

TO: The Faculty of the College of Engineering

FROM: The Faculty of the School of Biomedical Engineering

RE: New Undergraduate Course, BME 46000, Cardiovascular Mechanical Support and Devices

The faculty of the School of Biomedical Engineering have approved the following new course. This action is now submitted to the Engineering Faculty with a recommendation for approval.

BME 46000 Cardiovascular Mechanical Support and Devices

Term offered: Fall, Lecture 3, Cr. 3

Prerequisite: BME 25600

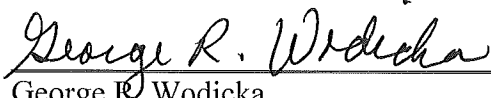
Concurrent prerequisite: BME 30400

Description: Designed to expose students to state-of-the-art medical technologies being utilized in the treatment of patients with cardiovascular diseases, the course emphasizes the role of the biomedical engineer in the design, development and implementation of these technologies for therapeutic impact. Students completing this course will have an understanding of the role of biomedical engineers in clinical engineering and clinical research. The three components of the course, didactic presentations and discussions, laboratory dissections, and clinical shadowing are integrated throughout to teach concepts such as cardiovascular physiology, heart failure and vascular disease, treatments and treatment complications, and future directions. Clinical experts in cardiovascular diagnosis and treatment are frequent guest lecturers.

Reason: This course is beneficial within the undergraduate curriculum as a technical elective course required by the Weldon School of Biomedical Engineering. This course serves as a focal point for integrated discourse on cardiovascular disease, medical technologies, and clinical practice. Students gain in-depth understanding of the interface between mechanics, devices, and care of patients within a wide range of cardiac and vascular diseases as an expansion of their learning in the required core course, BME 25600, Physiological Modeling in Human Health, as well as several of the other required undergraduate courses. The clinical shadowing experience further reinforces this understanding by providing the unique opportunity for students to witness biomedical engineering technology and healthcare in practice in a real clinical setting. Overall, the class lectures, physician guest speakers, tissue dissections, and shadowing experiences help bridge the gap between the current

undergraduate curriculum and the real-world application of the engineering concepts and technology needed in healthcare, the cardiovascular field and the overall clinical setting, whether the student is interested in a future in either industry or medicine.

This course has been offered three times previously as a 400-level experimental course. It is very popular with our BME students and fills to the limit each offering with the following enrollment history: Fall 2015 (20), Fall 2016 (22), and Spring 2017 (20).

A handwritten signature in cursive script that reads "George R. Wodicka". The signature is written in black ink and is positioned above a horizontal line.

George R. Wodicka,
Dane A. Miller Head and Professor
Weldon School of Biomedical Engineering

BME 46000 Cardiovascular Mechanical Support and Devices

Syllabus

2018 Spring Semester, 3 credits

Tuesday/Thursday from 3:00-4:15 pm, MJIS 1083

Prerequisites: BME 256 and concurrent with BME 304

Course Objectives: This course is designed to expose the student to state-of-the-art technologies being utilized in the treatment of patients with cardiovascular diseases. The course will emphasize the role of the bioengineer in the development and implementation of these therapies. Students completing this course will have an understanding of the role bioengineers play in clinical engineering and clinical research.

The class has three distinct components: 1) didactic presentations and discussion; 2) laboratory dissections; and 3) clinical shadowing. Some of the topics covered in the lectures are:

- 1) Cardiovascular anatomy and physiology
- 2) Heart function and hemodynamics
- 3) Heart failure and treatment
- 4) Vascular disease and treatment
- 5) Complications
- 6) Future directions and next generation of devices

Clinical shadowing will focus on clinical activities that coincide with the current lecture material. The following is a tentative list of the shadowing topics:

- 1) Heart Failure Clinic
- 2) Cardiac Catheterization Lab
- 3) OR-general cardiac surgery
- 4) OR-VAD implant/Heart Transplant
- 5) VAD-post-op management/outpatient clinic

Students will be expected to write an in-depth research or design proposal based on what they learn in the lectures and their experiences in the clinic.

Reason: This course will serve as a focal point of discourse for biomedical engineering students that are interested in cardiovascular disease, medical devices, or clinical practice. Students will gain an in-depth understanding of the interface between mechanics, devices, and care of patients with a wide range of cardiac and vascular diseases.

