

**MSE404**  
**Biomaterials Synthesis and Properties**  
**Spring 2026**

**Instructor:**

Dr. Nathan Gabrielson  
Phone: 217-300-3906  
Email: gabrlsn@illinois.edu  
Office: 209 Ceramics

**Teaching Assistants:**

TBA  
Email: TBA

**Course Text:**

Required: Xian, Wujing (2009) *A Laboratory Course in Biomaterials*. Boca Raton: CRC Press.

Available as an online resource at:

<https://www.taylorfrancis.com/books/9781420075823>

Supplemental: Ratner, Buddy D., ed (2013) *Biomaterials Science: An Introduction to Materials in Medicine*. 3<sup>rd</sup> Edition. San Diego: Elsevier Academic Press.

Available as an online resource at:

<http://www.sciencedirect.com/science/book/9780123746269>

Website: <http://canvas.illinois.edu>

**Class Meetings:**

Activity	Section	Time	Location
Laboratory	BS1	2:00 – 4:50 PM, Mon/Wed	218/220 Kiln House*
	BS2	2:00 – 4:50 PM, Tues/Thurs	218/220 Kiln House*
	BS3	8:00 – 10:50 AM, Tues/Thurs	218/220 Kiln House*
Office Hours	11:00-11:50 AM, Mon/Tues or by appointment		

\*A brief lecture will be given in 122 Kiln House prior to lab as needed

**Course Objectives:**

1. To learn laboratory science, methods and skills that are necessary for biomedical science and engineering.
2. To develop the written and oral communication skills essential for a clear, concise and persuasive presentation of research findings and results.
3. To facilitate critical thinking about research design, experimental observations and data analysis.
4. To gain experience working as part of a team.

**Grading:**

Lab reports, executive reports:	75%
Pre-lab quizzes:	15%
Lab participation/attendance:	10%

**Grading Scale:**

98-100 = A+	92-97 = A	90-91 = A-
88-89 = B+	82-87 = B	80-81 = B-
78-79 = C+	72-77 = C	70-71 = C-
68-69 = D+	62-67 = D	60-61 = D-
≤59 = F		

\*the lower number of the grading ranges may be lowered but not raised

**Grading Notes:**

1. This course consists of three modules. An individually written lab report or executive summary will be required for each module. Lab reports will be submitted online.
2. All students will receive 5 extension days. These can be applied to any report/executive summary. A tracker will be maintained in the gradebook. Once all 5 days have been used, reports or executive summaries that are received late will be docked 5 points each day until they are submitted. Reports that are not received within 20 days of the due date receive no points. Unused extension days will be translated to points that will be added to a lab report score.
3. You are required to read the lab procedures before attending the lab session. A brief quiz will be given at the beginning of each lab session. The quiz will focus on the fundamental concepts of each lab, not on minute experimental details.
4. Everyone is required to keep a lab notebook which will be subjected to daily inspection.

**Laboratory Policies:**

1. No food or beverages are allowed in the lab. Chewing gum is discouraged.
2. Long pants (covers the legs to the ankle) and closed-toed shoes are required for entry into the lab.
3. Avoid wearing your “best” clothes and consider wearing a lab coat.
4. Confine long hair, loose clothing and dangling jewelry.
5. Cover any cuts or scrapes with a bandage before attending lab.
6. Goggles/safety glasses are available and must be worn at all times in lab.
7. Wear disposable gloves at all times.
8. Never pipet by mouth.
9. Do not pick up broken glass with your hands, use a dust pan and broom.
10. Clean your lab space and equipment before departing.
11. Please exit the lab when making personal calls or sending texts or email messages. Abuse of this rule will result in cell phones being banned from the lab. Smartphones may be used during the lab exercises as references, calculators and other similar tools.
12. Thoroughly wash hands with soap prior to leaving the laboratory.

**Description of Course Modules:***Module I. Controlled release*

A model protein, bovine serum albumin (BSA), is encapsulated in a matrix of biodegradable poly(lactic-co-glycolic acid) (PLGA) through a double emulsion process. The encapsulation efficiency and drug loading of the resulting microspheres are evaluated. An in vitro controlled release study is subsequently performed, with data being collected throughout the semester.

*Module II. Natural biomaterials*

Collagen is extracted from bovine calf skin and purified. The dual nature of collagen as both a natural biomaterials and a protein are studied. Chitosan, another natural biomaterial, is used with collagen to form a collagen/chitosan composite material.

*Module V: Bioceramics*

Hydroxyapatite (HA) and fluoroapatite (FA) are synthesized. Porous composites of HA/FA and PLGA are fabricated and studied for their morphology, mechanical strength and degradability.

**Illness/Absences:**

If you are sick or otherwise cannot attend class, please let the instructor know. Missed quizzes will need to be repeated, and missed labs may need to be repeated at a time suitable for both the student and instructor.

