ~<br>106/12/17   | Forced Convection Over Exterior Surfaces                |  |
| 14                      | 106/12/18 ~<br>106/12/24   | Heat Exchangers   |  |
| 15                      | 106/12/25 ~<br>106/12/31   | Heat Exchanger Effectiveness                            |  |
| 16                      | 107/01/01 ~<br>107/01/07   | Heat Transfer with Phase Change                         |  |
| 17                      | 107/01/08 ~<br>107/01/14   | Condensation  |  |
| 18                      | 107/01/15 ~<br>107/01/21   | Final test  |  |
| Requirement             |  |   |  |
| Teaching Facility       | Computer, Projector  |   |  |
| Textbook(s)             | 1. Kreith_Principles_Heat_Transfer<br>2. Adrian Bejan-Heat Transfer Handbook-2003<br>3. Frank P. Incropera et al., Fundamentals of Heat and Mass Transfer  |   |  |
| Reference(s)            |  |   |  |
| Number of Assignment(s) | 5 (Filled in by assignment instructor only)  |   |  |
| Grading Policy          | ◆ Attendance : 10.0 %    ◆ Mark of Usual : 30.0 %    ◆ Midterm Exam : 30.0 %<br>◆ Final Exam : 30.0 %<br>◆ Other < > : %   |   |  |
| Note                    | This syllabus may be uploaded at the website of Course Syllabus Management System at <a href="http://info.ais.tku.edu.tw/csp">http://info.ais.tku.edu.tw/csp</a> or through the link of Course Syllabus Upload posted on the home page of TKU Office of Academic Affairs at <a href="http://www.acad.tku.edu.tw/CS/main.php">http://www.acad.tku.edu.tw/CS/main.php</a> .<br><b>※ Unauthorized photocopying is illegal. Using original textbooks is advised. It is a crime to improperly photocopy others' publications.</b> |   |  |