# Purdue University
请求添加/延期或修改大四本科课程
(100-400 Level)

**部门:** Biomedical Engineering  
**有效日期:** Fall 2009

**指示:** 请勾选以下描述此请求目的的项目。

- [X] 新课程及支持文件
- [ ] 存在课程在另一校园提供
- [ ] 到期的课程
- [ ] 改变学分
- [ ] 改变课程标题
- [ ] 改变课程编号
- [ ] 改变课程属性（仅限部门头衔）
- [ ] 改变课程学时
- [ ] 改变课程描述
- [ ] 改变课程要求
- [ ] 学期更改（仅限部门头衔）
- [ ] 从一个部门转移到另一个

**学生名称:**   
**教员名称:**   
**学院名称:**   
**专业名称:**   
**课程号:** 461  
**长期标题:** Transport Processes in Biomedical Engineering  
**短期标题:** Transport Proc in BME

**信用类型:**
- 固定学分: Cr. Hrs. 3
- 变动学分范围: Minimum Cr. Hrs. (Check One)  
- 最高学分: Maximum Cr. Hrs.

**等同学分:** Yes  
**博士学分:** No

**课程属性:**
- 1. Pass/Not Pass Only
- 2. Satisfactory/Unsatisfactory Only
- 3. 可重修
- 4. 通过考试
- 5. 名称要求
- 6. 特别费用
- 7. 注册审批类型
- 8. 变动标题
- 9. 指导
- 10. 荣誉
- 11. 全日制
- 12. 脱离校园

**课程描述: (包括要求)**

P: BME 334. This course explores engineering principles in mass and other transport processes in biological systems. Topics covered include diffusion, convection, reaction kinetics, transport in porous and fluid mediums, etc. Mathematical models of transport are developed and applied to biomedical problems and physiological systems such as the kidney/renal and oxygen/arterial systems.

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<th>Calumet Department Head</th>
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<th>Calumet School Dean</th>
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<th>North Central Department Head</th>
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<th>West Lafayette Department Head</th>
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<th>West Lafayette College/School Dean</th>
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**Office of the Registrar**
New Course Request

Check Appropriate Boxes: Undergraduate credit ☑ Graduate credit ☐ Professional credit ☐

1. School/Division: School of Engineering and Technology
2. Academic Subject Code: BME
3. Course Number: 461 (must be cleared with University Enrollment Services)
4. Instructor:
5. Course Title: Transport Processes in Biomedical Engineering
   Recommended Abbreviation (Optional): Transport Proc in BME
   (Limited to 32 Characters including spaces)
6. First time this course is to be offered (Semester/Year): Fall 2009
7. Credit Hours: Fixed at 3 or Variable from ___________ to ___________
8. Is this course to be graded S-F (only)? Yes ☐ No ☑
9. Is variable title approval being requested? Yes ☐ No ☑
10. Course description (not to exceed 50 words) for Bulletin publication:
    This course explores engineering principles in mass and other transport processes in biological systems. Topics covered include diffusion, convection, reaction kinetics, transport in porous and fluid mediums, etc. Mathematical models of transport are developed and applied to biomedical problems and physiological systems such as the kidney/renal and oxygen/arterial systems.
    Prerequisite: BME 334
11. Lecture Contact Hours: Fixed at 3 or Variable from ___________ to ___________
12. Non-Lecture Contact Hours: Fixed at 0 or Variable from ___________ to ___________
13. Estimated enrollment: 25 of which 0 percent are expected to be graduate students.
14. Frequency of scheduling: yearly ☑
15. Justification for new course: New BME undergraduate curriculum
16. Are the necessary reading materials currently available in the appropriate library? Yes ☑
17. Please append a complete outline of the proposed course, and indicate instructor (if known), textbooks, and other materials.
18. If this course overlaps with existing courses, please explain with which courses it overlaps and whether this overlap is necessary, desirable, or unimportant.
19. A copy of every new course proposal must be submitted to departments, schools, or divisions in which there may be overlap of the new course with existing courses or areas of strong concern, with instructions that they send comments directly to the originating Curriculum Committee. Please append a list of departments, schools, or divisions thus consulted.

Submitted by: [Signature]
Date: 4/15/09
Department Chairman/Division Director

Approved by: [Signature]
Date: ___________
Dean

[Signature]
Date: ___________
Chancellor/Vice-President

[Signature]
Date: ___________
University Enrollment Services

After School/Division approval, forward the last copy (without attachments) to University Enrollment Services for initial processing, and the remaining four copies and attachments to the Campus Chancellor or Vice-President.

