New Course Request

Indiana University

Indianapolis _________ Campus

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 442 (must be cleared with University Enrollment Services)

4. Instructor

5. Course Title Biofluid and Biosolid Mechanics

Recommended Abbreviation (Optional) Biofluid Biosolid Mech

(Limited to 32 Characters including spaces)

6. First time this course is to be offered (Semester/Year): Spring 2008

7. Credit Hours: Fixed at _______ 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 fluid and solid mechanics in the context of the human circulatory system. Principal equations are derived from differential analysis of fluid flow, and models of characteristic flow conditions are fully analyzed. Biosolid mechanics, vessel biomechanics, and hemodynamic analysis of the circulation system will also be discussed. Prerequisites: BME 352, BME 354.

11. Lecture Contact Hours: Fixed at _______ or Variable from _________ to _________

12. Non-Lecture Contact Hours: Fixed at _______ or Variable from _________ to _________

13. Estimated enrollment: _______ of which _______ percent are expected to be graduate students.

14. Frequency of scheduling: _______. Will this course be required for majors? Yes

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: ___________________________ Date 12/10/07

Department Chairman/Division Director

Approved by: __________________________ Date 12/11/07

Dean

Date __________________________

Chancellor/Vice-President

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 442 BIOFLUID & BIOSOLID MECHANICS

SPRING 2008

Instructor: Julie Y. Ji, Ph.D.
Office: SL-220J
Phone: 317-278-2275
E-mail: jji@iupui.edu

Class: Tue and Thur, 10:30 – 11:45 AM, SL-???

Office Hours: TBA

Prerequisite: BME 352/354


Reference Textbooks:
  WM Deen, Analysis of Transport Phenomena, Oxford 1998
  CR Ethier, CA Simmons, Introductory Biomechanics, Cambridge 2007

Course Description:
This course explores fluid and solid mechanics in the context of the human circulatory system. Principal equations are derived from differential analysis of fluid flow, and models of characteristic flow conditions are fully analyzed. Biosolid mechanics, vessel biomechanics, and hemodynamic analysis of the circulation system will also be discussed.

Instructional Goals:
After completion of this course students should be able to:

1. Understand basic physical properties of fluids.
2. Evaluate force and pressure balances acting on fluid.
3. Derive conservation of mass and linear momentum.
4. Derive and apply Navier-Stokes equations.
5. Able to solve classic flow models.
6. Analytically approach and solve fluid flow problems.
7. Evaluate stress and strain analysis of solids.
8. Understand physiology of the human circulation system.
10. Apply fluid mechanics to blood flow models.
11. Evaluate and design biofluid mechanics problems (project).

Content: Topics to be covered in this course can be primarily divided into 3 parts, with an emphasis on fundamental principles of fluid mechanics. This course will present an integrated introduction to basic fluid mechanics. Understanding basic physical properties of fluids and analyzing force and pressure balances are fundamental to solving engineering problems. Conservation of mass and linear momentum are derived from basic differential analysis of fluid flow. Problems-solving approaches and concepts are
explored for classic fluid dynamic models. Second part of this course will include an
introductory to solid mechanics, with discussions on mechanics of materials stresses and
strains, and viscoelasticity. Final part of this course will cover integration of fluid and
solid mechanics in the human circulation systems. Principles of fluid and solid mechanics
are used in the context of blood rheology, vessel biomechanics, and vascular implants.

Outline of Topics: (roughly by lectures, order may vary)

I. Principles of fluid mechanics
   1. Introduction: basic terms defined, viscosity
   2. Fluid statics: pressure and force balances
   3. Fluid kinematics: velocity, acceleration fields
   4. Control volume analysis, Reynolds Transport Theorem
   5. Differential analysis of fluid flow
   6. Conservation of Mass and Linear Momentum (continuity, momentum equations)
   7. Viscous flow – Navier-Stokes Equations
   8. Couette flow, Poiseuille flow
   9. Dimensional analysis
  10. Low Reynolds number flow – Stokes or creeping flow
  11. High Reynolds number – Bernoulli Equation
  12. Rotational, irrotational flow
  13. Viscous flow in pipe
  14. Boundary layer

