



## 教學大綱(Syllabus)-研究所

系務會議通過修訂日期：2008/01/03

updated: 2008/03/10

|                              |  |  |                 |                    |   |
|------------------------------|--|--|-----------------|--------------------|---|
| 課程編碼<br>(course no.)         | M010   |  |                 | 學分<br>(credits)    | 3   |
| 課程名稱<br>(course name)        | (中) 固態熱力學  |  |                 |                    |   |
|                              | (Eng.) Thermodynamics of Solids  |  |                 |                    |   |
| 開課系所班級<br>(dept. & year)     | 材料工程學系碩士班一年級<br>(Dept. of Mat. Engr., Master)  |  |                 | 授課教師<br>(teacher)  | 汪俊延 副教授<br>(Associate Prof.<br>Jun Yen Uan) |
| 課程類別<br>(course type)        | 選修<br>(Mandatory)  | 授課語言<br>(language)                                   | 中文<br>(Chinese) | 開課學期<br>(semester) | 下學期   |
| 課程簡述<br>(course description) | <p>(中) 課程前半部在介紹熱力學之基本觀念，從熱力學第一、第二定律出發，加強同學的基本觀念。後半部則強調熱力學在材料科學上之應用，導向對凝相、溶液/固溶體、相平衡、相圖等課題的討論，針對材料科學中的各種典型現象與行為，以熱力學的觀點加以剖析探討，另並探討統計熱力之觀念與應用，以期學生對熱力有概括性之瞭解。</p> <p>(Eng.) The objective of this course is to introduce the fundamental concepts of thermodynamics and further applications in material science. Students are expected to study condensed phase, liquid/solid solution, phase equilibrium, phase diagram and other typical phenomena and behaviors in material science in terms of thermodynamic theory. In addition, statistical thermodynamic model will provide an outline of thermodynamics for the students.</p> |  |                 |                    |   |
| 課程目標<br>(course objectives)  | <p>(中) 1.對熱力學基本定律的了解。<br/>2.認識熱彈性效應。<br/>3.了解 Gravity 效應<br/>4.學習二元合金系統的自由能<br/>5.了解熱力學相關方程式</p> <p>(Eng.) 1.Learn the laws of thermodynamics<br/>2. Learn thermoelastic effect<br/>3.Learn gravity effect<br/>4.Learn the Gibbs free energy of the binary alloy system<br/>5.Learn equations of thermodynamics</p>  |  |                 |                    |   |
| 先修課程(prerequisites)          |  |  |                 |                    |   |
| 課程編碼<br>(course no.)         | 課程名稱<br>(course name)  | 與課程銜接的重要概念、原理與技能<br>(relation to the current course) |                 |                    |   |
|                              |  |  |                 |                    |   |

| 教學模式<br>(teaching<br>methodology) | 模式<br>(methodology)       | 講授<br>(teaching) | 討論/報告<br>(discussion &<br>report) | 實驗/參訪<br>(exp./fab visit) | 遠距/網路教學<br>(remote/web<br>teaching) | 合計<br>(sum) |
|-----------------------------------|---------------------------|------------------|-----------------------------------|---------------------------|-------------------------------------|-------------|
|                                   | 學分分配<br>(credit distrib.) | 3                |                                   |                           |                                     | 3           |
|                                   | 授課時數分配<br>(hour distrib.) | 3                |                                   |                           |                                     | 3           |