UPS 724
University Enrollment Services Final—White; Chancellor/Vice-President—Blue; School/Division—Yellow; Department/Division—Pink; University Enrollment Services Advance—White
BME 461 TRANSPORT PROCESSES IN BIOMEDICAL ENGINEERING

FALL 2009

Instructor: TBD
Office:
Phone:
E-mail:

Class: Tue and Thur, 1:30 – 2:45 PM, SL-216

Office Hours: TBA

Prerequisite: BME 334

Textbook:
2. A Transport text book for engineers, such as:

Reference Textbooks:

Course Description:
This course explores engineering principles in mass and other transport processes in biological systems. Topics covered include diffusion, convection, reaction kinetics, transport in porous and fluid mediums, etc. Mathematical models of transport are developed and applied to biomedical problems and physiological systems such as the kidney/renal and oxygen/arterial systems.

Grading:
- Homework 20%
- Exam 1 25%
- Exam 2 25%
- Final Exam 30%

Notes:
- Weekly homework assignments will be a mix of analytical and numerical (e.g. MATLAB) problems
- Additional reading materials will be distributed separately
- No cell phones in class
- Class participation and effort are factors in your final grade
Outline of Topics for 28 Lectures

Diffusion
1. Introduction to class, conservation of mass and energy
2. Fick’s law of binary diffusion, Diffusion coefficient, random walk, Stokes-Einstein equation
3. Diffusion in 1-D, Cartesian, cylindrical, and spherical coordinates, boundary conditions
4. Diffusion limited reactions: protein binding on cell surfaces

Diffusion plus Convection
5. Transport by convection: Mass, molar fluxes, conservation of mass (Cartesian, cylindrical, spherical)
6. Dimensional analysis, Peclet number
7. Diffusion with Convection, boundary layer
8. Mass transfer coefficient
9. Transport in porous media: porosity, tortuosity, available volume
10. Transport and diffusion in porous media

Transport with Biological Reaction, in Physiology
11. Chemical kinetics and reaction mechanism: rates, mechanisms, first, second, reversible,
12. Enzyme kinetics, Michaelis-Menten kinetics, quasi-steady state
13. Receptor ligand binding kinetics
14. Oxygen-hemoglobin kinetics
15. Oxygen delivery, Krogh cylinder model of oxygen transport
16. Kidney renal physiology, tubular transport, ion channels
17. Glomerular filtration, permeability, hydraulic pressure
18. Hemodialysis
19. Osmotic pressure, Starling’s law
20. Electrolyte transport, Nernst-Planck equation

Thermodynamics, Heat Transfer
21. Thermodynamics basics
22. Energy balance, heat transfer
23. Thermal conductivity, conduction in biological systems
24. Thermal convection, fluid flow in biological systems
25. Conduction with convection – biological models
26. Temperature and pressure dependence of diffusivities
27. Applications of heat and mass transport
28. Review Lecture
Instructional Goals:

After completion of this course students should be able to:

1. Apply and solve mass diffusion equations. [a,e]
2. Apply and solve heat transfer equations. [a]
3. Understand and apply conservation of mass and energy balance. [a,e]
4. Understand and apply basic principles of thermodynamics [a]
5. Use appropriate boundary conditions to heat and mass transfer problems. [a]
6. Apply diffusion and transport equations to biological processes. [a]
7. Describe transport processes in physiological systems such as the renal system in the kidney, using engineering principles and mathematical analysis of transport. [l]
8. Use numerical methods to solve differential equations in transport. [e,k,m]
9. Apply conservation principles to transport processes. [a]
10. Understand and apply models of transport and enzyme kinetics. [c,l]
PURDUE SCHOOL OF ENGINEERING & TECHNOLOGY
OUTCOMES AND ASSESSMENT DATA SHEET

This is an internal document to identify and record expected outcomes and anticipated assessment strategies for all courses taught within the School of Engineering and Technology. Submission of this form, as noted below, is required and must accompany all new course and course change requests. Copies of this form should also be retained within the department and kept on file with the outline or syllabus for each course.

Course Number: BME 461 Course Title: Transport Processes in Biomedical Engineering

Procedure:

First, identify all instructional outcomes expected for this course, and then select all ABET outcomes which are consistent with those anticipated objectives from TABLE 1 below.