II. Solid mechanics
   15. Introduction to solid mechanics – elasticity, stress and strain
   16. Analysis of thin, thick-walled cylindrical tube
   17. Blood vessel mechanics
   18. Special topic – Equilibrium equation
   19. Special topic – Viscoelasticity
   20. Special topic – Properties of biomaterials

III. Biomechanics of the human circulation
   21. Rheology of blood
   22. Pressure-flow relationships in blood
   23. Static and steady flow – Applications of Bernoulli equation
   24. Static and steady flow – Rigid tube model, entrance length
   25. Unsteady and non-uniform models, Windkessel model, pulsatile flow condition
   26. Hemodynamics of atherosclerosis, curvatures and bifurcation of vessels

Grading:

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<th>Component</th>
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<td>Group Project</td>
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<td>Final Exam</td>
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Notes:
- There will be occasional guest lectures, with reading materials to be distributed
  separately.
- There will be approximately 1 homework assignment a week, usually given out on
  Wednesday and due the following Wednesday.
- Homework should be based on individual efforts.
- Projects may be group efforts – more instructions to come.
- No cell phones in class.
# Purdue University

**REQUEST FOR ADDITION, EXPIRATION, OR REVISION OF A COURSE**

**DEPARTMENT**: Biomedical Engineering  
**EFFECTIVE SESSION**: Spring 2007

**INSTRUCTIONS**: Please check the items below which describe the purpose of this request.

- [X] 1. New course with supporting documents
- 2. Add existing course
- 3. Expiration of a course
- 4. Change in course number
- 5. Change in course title
- 6. Change in course credit/attribute
- 7. Change in course attributes
- 8. Change in instructional hours
- 9. Change in course description
- 10. Change in course requisites
- 11. Change in semesters offered
- 12. Transfer from one department to another

**PROPOSED**

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<tr>
<th>Subject Abbreviation</th>
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<td>Course Number</td>
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<td>Long Title</td>
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<td>Short Title</td>
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**EXISTING**

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**TERMS OFFERED**

- [X] Summer  
- Spring  
- Fall

**CAMPUS(ES) INVOLVED**

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**CREDIT TYPE**

1. Fixed Credit: Cr. Hrs: 3
2. Variable Credit Range: Minimum Cr. Hrs: 3

**COURSE ATTRIBUTES**

- Check all that apply:
  - 1. Pass/Not Pass Only
  - 2. Satisfactory/Unsatisfactory Only
  - 3. Repeatable
  - 4. Credit by Examination
  - 5. Designated Required
  - 6. Special Fees
  - 7. Registration Approval Type: Instructor
  - 8. Variable Title
  - 9. Remedial
  - 10. Honors
  - 11. Full Time Privilege
  - 12. Off Campus Experience

**Instructional Type**

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**COURSE DESCRIPTION (INCLUDE REQUISITES):**

P: BME 352 and BME 354. This course explores fluid and solid mechanics in the context of the human circulatory system. Principal equations are derived from differential analysis of fluid flow, and models of characteristic flow conditions are fully analyzed. Biofluid mechanics, vessel biomechanics, and hemodynamic analysis of the circulation system will also be discussed.

**Signatures**

- Calumet Undergrad Curriculum Committee: Date
- Calumet Department Head: Date
- Fort Wayne Department Head: Date
- Fort Wayne School Dean: Date
- Indianapolis Department Head: Date
- Indianapolis School Dean: Date
- North Central Department Head: Date
- North Central Chancellor: Date
- West Lafayette Department Head: Date
- West Lafayette College/School Dean: Date
- Graduate Council Area Committee Chair: Date
- Graduata Dean: Date
- Fort Wayne Chancellor: Date
- Undergrad Curriculum Committee: Date
- Data Approved by Graduate Council: Date
- Graduate Council Secretary: Date
- West Lafayette Registrar: Date

**OFFICE OF THE REGISTRAR**