Primary Instructor:

Craig Goergen

Email: cgoergen@purdue.edu

Office: MJIS 3025

Phone: 765-494-1517

Office hours: By email appointment – I will always make time to meet.

Teaching Assistant:

Natalie Berry

Email: berry39@purdue.edu**Tentative Course Schedule:**

Date	Topic
Tues Jan 09	Course introduction and professional conduct in a clinical setting
Thur Jan 11	IU Health forms and cardiovascular anatomy
Tues Jan 16	Cardiovascular anatomy and EKGs
Thur Jan 18	Cardiac rhythm summary and dissection discussion
Tues Jan 23	<i>Dissection laboratory #1: mice</i>
Thur Jan 25	Cardiac surgery
Tues Jan 30	NO CLASS
Thur Feb 01	Former Student Visit: Mary Christy , Medical School
Tues Feb 06	<i>Field trip to Lyles-Porter for IUSM gross anatomy lab</i>
Thur Feb 08	Tissue engineering and medical devices
Tues Feb 13	Guest Lecture: Dr. Tyler Novak, PhD , Cook Biotech
Thur Feb 15	<i>Dissection laboratory #2: pig hearts</i>
Tues Feb 20	Guest Lecture: Dr. Thomas Wozniak , Thoracic and Transplant Surgery
Thur Feb 22	Guest Lecture: Dr. W. Aaron Kay , Congenital Heart Disease
Tues Feb 27	Congenital heart disease
Thur Mar 01	Stents and stent grafts
Tues Mar 06	Guest Lecture: Dr. Neil Mascarenhas , Interventional Radiology
Thur Mar 08	Midterm Exam - in class
Tues Mar 13	NO CLASS - Spring Break
Thur Mar 15	NO CLASS - Spring Break
Tues Mar 20	Former Student Visit: Hilary Schroeder , Rural Health
Thur Mar 22	VAD introduction
Tues Mar 27	Guest Lecture: Dr. I-Wen Wang , Cardiac Surgery
Thur Mar 29	Former Student Visit: Tori Hensley , Cardiac Arrhythmias
Tues Apr 03	NO CLASS
Thur Apr 05	Guest Lecture: Dr. Gopi Dandamudi , Advanced Cardiac Pacing
Tues Apr 10	Guest Lecture: Dr. Vitaliy Rayz , Computational Modeling and Devices
Thur Apr 12	NO CLASS
Tues Apr 17	Guest lecture summary
Thur Apr 19	Class presentations
Tues Apr 24	Class presentations
Thur Apr 26	Review session for final and course wrap-up
	Final Exam – do not book travel yet

Grade Assessment:

1. Class participation and homework completion - 5%
2. Individual shadow reports - 15%
3. Group project - 30% total
 - a. Mid-semester project update - 5%
 - b. Two page final written document - 10%
 - c. Ten minute in class oral presentation - 10%
 - d. Team member peer evaluation - 5%
4. Midterm exam - 15%
5. Final exam - 35%

Final Exam:

Do not book travel plans until you know the final exam schedule. Makeups final will be given only at the discretion of the instructor; format may be different. Advance notice, when possible, is highly recommended. Students must adhere to Purdue policy as outlined: http://www.purdue.edu/usp/acad_policies/attendance.shtml

Grade Distribution:

A	93-100%
A-	90-92.9%
B+	87-89.9%
B	83-86.9%
B-	80-82.9%
C+	77-79.9%
C	73-76.9%
C-	70-72.9%
D+	67-69.9%
D	63-66.9%
D-	60-62.9%
F	59.9% and below

Purdue Honor Pledge: *As a boilermaker pursuing academic excellence, I pledge to be honest and true in all that I do. Accountable together - we are Purdue*

Expectations:

Attend lecture, participate in discussions, communicate concerns to the instructor, and provide constructive feedback. Participate in clinical experiences that will take place at IU Arnett in Lafayette, IU Methodist in Indianapolis, IUPUI, Riley Hospital for Children, or Roudebush VA Medical Center. This syllabus and course schedule is subject to change at the instructor's discretion.