<table>
<thead>
<tr>
<th>TABLE 1 - ABET OUTCOMES</th>
<th>ENGINEERING - EAC Criteria #3</th>
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<tbody>
<tr>
<td>An ability to apply knowledge of mathematics, science, and engineering</td>
<td>a</td>
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<tr>
<td>An ability to design and construct experiments as well as to analyze and interpret data.</td>
<td>b</td>
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<tr>
<td>An ability to design a system, component, or process to meet desired needs.</td>
<td>c</td>
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<tr>
<td>An ability to function on multi-disciplinary teams.</td>
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<td>An ability to identify, formulate and solve engineering problems.</td>
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<tr>
<td>An understanding of professional and ethical responsibility.</td>
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<tr>
<td>An ability to communicate effectively.</td>
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<tr>
<td>The broad education necessary to understand the impact of engineering solutions in global societal context.</td>
<td>h</td>
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<tr>
<td>A recognition of the need for and ability to engage in life-long learning.</td>
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<td>A knowledge of contemporary issues.</td>
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<tr>
<td>An ability to use the techniques, skill and modern engineering tools necessary for engineering practice.</td>
<td>k</td>
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</table>

Subsets for each of the six IUPUI Principles of Undergraduate Learning (PUL) are given on the reverse side in TABLE 2. Using a number corresponding to each ABET outcome identified from TABLE 1 above to select a column, place an "o" or "x" mark in the applicable TABLE 2 row(s) cell for each PUL. Courses will often address multiple ABET outcomes and ABET outcomes frequently will overlap more than one PUL subset. Thus, it is expected completed data sheets may contain marks in several cells thereby indicating the course simultaneously satisfies multiple Principles of Undergraduate Learning while fulfilling its intended ABET objective(s).

After completing TABLE 2, briefly define or explain how the course outcomes or objectives will be evaluated within the context of the departmental assessment program in the space below:

Course objectives will be assessed by student performance on homework, exams, and written assignments. Individual assignments linked to specific course and ABET outcomes will be used to assess achievement of those outcomes.

Submitted By: Karen Allfrey Date: 18 February 2009
TABLE 2 - MATRIX OF EXPECTED COURSE OUTCOMES

(Suggestion - while completing Table 2, place a copy of the ABET outcomes from Table 1 along side for easy cross referencing.)

<table>
<thead>
<tr>
<th>PRINCIPLES OF UNDERGRADUATE LEARNING - &quot;Require all students to demonstrate an ability to:&quot;</th>
<th>ENGINEERING OUTCOMES - EAC CRITERIA #3: Items (a) to (k)</th>
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<tbody>
<tr>
<td>1(a) - Express ideas and facts effectively in written formats</td>
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<td>1(b) - Comprehend, interpret, and analyze texts</td>
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<td>1(c) - Communicate orally in one-on-one and group settings</td>
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<td>1(d) - Solve problems that are quantitative in nature</td>
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<td>1(e) - Make efficient use of information resources and technology for personal and professional needs</td>
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<td>2(a) - Analyze complex issues and make informed decisions</td>
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<td>2(b) - Synthesize information in order to arrive at reasoned conclusions</td>
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<td>2(c) - Evaluate the logic, validity, and relevance of data</td>
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<td>2(d) - Solve challenging problems</td>
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<td>2(e) - Use knowledge and understanding to generate and explore new questions</td>
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<td>3(a) - Apply knowledge to enhance personal lives</td>
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<td>3(b) - Apply knowledge to meet professional standards and competencies</td>
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<td>3(c) - Apply knowledge to further the goals of society</td>
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<td>4(a) - Demonstrate substantial knowledge and understanding of at least one field of study</td>
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<td>4(b) - Compare and contrast approaches to knowledge in different disciplines</td>
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<td>4(c) - Modify their approach to an issue or problem based on the contexts and requirements of particular situations</td>
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<td>5(a) - Compare and contrast the range of diversity and universality in human history, societies, and ways of life</td>
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<td>5(b) - Analyze and understand the interconnectedness of global and local concerns</td>
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<td>5(c) - Operate with civility in a complex social world</td>
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<td>6(a) - Make informed and principles choices regarding conflicting situations in their personal and public lives and to foresee the consequences of these choices</td>
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<tr>
<td>6(b) - Recognize the importance of aesthetics in their personal lives and to society</td>
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