| <b>授課進度與內容 (週次、單元名稱與內容、習作/考試進度、備註)</b><br><b>(course content and homework/tests schedule)</b> |   |  |                |
|---|---|--|----------------|
| 週次<br>(week)  | 單元名稱與內容<br>(subject and content)                              | 習作/考試<br>進度<br>(homework<br>and tests) | 備註<br>(remark) |
| 01  | The first law of thermodynamics                               |  |                |
| 02  | The second law of thermodynamics                              |  |                |
| 03  | Some relations between thermodynamic quantities               |  |                |
| 04  | Some relations between thermodynamic quantities               |  |                |
| 05  | Thermodynamic of phase transformations and chemical reactions |  |                |
| 06  | Partial molal and excess quantities                           |  |                |
| 07  | Partial molal and excess quantities                           |  |                |
| 08  | Thermodynamic properties of alloy systems – A model approach  |  |                |
| 09  | Equilibrium between phase of variable composition             |  |                |
| 10  | Free energy of binary systems                                 |  |                |
| 11  | Midterm exams   | 期中考                                    |                |
| 12  | Thermodynamics of surfaces and interfaces                     |  |                |
| 13  | Thermodynamics of surfaces and interfaces                     |  |                |
| 14  | Classification of defects in crystals                         |  |                |
| 15  | Defects in metals   |  |                |
| 16  | Defects in metals   |  |                |
| 17  | Defects in nearly stoichiometric compounds                    |  |                |
| 18  | Final exams   | 期末考                                    |                |
| <b>學習評量方式</b><br><b>(evaluation)</b>  |   |  |                |
| Midterm exams (50%)<br>Final exams (50%)  |   |  |                |
| <b>教科書 (書名、作者、書局、代理商、說明)</b><br><b>(textbook)</b>   |   |  |                |
| 1. Richard A. Swalin , “Thermodynamics of solids”, 2nd edition, John Wiley & Sons, New York   |   |  |                |



參考書目 (書名、作者、書局、代理商、說明)  
(other references)

1. R.E.Sonntag and G.J.Van Wylen, "Introduction to Thermodynamics" , John Wiley & Sons, 1991.
2. David R. Gaskell, "interductuon to the thermodynamics of Material" third edition, 偉明圖書有限公司

課程教材 (教師個人網址請列在本校內之網址。)  
(teaching aids & teacher's website)

[web.nchu.edu.tw/~jyuan/](http://web.nchu.edu.tw/~jyuan/)



**與學系教育目標之關聯性(材料系)**  
**(relation to educational objective of materials engineering department)**

1. 提供材料性質、製程與應用及跨領域知識與訓練  
To provide interdisciplinary know-how and training on materials properties, processing, and applications
2. 培育具獨立思考、創新與實作能力之材料科技人才  
To train materials technology students for independent thinking, innovation, and practical skills
3. 培養團隊合作精神與溝通協調整合能力  
To cultivate the spirit of teamwork and the capacity of integrated cooperation
4. 建立多元價值與國際觀  
To inculcate multifarious values and cosmopolitan worldview
5. 強化綠色材料科技教育  
To implement educational programs in eco-materials technology

**與學系教育核心能力之關聯性(材料系)**  
**(relation to educational core abilities for materials engineering department)**

- (A) 特定材料之專業知識  
Specialized knowledge in Materials science and Engineering
- (B) 策劃及執行專題研究之能力  
Ability to plan and execute a research project
- (C) 撰寫專業論文之能力  
Ability to write journal articles
- (D) 創新思考及獨立解決問題之能力  
Ability to do innovative thinking and independent problem solving
- (E) 跨領域協調整合之能力  
Ability to work in an interdisciplinary setting
- (F) 國際觀及綠色材料意識  
A fine international scope and general concept of eco-material
- (G) 領導、管理及規劃之能力  
Ability in leadership, management, and organization
- (H) 終身自我學習成長之能力  
Ability for life-long learning
- (I) 學術專業倫理  
Professional ethics in Science and Engineering

### 課程內涵達成學系【教育目標】比對資料

| 授課進度與內容   | 教育目標                                |                                     |                          |                          |                          |
|---|-------------------------------------|-------------------------------------|--------------------------|--------------------------|--------------------------|
|   | 目標一                                 | 目標二                                 | 目標三                      | 目標四                      | 目標五                      |
| 提供材料性質、製程與應用及跨領域知識與訓練   | 培育具獨立思考、創新與實作能力之材料科技人才              | 培養團隊合作精神與溝通協調整合能力                   | 建立多元價值與國際觀               | 強調綠色材料科技教育               |                          |
| 請勾選關聯性 <input checked="" type="checkbox"/>                    | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| The first law of thermodynamics                               | 1                                   | 1                                   | 0                        | 0                        | 0                        |
| The second law of thermodynamics                              | 1                                   | 1                                   | 0                        | 0                        | 0                        |
| Some relations between thermodynamic quantities               | 1                                   | 1                                   | 0                        | 0                        | 0                        |
| Thermodynamic of phase transformations and chemical reactions | 1                                   | 1                                   | 0                        | 0                        | 0                        |
| Partial molal and excess quantities                           | 1                                   | 1                                   | 0                        | 0                        | 0                        |
| Thermodynamic properties of alloy systems – A model approach  | 1                                   | 1                                   | 0                        | 0                        | 0                        |
| Equilibrium between phase of variable composition             | 1                                   | 1                                   | 0                        | 0                        | 0                        |
| Free energy of binary systems                                 | 1                                   | 1                                   | 0                        | 0                        | 0                        |
| Thermodynamics of surfaces and interfaces                     | 1                                   | 1                                   | 0                        | 0                        | 0                        |
| Classification of defects in crystals                         | 1                                   | 1                                   | 0                        | 0                        | 0                        |
| Defects in metals   | 1                                   | 1                                   | 0                        | 0                        | 0                        |
| Defects in nearly stoichiometric compounds                    | 1                                   | 1                                   | 0                        | 0                        | 0                        |
| 總計(%)   | 100                                 | 100                                 | 0                        | 0                        | 0                        |

