



College of Engineering

Engineering Faculty Document
No.: 46-26
10/21/25

TO: The Engineering Faculty

FROM: The Faculty of the Weldon School of Biomedical Engineering

RE: New 300 level course – BME 32600: Applied Biomaterials I

The Faculty of the Weldon School of Biomedical Engineering has approved the following new 300-level course. This action is now submitted to the Engineering Faculty with a recommendation for approval.

FROM:
BME 39500: Applied Biomaterials I
Semesters offered: Spring
Total number of credits: 3 (3 lecture credits)
Prerequisites: BME 22000
Major Restriction: Biomedical Engineering only

TO:
BME 32600: Applied Biomaterials I
Semesters offered: Spring
Total number of credits: 3 (3 lecture credits)
Prerequisites: BME 22000 and BME 32000
Major Restriction: Biomedical Engineering only

COURSE DESCRIPTION:

This course will explore the various biomedical applications of biomaterials - covering the broadly defined areas of (1) 3D printing and biofabrication, (2) Controlled drug delivery, (3) Tissue engineering, and (4) Disease modeling. Students will delve deeper into the specific requirements and expected outcomes for each application and will explore the design space and mode of application for biomaterials. Students will appreciate unique and context-dependent criteria for the design of biomaterials, demonstrate knowledge of fabrication methods, identify biomaterials with the most appropriate biochemical and biophysical properties, and choose the most relevant biomaterials for applications in 3D printing, tissue engineering, drug delivery, and disease modeling.

RATIONALE:

BME 32600 was developed to support our new depth area in Biomaterials and to help integrate content between IUPUI and Purdue courses during the integration period. A solid foundation of biomaterials is vital to BME education, and that foundation is now provided in the required course BME 32000 Biomaterials. This *new* course, BME 32600 Applied Biomaterials I, will offer an opportunity for students who select the Biomaterials depth area to gain greater depth in how biomaterial fundamentals are used in real world research

and industry applications. The new course will help satisfy the depth area requirements in the BME curriculum. The course piloted with a temporary number in Spring 2025 with 8 students who expressed positive comments on the class and gave an average course eval rating of 4.52.

Signed by:

Kevin Otto

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Kevin Otto, Ph.D.

Dane A. Miller Head and Professor

Weldon School of Biomedical Engineering

Link to Curriculog entry: [BME - 32600 - Applied Biomaterials I | Curriculum](#)



Course Information

- **Course:** BME 32600 – Applied Biomaterials I
- **CRN:** 25235
- **Meeting Times:** Tuesday & Thursday, 1:30 pm – 2:45 pm, MJIS 1083
- **Instructional Modality:** Face-to-Face
- **Course credit hours:** 3
- **Prerequisites:** BME 220 and BME 320
- **Lecture Books:**
 - Fundamentals and Applications of Controlled Release Drug Delivery. Siepmann, Siegel, Rathbone (Editors). Springer 2012. ISBN 978-1-4614-0881-9.
 - 3D Bioprinting: Fundamentals, Principles and Applications, Ibrahim T. Ozbolat. Elsevier 2016. ISBN: 978-0-1280-3010-3.
 - Tissue Engineering: Engineering Principles for the Design of Replacement Organs and Tissues, Mark W. Satzman. ISBN: 978-0-1980-3240-3.

Instructor(s) Contact Information

- **Instructor:** Dr. Taimoor H. Qazi (Assistant Professor of Biomedical Engineering)
- **Office:** MJIS 2082
- **Email:** tqazi@purdue.edu
- **Office hours, times, and location** – By appointment only. You may contact Dr. Qazi by email and include BME320 in the subject line.
- **Teaching Assistants** – Tuba Marjan (tmarjan@purdue.edu).

