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IN ENGINEERING@PEKING UNIVERSITY

PKU ENGINEERING PRESENTS
2014 GLOBEX SUMMER PROGRAM@PEKING UNIVERSITY, BEIJING, CHINA
## PERSONAL EXPENSE TABLE (RMB/USD)

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost USD (CNY)</th>
<th>1-month (Jul 1-31, 2014) stay in Beijing</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accommodation</td>
<td>608 (3680)</td>
<td>1. CNY 115/day X 32 days; double or triple room occupancy @ Beijing Post &amp; Telecom Conference Center located near PKU. 2. Pro-rate your accommodation if your stay is not 32 days.</td>
<td></td>
</tr>
<tr>
<td>Meals</td>
<td>317 (1920)</td>
<td>3. CNY 60/day X 32 days (meals at PKU cafeterias). 4. Pro-rate your meals if your stay is not 32 days.</td>
<td></td>
</tr>
<tr>
<td>Public transportation</td>
<td>83 (500)</td>
<td>Taxi, bus and subway</td>
<td></td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>83 (500)</td>
<td>Comments listed under “TOTAL” (see below) apply.</td>
<td></td>
</tr>
<tr>
<td>SUB-TOTAL</td>
<td>1091 (6600)</td>
<td>Taxi, bus and subway</td>
<td></td>
</tr>
<tr>
<td>Globex Tuition</td>
<td>315 (2000)</td>
<td>CNY 1200 if you are participating in the 3-day Beijing city tour scheduled from July 3-5, 2014 inclusive.</td>
<td></td>
</tr>
<tr>
<td>BJ Tours</td>
<td>198 (1200)</td>
<td>ADD: CNY 120 if you are participating in the 3-day Beijing city tour scheduled from July 3-5, 2014 inclusive.</td>
<td></td>
</tr>
<tr>
<td>Internet Access</td>
<td>20 (120)</td>
<td>CNY 120 for 1-month PKU on-campus WIFI access. ADD: CNY 330 for 1-month Beijing City-wide 3G access.</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>1644 (9900)</td>
<td>1. All expenses are estimates; your actual cost may be different. 2. Airfare is not included in the estimated total expenses. 3. The hotel accepts MasterCard &amp; Visa credit cards.</td>
<td></td>
</tr>
</tbody>
</table>
Welcome to China!

2 Suggested Routes

Outbound Option 1
Enter through BJ and Depart from BJ

Outbound Option 2
Enter through BJ and Depart from SH
BJ to SH is 1318 km (819 mi) and takes just under 5 hours traveling on a bullet train

Field Trip B
China Today: Xi’an and Luoyang Route

Field Trip C
China Economy: Suzhou, Wuxi & Shanghai Route
2014 GLOBEX SUMMER INSTRUCTORS

Susan MAYS
Center for East Asian Studies
The University of Texas at Austin
(mays999@gmail.com)

01 China Economy: Technology, Growth and Global Connections (3 Credits)
中国经济：科技、增长与全球联系

Description
The course addresses China’s economic and technological development in a global context, circa 1978 to the present. It examines major trends in the economy and society, including trends in income, the workforce, trade, foreign investment, and ownership (i.e., public vs. private.) The class presents China’s progress and challenges in education, healthcare, family economics, environment and law. In all these topics, the course considers China’s unique history and culture while also addressing the role of technology and global partnerships. The final week includes a trip to the Shanghai region to visit tech-related organizations.

Objectives
● To develop an understanding of the key trends, drivers, and challenges in China’s unique and dynamic economy, in a global context.

Topics
● China’s “Opening” from 1978 and an Overview of the Chinese Government
● Rural-to-Urban Labor Migration and Export-led Development
● Reforms to State-owned Enterprises in China
● Economic Trends (GDP, trade, income, etc.)
● Education and Healthcare
● Family Economics (e.g., eldercare, single-child families, savings, etc.)
● Ownership Sectors (state, private, Sino-foreign joint ventures, foreign)
● China’s Evolving Legal System; Internet and Media

Grading
Individual Paper (5-7 pgs) and Presentation
36%
Exam on July 18, 2014
30%
Small Group Paper (5-7 pgs) and Presentation
36%
Attendance and Participation
20%

Total 100%

Reference
● Other articles provided by instructor.
**02 Interfaces and Plastic Deformation in Materials: From Theory to Engineering (3 Credits)**  
材料界面及塑性变形：从理论到工程

**Description**  
Interfaces are a main feature of crystalline materials. They play a key role in most of their properties, especially in their plastic deformation. The course will first present, in a simple way, the theoretical basis of the study of interfaces. Many practical examples will be given and the issues they raise will be analyzed. The main goal of the course is to lead the student from the concept of “ideal” to “real” interface and thus, to address the opportunities emerging through “Interface Engineering”. The course will be divided into 3 parts: concept of perfect interface at equilibrium, and questions about the maintenance of its crystalline state; failed interfaces that constitute “real” interfaces, the formation and the behavior of different defects and their role on plastic deformations; and interface networks in polycrystals and the role they play in interface engineering.