- 註：
1. 所有必修課均須填寫此表。
  2. 矩陣中請填入關聯性； 1 表示相關，0 表示無相關。
  3. 學系教育目標項次請依據表1填寫。

**課程內涵達成學系【核心能力】比對資料(研究所)**

| 授課進度與內容   | 核心能力                                |                                     |                                     |                          |                          |                          |                          |                          |                                     |
|---|-------------------------------------|-------------------------------------|-------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|-------------------------------------|
|   | A<br>特定材料之專業知識                      | B<br>策劃及執行專題研究之能力                   | C<br>撰寫專業論文之能力                      | D<br>創新思考及獨立解決問題之能力      | E<br>跨領域協調整合之能力          | F<br>國際觀及綠色材料意識          | G<br>領導、管理及規劃之能力         | H<br>終身自我學習成長之能力         | I<br>學術專業倫理                         |
| 請勾選關聯性 <input checked="" type="checkbox"/>                    | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| The first law of thermodynamics                               | 1                                   | 1                                   | 1                                   | 0                        | 0                        | 0                        | 0                        | 0                        | 1                                   |
| The second law of thermodynamics                              | 1                                   | 1                                   | 1                                   | 0                        | 0                        | 0                        | 0                        | 0                        | 1                                   |
| Some relations between thermodynamic quantities               | 1                                   | 1                                   | 1                                   | 0                        | 0                        | 0                        | 0                        | 0                        | 1                                   |
| Thermodynamic of phase transformations and chemical reactions | 1                                   | 1                                   | 1                                   | 0                        | 0                        | 0                        | 0                        | 0                        | 1                                   |
| Partial molal and excess quantities                           | 1                                   | 1                                   | 1                                   | 0                        | 0                        | 0                        | 0                        | 0                        | 1                                   |
| Thermodynamic properties of alloy systems – A model approach  | 1                                   | 1                                   | 1                                   | 0                        | 0                        | 0                        | 0                        | 0                        | 1                                   |
| Equilibrium between phase of variable composition             | 1                                   | 1                                   | 1                                   | 0                        | 0                        | 0                        | 0                        | 0                        | 1                                   |
| Free energy of binary systems                                 | 1                                   | 1                                   | 1                                   | 0                        | 0                        | 0                        | 0                        | 0                        | 1                                   |
| Thermodynamics of surfaces and interfaces                     | 1                                   | 1                                   | 1                                   | 0                        | 0                        | 0                        | 0                        | 0                        | 1                                   |
| Classification of defects in crystals                         | 1                                   | 1                                   | 1                                   | 0                        | 0                        | 0                        | 0                        | 0                        | 1                                   |
| Defects in metals   | 1                                   | 1                                   | 1                                   | 0                        | 0                        | 0                        | 0                        | 0                        | 1                                   |
| Defects in nearly stoichiometric compounds                    | 1                                   | 1                                   | 1                                   | 0                        | 0                        | 0                        | 0                        | 0                        | 1                                   |
| 總計(%)   | 100                                 | 100                                 | 100                                 | 0                        | 0                        | 0                        | 0                        | 0                        | 100                                 |

- 註：
1. 所有必修課均須填寫此表。
  2. 矩陣中請填入關聯性； 1 表示相關，0 表示無相關。
  3. 學系教育目標項次請依據表1填寫。