**Academic Integrity:**

Academic dishonesty may result in a failing grade. Every student is expected to review and abide by the Academic Integrity Policy found at <https://studentcode.illinois.edu/article1/part4/1-401/>. Ignorance is not an excuse for any academic dishonesty. It is your responsibility to read this policy to avoid any misunderstanding. Do not hesitate to ask if you are in doubt about what constitutes plagiarism, cheating, or any other breach of academic integrity.

**Students with Disabilities:**

To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor as soon as possible and provide the instructor with a Letter of Academic Accommodations from Disability Resources and Educational Services (DRES). To ensure that disability-related concerns are properly addressed from the beginning, students with disabilities who require assistance to participate in this class should apply for services with DRES and see the instructor as soon as possible. If you need accommodation for any sort of disability, please speak to me after class. DRES provides students with academic accommodations, access, and support services. To contact DRES, visit 1207 S. Oak St., Champaign, call 217-333-1970, e-mail [mdisability@illinois.edu](mailto:mdisability@illinois.edu) or visit the DRES website at <http://www.disability.illinois.edu/>.

**Mental Health:**

Significant stress, mood changes, excessive worry, substance/alcohol misuse or interferences in eating or sleep can have an impact on academic performance, social development, and emotional wellbeing. The University of Illinois offers a variety of confidential services including individual and group counseling, crisis intervention, psychiatric services, and specialized screenings which are covered through the Student Health Fee. If you or someone you know experiences any of the above mental health concerns, it is strongly encouraged to contact or visit any of the University's resources provided below. Getting help is a smart and courageous thing to do for yourself and for those who care about you.

Counseling Center (217) 333-3704

McKinley Health Center (217) 333-2700

National Suicide Prevention Lifeline (800) 273-8255

Rosecrance Crisis Line (217) 359-4141 (available 24/7, 365 days a year)

If you are in immediate danger, call 911.

**Disruptive Behavior:**

Behavior that persistently or grossly interferes with classroom activities is considered disruptive behavior and may be subject to disciplinary action. Such behavior inhibits other students' ability to learn and an instructor's ability to teach. A student responsible for disruptive behavior may be required to leave class pending discussion and resolution of the problem and may be reported to the Office for Student Conflict Resolution (<https://conflictresolution.illinois.edu>; [mconflictresolution@illinois.edu](mailto:mconflictresolution@illinois.edu); 333-3680) for disciplinary action.

**Emergency Response Recommendations:**

Emergency response recommendations and campus building floor plans can be found at the following website: <https://police.illinois.edu/em/run-hide-fight/>.

**Religious Observances:**

Illinois law requires the University to reasonably accommodate its students' religious beliefs, observances, and practices in regard to admissions, class attendance, and the scheduling of examinations and work requirements. Students should complete the Request for Accommodation for Religious Observances form should any instructors require an absence letter in order to manage the absence. In order to best facilitate planning and communication between students and faculty, students should make requests for absence letters as early as possible in the semester in which the request applies.

**Sexual Misconduct Reporting Obligation:**

The University of Illinois is committed to combating sexual misconduct. Faculty and staff members are required to report any instances of sexual misconduct to the University's Title IX and Disability Office. In turn, an individual with the Title IX and Disability Office will provide information about rights and options, including accommodations, support services, the campus disciplinary process, and law enforcement options.

A list of the designated University employees who, as counselors, confidential advisors, and medical professionals, do not have this reporting responsibility and can maintain confidentiality, can be found at <http://wecare.illinois.edu/resources/students/#confidential>.

Other information about resources and reporting is available at <http://wecare.illinois.edu>.

**Diversity, Equity, and Inclusion (DEI) Statement:**

The University of Illinois, the Grainger College of Engineering, the Materials Science and Engineering department, and MSE404-BS operate under the guiding principle that "Our entire community benefits when individuals from different personal, cultural, and disciplinary perspectives are working together." MSE404-BA will be a safe and inclusive place for active learning with no tolerance for discrimination of any kind. To learn more about DEI activities in MatSE and MatSE's DEI committee here: <https://matse.illinois.edu/dei>. Aspects of DEI in the UIUC community are covered by the IDEA institute: <https://idea.illinois.edu>.

**Generative AI Policy**

Generative AI, such as ChatGPT, Microsoft Copilot, and Gemini, can answer questions and generate text, images, and other media. The appropriate use of generative AI varies from course to course. In this class, there are times when generative AI may be useful. If you choose to use generative AI as permitted below, you must document and attribute all AI contributions to your coursework and take full responsibility for the contributions including the accuracy of the information and reliability of sources. When using generative AI, keep a journal documenting prompts, AI responses, and your usage. Your instructor may ask you to provide this documentation.

You may use generative AI for the purpose of creating images/schematics and checking report grammar.

You MAY NOT use generative AI to write substantial portions of the report.