Required Text and Equipment:

- Rapid Interpretation of EKG's, Dale Dubin
 - We will use the 6th edition in class
 - ISBN-13: 978-0912912066
 - ISBN-10: 0912912065
 - <http://www.amazon.com/Rapid-Interpretation-EKGs-Sixth-Edition/dp/0912912065>
- Discussions and assignments based on lecture slides and primary literature.

Selected articles and slides posted on Blackboard Learn:

<https://mycourses.purdue.edu>

Course climate:

Respectful feedback is welcomed. In this course, each voice in the classroom has something of value to contribute. Please take care to respect the different experiences, beliefs and values expressed by students and staff involved in this course. We support Purdue's commitment to diversity, and welcome individuals of all ages, backgrounds, citizenships, disabilities, education, ethnicities, family statuses, genders, gender identities, geographical locations, languages, military experience, political views, races, religions, sexual orientations, socioeconomic statuses, and work experiences.

Academic Dishonesty

All students are expected to perform with the highest academic integrity. Students are expected to abide by the Purdue University Code of Honor and Regulations regarding student conduct. The bottom line is DON'T CHEAT, and DON'T HELP OTHERS CHEAT. Any student involved in acts of academic dishonesty, including cheating and plagiarism, will fail the course. The source of the following two excerpts can be found at:

http://www.purdue.edu/univregs/pages/stu_conduct/stu_regulations.html

Part 5: Section II- Purdue University Code of Honor: "To foster a climate of trust and high standards of academic achievement, Purdue University is committed to cultivating academic integrity and expects students to exhibit the highest standards of honor in their scholastic endeavors. Academic integrity is essential to the success of Purdue University's mission. As members of the academic community, our foremost interest is toward achieving noble educational goals and our foremost responsibility is to ensure that academic honesty prevails."

Part 5: Section III Regulations Governing Student Conduct, Disciplinary Proceedings, and Appeals "Misconduct Subject to Disciplinary Penalties. The following actions constitute misconduct for which students may be subject to administrative action or disciplinary penalties. Dishonesty in

connection with any University activity. Cheating, plagiarism, or knowingly furnishing false information to the University are examples of dishonesty. The commitment of the acts of cheating, lying, stealing, and deceit in any of their diverse forms (such as the use of ghost-written papers, the use of substitutes for taking examinations, the use of illegal cribs, plagiarism, and copying during examinations) is dishonest and must not be tolerated. Moreover, knowingly to aid and abet, directly or indirectly, other parties in committing dishonest acts is in itself dishonest. (University Senate Document 72-18, December 15, 1972).”

Attendance

Students are expected to be present for every meeting of the classes in which they are enrolled. Only the instructor can excuse a student from a course requirement or responsibility. When conflicts or absences can be anticipated, such as for many University sponsored activities and religious observations, the student should inform the instructor of the situation as far in advance as possible. For unanticipated or emergency absences when advance notification to an instructor is not possible, the student should contact the instructor as soon as possible by email, or by contacting the main office that offers the course. When the student is unable to make direct contact with the instructor and is unable to leave word with the instructor’s department because of circumstances beyond the student’s control, and in cases of bereavement, the student or the student’s representative should contact the Office of the Dean of Students.

Grief Absence Policy for Students

Purdue University recognizes that a time of bereavement is very difficult for a student. The University therefore provides the following rights to students facing the loss of a family member through the Grief Absence Policy for Students (GAPS). GAPS Policy: Students will be excused for funeral leave and given the opportunity to earn equivalent credit and to demonstrate evidence of meeting the learning outcomes for misses assignments or assessments in the event of the death of a member of the student’s family.

Missed or Late Work

Late work can be submitted with a 10% deduction per late day.

Violent Behavior Policy

Purdue University is committed to providing a safe and secure campus environment for members of the university community. Purdue strives to create an educational environment for students and a work environment for employees that promote educational and career goals. Violent Behavior impedes such goals. Therefore, Violent Behavior is prohibited in or on any University Facility or while participating in any university activity.

Students with Disabilities

Purdue University is required to respond to the needs of the students with disabilities as outlined in both the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990 through the provision of auxiliary aids and services that allow a student with a disability to fully access and participate in the programs, services, and activities at Purdue University. If you have a disability that requires special academic accommodation, please make an appointment to speak with me within the first three (3) weeks of the semester in order to discuss any adjustments. It is important that we talk about this at the beginning of the semester. It is the student's responsibility to notify the Disability Resource Center (<http://www.purdue.edu/drc>) of an impairment/condition that may require accommodations or classroom modifications.