Course Description

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3D printing and Biofabrication

- Biomaterial printability
- Extrusion printing
- Light-assisted printing
- 3D printing design space: parameters, advances, and limitations
- Biomaterial inks versus Bioinks - concepts and compositions
- Bioprinting techniques and special considerations when printing with cells
- Tissue and organ biofabrication
- Applications of 3D printed and biofabricated biomaterials

Controlled Drug Delivery

- Controlled release concepts
- Dosing and pharmacokinetics
- Hydrophilic versus hydrophobic drugs
- Drug targeting to specific sites in the body
- Implantable and Injectable drug depots
- Aerosolized drug delivery systems
- Hydrogels for controlled drug delivery
- Micelles, microparticles, and nanoparticles for drug compartmentalization
- Advanced drug release systems: Microneedle patches, stimuli-responsive biomaterials, and the Covid-19 vaccine

Tissue Engineering

- Principles of tissue engineering: biomaterial scaffolds, cells, and growth factors
- In vitro, in vivo, and in situ tissue engineering
- Bioreactors for mechanical and electrical priming of implantable biomaterials
- 2D, 2.5D, and 3D biomaterials for tissue engineering
- Controlling cell-material interactions in biomaterials
- Biomaterials for cartilage tissue engineering
- Biomaterials for bone tissue engineering
- Biomaterials for skeletal muscle tissue engineering
- Biomaterials for cardiac tissue engineering

Disease Modeling

- Biomaterials for personalized medicine
- Modeling biological processes in vitro
- Biomaterial-assisted organoid culture

Learning Resources, Technology & Texts

The primary resource for the course will be the lecture slides. Additionally, three books are listed for consultation and further reading. (1) Fundamentals and Applications of Controlled Release Drug Delivery. Siepmann, Siegel, Rathbone (Editors). Springer 2012. ISBN 978-1-4614-0881-9. (1) 3D Bioprinting: Fundamentals, Principles and Applications, Ibrahim T. Ozbolat. Elsevier 2016. ISBN: 978-0-1280-3010-3. (3) Tissue Engineering: Engineering Principles for the Design of Replacement Organs and Tissues, Mark W. Sazman. ISBN: 978-0-1980-3240-3. Soft copies of these books are accessible through Purdue Libraries. Dr. Qazi may assign additional reading from primary scientific literature. These will be shared on BrightSpace.

Learning Outcomes

By the end of the course, you will be able to:

- Apply your knowledge of biomaterials to design new biomaterial inks and bioinks
- Understand the principles of 3D biofabrication and appreciate the properties of biomaterials in this field
- Describe the most essential engineering criteria for formulating printable biomaterial inks
- Identify and apply concepts in extrusion-based and light-based 3D fabrication

- Describe the challenges in controlled drug release and drug delivery
- Understand the fundamental concepts of biomaterial interactions with bioactive molecules and drugs
- Learn the state-of-the-art applications of biomaterials in controlled drug delivery
- Describe the principles of tissue engineering
- Identify different sources and properties of cells and growth factors
- Appreciate the role of bioreactors in tissue engineering
- Describe biomaterial properties for tissue engineering of soft and hard tissues
- Learn about applications of biomaterials in basic research
- Identify key proteins, signaling elements, and biomarkers of cell-material interactions
- Learn how to design biomaterials with specific biophysical, mechanical, and biochemical properties
- Understand organoid growth and the importance of the biomaterial extracellular environment

Assignments

Class Participation 10% (Student-teacher interactions are vital for learning and demonstrating your interest in the course content)

Quizzes: **30%** (Weekly in-class quizzes are meant to ensure that students learn the concepts from the homework sets and are able to apply that knowledge independently)

Mid-term Exam: **30%** (Students will be tested on the material covered in the first half of the semester)

Final Exam: **30%** (Students will be tested on the material covered in the second half of the semester)

Grading Scale

In this class, grades reflect the sum of your achievement throughout the semester. We anticipate that grades will be assigned according to the standard rubric below, but it is possible that there will be a curve. If there is a curve, the rubric below will be a guarantee. Percentages will be rounded to the nearest 0.1% for this purpose.