If you have a question about the use of Generative AI, please reach out to the instructor. Failure to abide by these guidelines is a violation of academic integrity. We will investigate suspected uses of generative AI that do not follow these guidelines and apply sanctions as outlined in the University of Illinois Student Code.

# January

2026

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
					1	2
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	MLK Day (No Class)	19	No Class	20	L1 – Intro	22
25	26	27	28	29	30	31
	L2 – M1-S1-P1 (Double Emulsion, p18)	L2 – M1-S1-P1 (Double Emulsion, p18)	L3 – M1-S1-P2 (Harvest Microspheres, p21)	L3 – M1-S1-P2 (Harvest Microspheres, p21)		

# February

2026

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	2	3	4	5	6	7
	<b>L4 – M1-S3</b> (Controlled Release, p29) // <b>M1-S2</b> (Encapsulation Efficiency and Drug Load, p24)	<b>L4 – M1-S3</b> (Controlled Release, p29) // <b>M1-S2</b> (Encapsulation Efficiency and Drug Load, p24)	<b>L5 – M2-S1</b> (Collagen Extraction, p46) // <b>M1-S3</b> (Cont. Rel., p29)	<b>L5 – M2-S1</b> (Collagen Extraction, p46) // <b>M1-S3</b> (Cont. Rel., p29)		
8	9	10	11	12	13	14
	<b>L6 – M2-S2-P1</b> (Collagen Precipitation, p51) // <b>M1-S3</b> (Controlled Release, p29)	<b>L6 – M2-S2-P1</b> (Collagen Precipitation, p51) // <b>M1-S3</b> (Controlled Release, p29)	<b>L7 – M2-S3-P1</b> (SDS-PAGE, p57) // <b>M2-S2-P2</b> (Collagen Lyoph. p55) // <b>M2-S4-P1</b> (Dermis Prep, p65) // <b>M1-S3</b> (Control Release, p29)	<b>L7 – M2-S3-P1</b> (SDS-PAGE, p57) // <b>M2-S2-P2</b> (Collagen Lyoph. p55) // <b>M2-S4-P1</b> (Dermis Prep, p65) // <b>M1-S3</b> (Control Release, p29)		
15	16	17	18	19	20	21
<b>Module I (Microspheres) Executive Summary Due @ 11:59PM</b>		<b>L8 – M2-S3-P1</b> (Dry SDS-PAGE Gels, p63) // <b>M2-S4-P2</b> (Collagen Sponges, p68) // <b>M1-S3</b> (Controlled Release, p29)	<b>L8 – M2-S3-P1</b> (Dry SDS-PAGE Gels, p63) // <b>M2-S4-P2</b> (Collagen Sponges, p68) // <b>M1-S3</b> (Controlled Release, p29)	<b>L9 – M2-S3-P3</b> (Image SDS-PAGE Gel, p64) // <b>M5-S1-P1</b> (HA/FA Synthesis, p168) // <b>M1-S3</b> (Controlled Release, p29)	<b>L9 – M2-S3-P3</b> (Image SDS-PAGE Gel, p64) // <b>M5-S1-P1</b> (HA/FA Synthesis, p168) // <b>M1-S3</b> (Controlled Release, p29)	
22	23	24	25	26	27	28
	<b>L10 – M5-S1-P2</b> (Harvest & Dry HA/FA, p169) // <b>M5-S2-P1</b> (Heat Treat HA/FA, p174) // <b>M1-S3</b> (Controlled Release, p29)	<b>L10 – M5-S1-P2</b> (Harvest & Dry HA/FA, p169) // <b>M5-S2-P1</b> (Heat Treat HA/FA, p174) // <b>M1-S3</b> (Controlled Release, p29)	<b>L11 – M5-S3</b> (Compression Molding, p178) // <b>M1-S3</b> (Controlled Release, p29)	<b>L11 – M5-S3</b> (Compression Molding, p178) // <b>M1-S3</b> (Controlled Release, p29)		

# March

# 2026

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1  <b>Module II (Collagen) Report Due @ 11:59PM</b>	2  <b>L12 –M1-S3 (Controlled Release, p29) // L13 – M1-S4 (Controlled Release Evaluation, p32)</b>	3  <b>L12 –M1-S3 (Controlled Release, p29) // L13 – M1-S4 (Controlled Release Evaluation, p32)</b>	4  <b>L13 –M5-S4-P2 (Compression Testing, p183)</b>	5  <b>L13 –M5-S4-P2 (Compression Testing, p183)</b>	6	7
8	9 No Class	10 No Class	11 No Class	12 No Class	13 Last Day of MSE404-BS	14
15  <b>Updated Module I (Microspheres) Executive Summary Due @ 11:59PM</b>	16	17	18	19	20	21
22  <b>Module V (HA/FA) Report Due @ 11:59PM</b>	23	24	25	26	27	28
29	30	31				