**Objective**  
To develop an understanding of one of the fundamental components of the microstructure of the crystalline materials: their interfaces. The main goal of the course is to go from the concept of “ideal” interface to “real” interface in bicrystals, then to “interface network” in polycrystals and thus, to address the opportunities emerging through “Interface Engineering”.

**Topics**  
- Introduction: some basic knowledge of crystalline materials
- Different types of interfaces: homophase (grain boundaries) and heterophase interfaces
- Geometry – bicrystallography
- Interface dislocations
- Atomic description of interfaces
- Energy of interfaces
- Defects in interface structures
- Segregation and precipitation at interfaces
- Elementary interface deformation mechanisms: interactions between crystal dislocations and interfaces and interfacial stress relaxations
- Interfaces and high temperature plasticity
- Triple junctions: from free to constrained interfaces
- Interface networks – interface texture
- Update on the concept of interface engineering

**References**  

**Grading**  
- Homework Assignment: 30%
- Midterm Project: 15%
- Final Project Assessment: 35%
- Discussion: 10%

**03 China Today - Tradition and Modernization (3 Credits)**  
今日中国 - 传统与改革

**Description**  
The course helps students understand what they see in China today, including rapid urbanization, traffic congestion, pollutants, great foods, etc. that are part of the country’s rapid rise to the World’s second largest economy. The course will review the processes of the economic reform in light of the Confucian-Daoist tradition and modern history since 1949. The course encourages critical thinking and interaction. Students will read and critique articles selected from the media, conduct group-based research projects, and participate in field trips to Beijing’s suburbs, Xian and Luoyang.

**Objectives**  
To understand China’s socio-economic changes and the underlying ideological transformation, and be able to apply such understanding to analysis.

**Text**  
Patricia Buckley Ebrey, The Cambridge Illustrated History of China, Cambridge University Press, 2010 (available at amazon.com from USD7-43). It is recommended that students purchase the book at their home country to avoid shipping delays.

**Overview of the Final Project**  
The project consists of a research paper (less than 10 pages) based on reading and field study on one issue (of students’ choice) faced by the modern Chinese economy. Students are to work in teams of two. The work should be evenly divided and team members will receive the same project grade. All papers should provide a review of the current literature, recently published data, first-hand account, and a conclusion with proposed solutions. Topics must be approved by the instructor. Each team will give a PowerPoint presentation and submit a final report.

**Sample project**  
“If it is so good, why is it so bad — An Analysis of Beijing’s Air Pollution”
- source of the problem
- data and trend
- what are some measures taken & results
- what would be a better solution

**Grading**  
- Homework Assignment: 30%
- Midterm Exam: 20%
- Critique of Article: 20%
- Final Project: 30%
### Objectives

- Develop macroscopic models of smart materials and relate those models to equivalent electrical energy circuits.
- Model and understand the nonlinear effects that effect smart materials.
- Utilize smart materials in actuator, sensor and controlled materials design.
- Apply smart materials to practical engineering systems.

### Syllabus

**Class Organization, introduction and overview of Smart Materials**
- Mathematical preliminaries (notation)
- Matrix and tensor mathematics
- General constitutive modeling

**Piezolectric Materials**
- What are piezoelectric materials
- PZT properties and material constants
- Piezoelectric films
- Nonlinear effects
- Hydroelectrics, creep, depoling
- Incorporating PZT into structural systems
- Electrostrictive materials (PRN)
- Design with piezoelectric

**Electrorheological Fluids and Magnetorheological Fluids**
- What are ER/MR Fluids
- ER/MR Fluid Dashpot Dampers
- Newtonian shear flow, Bingham plastic shear flow, Rectangular Duct Analysis
- Design with ER/MR Fluids

**Shape Memory Alloys**
- What are shape memory alloys?
- Constitutive Models
- Tanaka Model, Liang and Rogers Model, Brinson Model
- Testing of SMA Wires, SMA applications
- Design with Shape Memory

**Project Overview**
The project consists of a design and analysis of a system using smart materials. Each subsection will result in a mini-design project.