Nondiscrimination

Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her own potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life.

Purdue University prohibits discrimination against any member of the University community on the basis of race, religion, color, sex, age, national origin or ancestry, genetic information, marital status, parental status, sexual orientation, gender identity and expression, disability, or status as a veteran. The University will conduct its programs, services and activities consistent with applicable federal, state and local laws, regulations and orders and in conformance with the procedures and limitations as set forth in [Executive Memorandum No. D-1](#), which provides specific contractual rights and remedies. Any student who believes they have been discriminated against may visit www.purdue.edu/report-hate to submit a complaint to the Office of Institutional Equity. Information may be reported anonymously.

Emergencies

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Relevant changes to this course will be posted onto the course website or can be obtained by contacting the instructors or TAs via email or phone. You are expected to read your @purdue.edu email on a frequent basis.

EMERGENCY PREPAREDNESS

EMERGENCY NOTIFICATION PROCEDURES are based on a simple concept – if you hear a fire alarm inside, proceed outside. If you hear a siren outside, proceed inside.

- **Indoor Fire Alarms** mean to stop class or research and immediately evacuate the building.
- Proceed to your Emergency Assembly Area away from building doors. **Remain outside**

until police, fire, or other emergency response personnel provide additional guidance or tell you it is safe to leave.

- **All Hazards Outdoor Emergency Warning Sirens** mean to immediately seek shelter (**Shelter in Place**) in a safe location within the closest building.
 - “Shelter in place” means seeking immediate shelter inside a building or University residence. This course of action may need to be taken during a tornado, a civil disturbance including a shooting or release of hazardous materials in the outside air. Once safely inside, find out more details about the emergency*. **Remain in place** until police, fire, or other emergency response personnel provide additional guidance or tell you it is safe to leave.

**In both cases, you should seek additional clarifying information by all means possible...Purdue Emergency Status page, text message, email alert, TV, radio, etc...review the Purdue Emergency Warning Notification System multi-communication layers at http://www.purdue.edu/epps/emergency_preparedness/warning-system.html*

EMERGENCY RESPONSE PROCEDURES:

Review the **Emergency Procedures Guidelines**

https://www.purdue.edu/emergency_preparedness/flipchart/index.html

- Review the **Building Emergency Plan** (available on the Emergency Preparedness website or from the building deputy) for:
 - evacuation routes, exit points, and emergency assembly area
 - when and how to evacuate the building.
 - shelter in place procedures and locations
 - additional building specific procedures and requirements.

EMERGENCY PREPAREDNESS AWARENESS VIDEOS

"Shots Fired on Campus: When Lightning Strikes," is a 20-minute active shooter awareness video that illustrates what to look for and how to prepare and react to this type of incident. See: <http://www.purdue.edu/securePurdue/news/2010/emergency-preparedness-shots-fired-on-campus-video.cfm> (Link is also located on the EP website)

MORE INFORMATION

Reference the Emergency Preparedness web site for additional information:
https://www.purdue.edu/epps/emergency_preparedness/

BME 460 Learning Outcomes

- 1) At the end of BME 460, Cardiovascular Mechanical Support and Devices, students will be able to identify key anatomical and physiological features of the cardiovascular system. They will learn this by dissecting mice and pig hearts, viewing illustrations, and both reading research articles and the textbook focused on EKGs.
- 2) At the end of BME 460, students will be able to more easily identify unmet clinical needs and practice brainstorming possible solutions by writing an in depth report and giving an oral presentation based on both the course material and their clinical experiences.
- 3) At the end of BME 460, students will be able to recognize fundamental engineering concepts used to design and utilize cardiovascular medical devices by writing shadow reports based on their immersion within a clinical setting.
- 4) At the end of BME 460, students will be able to describe and diagnose various cardiac and vascular diseases by completing a mid semester and final examination covering the course material.
- 5) At the end of BME 460, students will be able to explain the role of a biomedical engineer in the development and implementation of cardiovascular disease treatment in healthcare by interacting with multiple health care professionals during and after their guest lectures.