A+	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F
97 - 100 %	94 - 96.9 %	90 - 93.9 %	87 - 89.9 %	84 - 86.9 %	80 - 83.9 %	77 - 79.9 %	74 - 76.9 %	70 - 73.9 %	67 - 69.9 %	64 - 66.9 %	60 - 63.9 %	0 - 59.9 %

If suspected academic dishonesty occurs near the end of the course or cannot be resolved before final grade submissions, the instructor may assign a grade of Incomplete until investigations conclude.

Attendance Policy

Students are expected to attend all classes in-person unless they are ill or otherwise unable to attend class. If they feel ill or feel that they have been exposed to a virus, students should stay home and contact the Protect Purdue Health Center (496-INFO). Notes and/or videos will be posted from each lecture to help students who

are not able to attend class. But it is also recommended that you contact other students to ensure that you are aware of any changes to assignments or due dates.

Classroom engagement is extremely important and associated with your overall success in the course. The importance and value of course engagement and ways in which you can engage with the course content even if you are in quarantine or isolation, will be discussed at the beginning of the semester.

Only the instructor can excuse a student from a course requirement or responsibility. When conflicts 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 conflicts, when advance notification to an instructor is not possible, the student should contact the instructor/instructional team as soon as possible by email, through Brightspace, or by phone. In cases of bereavement, quarantine, or isolation, the student or the student's representative should contact the Office of the Dean of Students via [email](#) or phone at 765-494-1747. Our course Brightspace includes a link to the Dean of Students under 'Campus Resources.

Academic Guidance in the Event a Student is Quarantined/Isolated

If you must quarantine or isolate at any point in time during the semester, please reach out to me via email so that we can communicate about how you can continue to learn remotely. Work with the Protect Purdue Health Center (PPHC) to get documentation and support, including access to an Academic Case Manager who can provide you with general guidelines/resources around communicating with your instructors, be available for academic support, and offer suggestions for how to be successful when learning remotely. Your Academic Case Manager can be reached at acmq@purdue.edu. Importantly, if you find yourself too sick to progress in the course, notify your academic case manager and notify me via email or Brightspace. We will make individualized arrangements based on your particular situation.

Course Schedule

Week	Topic
1	Introduction and orientation to biomaterials
2	Biomaterial fabrication via 3D printing and additive manufacturing
3	Biomaterials for bioinks, bioprinting and biofabrication
4	Extrusion and light-assisted printing
5	Advances in biofabrication
6	Fundamentals and applications of drug delivery
7	Challenges in drug formulations and biomaterial-drug conjugates
8	Biomaterials for controlled and targeted drug delivery
9	Drug depots, microneedles, micro and nanoparticles for drug delivery
9 contd.	Mid-term EXAM
10	Principles of tissue engineering
11	Cells: sources, properties, and interactions with biomaterials
12	Growth factors/Biologics: sources, properties, and interactions with biomaterials

13	Designing biomaterials for musculoskeletal and non-musculoskeletal tissues
14	Concepts and advances in personalized medicine for disease modeling
15	Biomaterials application in organoid growth and basic research
16	Quiet week and FINAL EXAM

* Schedule and assignments subject to change. Any changes will be posted in the learning management system.

Classroom Guidance Regarding Protect Purdue

The [Protect Purdue Plan](#), which includes the [Protect Purdue Pledge](#), is campus policy and as such all members of the Purdue community must comply with the required health and safety guidelines. Required behaviors in this class include: staying home and contacting the Protect Purdue Health Center (496-INFO) if you feel ill or know you have been exposed to the virus, properly wearing a mask [in classrooms and campus building](#), at all times (e.g., mask covers nose and mouth, no eating/drinking in the classroom), disinfecting desk/workspace before and after use, maintaining appropriate social distancing with peers and instructors (including when entering/exiting classrooms), refraining from moving furniture, avoiding shared use of personal items, maintaining robust hygiene (e.g., handwashing, disposal of tissues) prior to, during and after class, and following all safety directions from the instructor.