**Text**
Course Notes prepared by the instructor.

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### Description

Imagine a world where aircraft monitor their structural health, twist their wings into optimal aerodynamic shapes, and actively control their own vibration, or a world where automobiles brace themselves for impact or actively adjust the ride and comfort for the passengers. Imagine a world where antennas alter their shapes and actively tune themselves. On a limited basis, often experimental, that is today’s world. The technology that will enable many of the previously mentioned advances lies in the field of “Smart Materials.” Smart Materials incorporate materials that have the ability to alter their performance in response to their surrounding.

### Electrorheological Fluids and Magnetorheological Fluids

- What are ER/MR Fluids
- ER/MR Fluid Dashpot Dampers
- Newtonian shear flow, Bingham plastic shear flow, Rectangular Duct Analysis
- Design with ER/MR Fluids

- Shape Memory Alloys
  - What are shape memory alloys?
  - Constitutive Models
  - Tanaka Model, Liang and Rogers Model, Brinson Model
  - Testing of SMA Wires, SMA applications
  - Design with Shape Memory

### Project Overview

The project consists of a design and analysis of a system using smart materials. Each subsection will result in a mini-design project.

**Text**
Course Notes prepared by the instructor.
Biomaterials and Biocompatibility (3 Credits)

**Description**
This course is designed to introduce students to a more advanced understanding of biomaterials. Throughout the course ties are made between the topic of study and clinically relevant biomaterial performance. The course will introduce various biomaterials such as polymers, metals, and ceramics with the focus on their synthesis, characterization, structure-property relationship and surface modification. The biocompatibility issues of biomaterials will be discussed from different aspects such as protein adsorption, foreign body reaction, immune and inflammatory response etc. Finally, examples of clinical applications will be given.

**Objective**
To be familiar with the general types of materials used in biomedical applications. To understand the basic principles behind tissue response to artificial device implantation. To understand techniques utilized to control the physiologic response to implants. To be familiar with the design strategies and clinical applications of biomaterials.

**Topics**
- Introduction of different materials (polymers, metals, ceramics, glasses, and nature derived materials)
- Surface analysis and surface modification
- Protein adsorption and cell adhesion
- Inflammatory host tissue response, foreign body reaction and wound healing
- Immune response
- Blood-biomaterial interaction
- Calcification, tumorgenesis and Infection
- In vitro and in vivo biocompatibility evaluation
- Biomedical design strategies in clinical applications (cardiovascular, neurological, drug delivery, etc.)

**Reference**

**Text**

**Grading**
- Quizzes: 20%
- Participation: 10%
- Final Exam: 40%
- Examination: 30%
- Total: 100%

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Applied Finite Element Technology (3 Credits)

**Reference**

**Description**
The computational aided engineering methods are extensively used in real-life engineering applications and industry. Techniques such as finite element method are very versatile and frequently indispensable part of engineering analysis and design. These methods are now widely used in practically all branches of engineering including the analysis of structures, solids, and fluids. In this introductory course, you will develop an understanding for the basis of the commonly used computational methods in mechanical systems analysis and design. Modeling of mechanical engineering problems using finite element method will be discussed. You will also have an opportunity to use finite element for projects. At the end of the course you will be able to develop finite element models and obtain solutions for linear and some nonlinear practical engineering problems.

**Objective**
To develop an understanding of finite element (FE) method and its application to real-life engineering problems. You will learn the three phases of FE process, and element development/discretization techniques. At the end of the course you will be able to develop finite element models and obtain solutions for linear and some nonlinear practical engineering problems.

**Topics**
- Review the general steps of the Finite Element Method (FEM): Applications and advantages of the FEM, role of the computer and computer programs for the FEM.
- Formulation of the FEM, linear analysis in solid and structural mechanics: Formulation of the displacement-based finite element method, Convergence of analysis results, Incompatible and mixed finite element models.

**Grading**
- Quizzes: 20%
- Project assignment: 30%
- Midterm Exam: 10%
- Final Exam: 40%
- Total: 100%
## Machine Learning in Biomedicine (3 Credits)

**Description**
This course is designed for students interested in biology, biomedicine, computing, and their intersection, as well as in biomedical engineering. The course aims to demonstrate how fundamental computational and algorithmic methods form the basis and the core of modern methods in computational biomedicine. It presents hardline topics in machine learning, probability, statistical modeling and algorithms, while focusing on their practical application as building blocks for computational biology and medicine. The computational topics covered include: dynamic programming; Bayesian methods; Bayesian networks; Hidden Markov models and the theory behind them; categorization-classification and clustering; text mining and information retrieval. Examples of the biomedical applications covered include: biological sequence alignment; gene finding; protein subcellular location prediction; cardiovascular data analysis; anomaly detection; biomedical text mining.

**Objective**
By the end of the course students should be able to see and understand how computational (and mathematical) concepts that might have seemed abstract and possibly "arbitrary" when first encountered in introductory math and computer science classes, such as dynamic programming, conditional probability or Bayes rule, are directly applicable to problems in biomedical data analysis. Moreover, students will be able to apply such methods and make new connections between theoretical material in computer science & mathematics and applications in biology and medicine.

<table>
<thead>
<tr>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
</tr>
<tr>
<td>Dynamic programming and biological sequence alignment</td>
</tr>
<tr>
<td>Conditional probability, Bayes’ theorem, expectation maximization, their role in clustering and classification, with biomedical and clinical applications.</td>
</tr>
<tr>
<td>Hidden Markov models and their biological/clinical applications.</td>
</tr>
<tr>
<td>Biomedical text mining and the computational methods applied in it.</td>
</tr>
<tr>
<td>Protein subcellular Location Prediction from sequence and from text data.</td>
</tr>
<tr>
<td>Bayesian networks and their application in modeling for biomedicine.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to Computational Molecular Biology by C. Sutcliffe and J. Mabiana (Cengage Learning, 1997)</td>
</tr>
<tr>
<td>Mining the Biomedical Literature by H. Shatkay and M. Craven (MIT Press, 2012)</td>
</tr>
<tr>
<td>Molecular Biology of the Cell by B. Alberts et al. (Garland Science, 2007)</td>
</tr>
<tr>
<td>Journal Papers</td>
</tr>
</tbody>
</table>

**Grading**
| Midterm assessment tests | 25% each |
| Homework assignments | 40% |
| Participation and discussion | 10% |
| Total | 100% |

## Introduction to Nanomedicine: Basic Concepts and Applications (3 Credits)

**Description**
Most commercially available healthcare products such as detergent, toothpaste and sunscreen, all contain nanoparticles in their formulation. At a fundamental level, the canonical biomolecules, including nucleic acids, sugars and proteins, also assume a size in the nanometer range. Due to enormous improvement in technologies that support the fabrication and manipulation of nanosized objects in the past two decades, increasing research efforts have focused on engineering biomolecules at the nanometer length scale. This emergent class of biomaterials forms the basis of numerous “nanomedicine” applications that are now under active investigation, and may provide promising solutions to some of the world’s most severe diseases and other healthcare problems. This course will provide an overview of the field of nanomedicine. We will first articulate how “nano” as a length scale is relevant to biomedical research efforts have focused on engineering biomolecules at the nanometer length scale. This emergent class of bionanomaterials forms the basis of numerous “nanomedicine” applications that are now under active investigation, and may provide promising solutions to some of the world’s most severe diseases and other healthcare problems. This course will provide an overview of the field of nanomedicine. We will first articulate how “nano” as a length scale is relevant to biomedical applications. We will then explain the tools for the assembly and characterization of biomaterials, and illustrate the materials design considerations for creating nanomaterial-based agents involved in each of the pillar. We will conclude by delineating the process for translating nanomedicine products from laboratory discoveries to clinically relevant therapies.

**Objective**
- Other review articles and reference readings will be distributed in class.

<table>
<thead>
<tr>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other review articles and reference readings will be distributed in class.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Syllabus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part 1: Introduction</td>
</tr>
<tr>
<td>“Nano” as a bio-relevant length scale</td>
</tr>
<tr>
<td>Commercial “bio-nano” healthcare products</td>
</tr>
<tr>
<td>Part 2: Bionanomaterials</td>
</tr>
<tr>
<td>Fabrication and characterization</td>
</tr>
<tr>
<td>Part 3: Key Applications in Medicine</td>
</tr>
<tr>
<td>Diagnostics and imaging</td>
</tr>
<tr>
<td>Targeted drug delivery</td>
</tr>
<tr>
<td>Part 4: Clinical Translation</td>
</tr>
<tr>
<td>Milestones of the translation process</td>
</tr>
<tr>
<td>Case studies</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Grading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midterm Exam</td>
</tr>
<tr>
<td>Final Exam</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>
**Places of Direct Interest**
A. Beijing Post and Telecom Conference Center  
B. PKU Zhong Guan Yuan Global Village  
C. Student Center  
D. PKU Hospital  
E. Classroom Building No. 2  
F. Room 247, COE Office of International Relations, Dian Jiao Building  
* Cafeterias

**Places of Optional Interest**
1. Yan Nan Yuan, College of Engineering  
2. Boya Tower  
3. Southeast Gate  
4. West Gate  
5. Side West Gate  
6. South Gate  
7. PKU Centennial Lecture Hall  
8. Weiming Lake  
9. Wu Mar  
10. Southwest Gate  
11. East Gate

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