Students who are not engaging in these behaviors (e.g., wearing a mask) will be offered the opportunity to comply. If non-compliance continues, possible results include instructors asking the student to leave class and instructors dismissing the whole class. Students who do not comply with the required health behaviors are violating the University Code of Conduct and will be reported to the Dean of Students Office with sanctions ranging from educational requirements to dismissal from the university.

Any student who has substantial reason to believe that another person in a campus room (e.g., classroom) is threatening the safety of others by not complying (e.g., not properly wearing a mask) may leave the room without consequence. The student is encouraged to report the behavior to and discuss the next steps with their instructor. Students also have the option of reporting the behavior to the [Office of the Student Rights and Responsibilities](#). See also [Purdue University Bill of Student Rights](#).

Academic Integrity

Academic integrity is one of the highest values that Purdue University holds. Individuals are encouraged to alert university officials to potential breaches of this value by either emailing integrity@purdue.edu or by calling 765-494-8778. While information may be submitted anonymously, the more information is submitted the greater the opportunity for the university to investigate the concern. More details are available on our course Brightspace table of contents, under University Policies.

Policy on Presentations, Materials, and Notes: The instructor's presentations and course materials are subject to the instructor's copyright. In addition, notes are "considered to be 'derivative works' of the instructor's presentations and materials, and they are thus subject to the instructor's copyright in such presentations and materials." As such, they cannot be sold or bartered without express written permission from the instructor.

Policy on Academic Dishonesty: Purdue prohibits "dishonesty in connection with any University activity. Cheating, plagiarism, or knowingly furnishing false information to the University are examples of dishonesty" (Section B.2.a of the [Student Regulations](#)). Furthermore, "the commitment of acts of cheating, lying, and deceit

in any of their diverse forms (such as the use of ghostwritten 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).

Suspected academic misconduct will be addressed by the instructor and referred to the Office of Student Rights and Responsibilities (OSRR) for review at the university level. Any violation of course policies as it relates to academic integrity will result minimally in a zero grade for that particular assignment, and at the instructor's discretion may result in a failing grade for the course. In addition, all incidents of academic misconduct will be forwarded to OSRR, where university penalties, including removal from the university, may be considered. Students can report issues of academic integrity that they observe, and may do so anonymously, through the OSRR by calling 765-494-8778 or emailing integrity@purdue.edu.

Nondiscrimination Statement

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 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.

Accessibility

The teaching team wants you to excel and recognizes that students excel in different ways. We strive to make learning experiences as accessible as possible. If there is an accommodation that will help you learn more effectively, please let us know about it as soon as possible. If it is within our power to provide the accommodation, we will do so. In some cases, Purdue University requires documentation of a particular need so that resources can be allocated. If you anticipate or experience physical or academic barriers based on disability, you are welcome to let me know so that we can discuss options. You are also encouraged to contact the Disability Resource Center at: drc@purdue.edu or by phone: 765-494-1247."

Mental Health/Wellness Statement

If you find yourself beginning to feel some **stress, anxiety and/or feeling slightly overwhelmed**, try [WellTrack](#). Sign in and find information and tools at your fingertips, available to you at any time.

If you need **support and information about options and resources**, please contact or see the [Office of the Dean of Students](#). Call 765-494-1747. Hours of operation are M-F, 8 am- 5 pm.

If you find yourself **struggling to find a healthy balance between academics, social life, stress, etc.** sign up for free one-on-one virtual or in-person sessions with a [Purdue Wellness Coach at RecWell](#). Student coaches can help you navigate through barriers and challenges toward your goals throughout the semester. Sign up is completely free and can be done on BoilerConnect. If you have any questions, please contact Purdue Wellness at evans240@purdue.edu.

If you're ***struggling and need mental health services***: Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of mental health support, services are available. For help, such individuals should contact [Counseling and Psychological Services \(CAPS\)](#) at 765-494-6995 during and after hours, on weekends and holidays, or by going to the CAPS office on the second floor of the Purdue University Student Health Center (PUSH) during business hours.

Emergency Preparation

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 instructor via email or office phone. **You are expected to read your @purdue.edu email on a frequent basis.**