



WPI

Graduate Programs in Biomedical Engineering

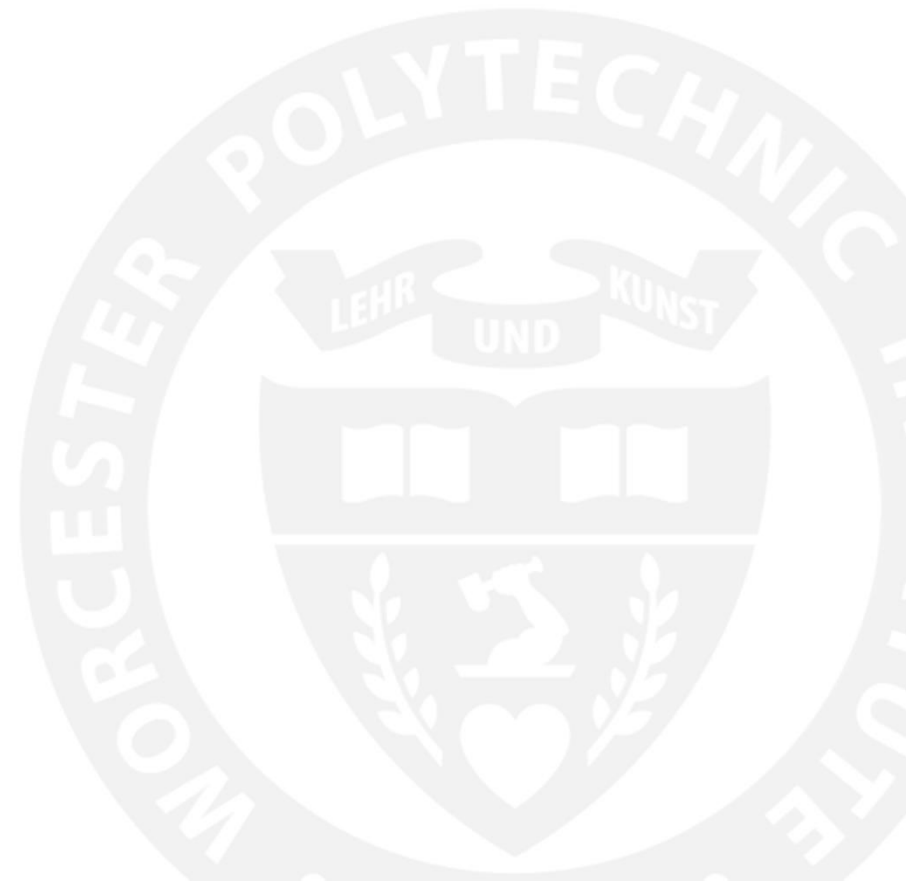
New Graduate Student Orientation

August 23, 2023

Catherine Whittington, Assistant Professor, BME

Haichong (Kai) Zhang, Assistant Professor, BME and Robotics

BMEGradProgram@wpi.edu



Introductions!


Hello

My Name Is

Outline

- Graduate program contacts and Getting started
- Program Overview and Degree requirements
- Course information and Advising
- Additional program information and Final thoughts
- **Q & A!!!** (*but you can ask questions at any time*)
- Faculty research and MS project opportunities

How do I find information about the graduate program?

- Primary resource: 
<https://wp.wpi.edu/bme/grad/>
- All inquiries:
BMEGradProgram@wpi.edu
- BME Graduate Committee
- BME Administrative Staff
- BME Department Leadership



BME Graduate Studies Committee



Dirk Albrecht

Associate Professor, BME



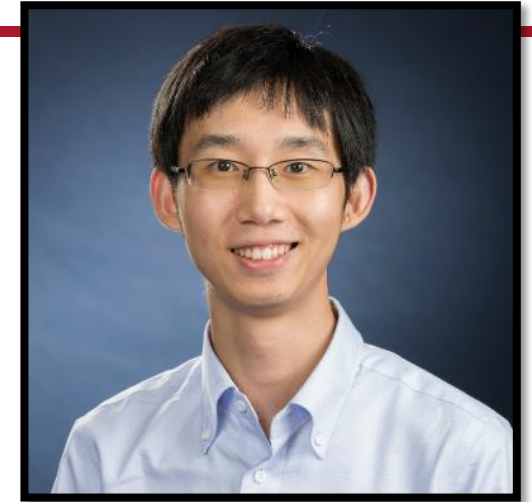
Songbai Ji

Professor, BME



Catherine Whittington

Assistant Professor, BME



Haichong (Kai) Zhang

Assistant Professor, BME and Robotics



Adam Lammert

Assistant Professor, BME



George Pins

Professor, BME



June Norton

Graduate Program Administrative Assistant

Feedback to the GSC (Grad Studies Committee)

- Are things going well? Or not so well? How can Grad Studies improve your experience?
- Let us know!
 - Speak to your Academic or Research Advisor
 - Come to GSC Office hours (dates/times TBD)
 - Use the GSC feedback form
 - Anonymous if needed



BME Administrative Staff



- **June Norton**
 - Graduate Program
 - 4017D
 - jnorton@wpi.edu



- **Kate Harrison**
 - Undergraduate Program
 - 4017E
 - Kharrison@wpi.edu



- **Lynda Hammett**
 - BME Department; Assistant to Department Head
 - GP 4009
 - lhammett@wpi.edu

BME Leadership



Kristen Billiar
Professor, BME
Department Chair

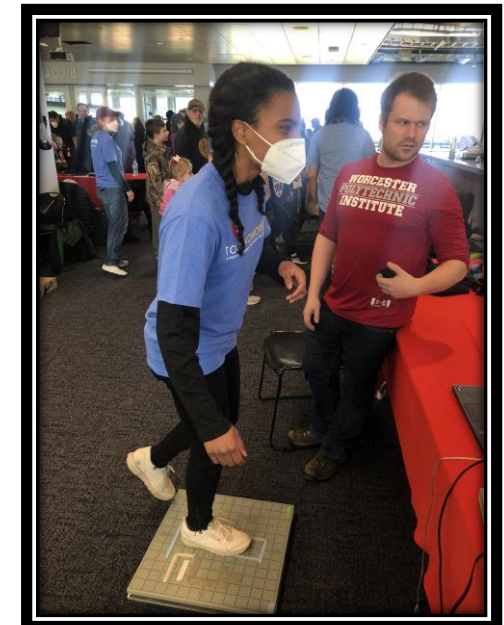


Karen Troy
Professor, BME
Associate Department Chair

WPI BME Community

Get involved! Build your network

- BMES Chapter, officers
- Local/Regional meetings
- BME and Gateway “Happy Hours”
- BME cookouts
- WPI BME DEI Committee (student rep)



Getting Started

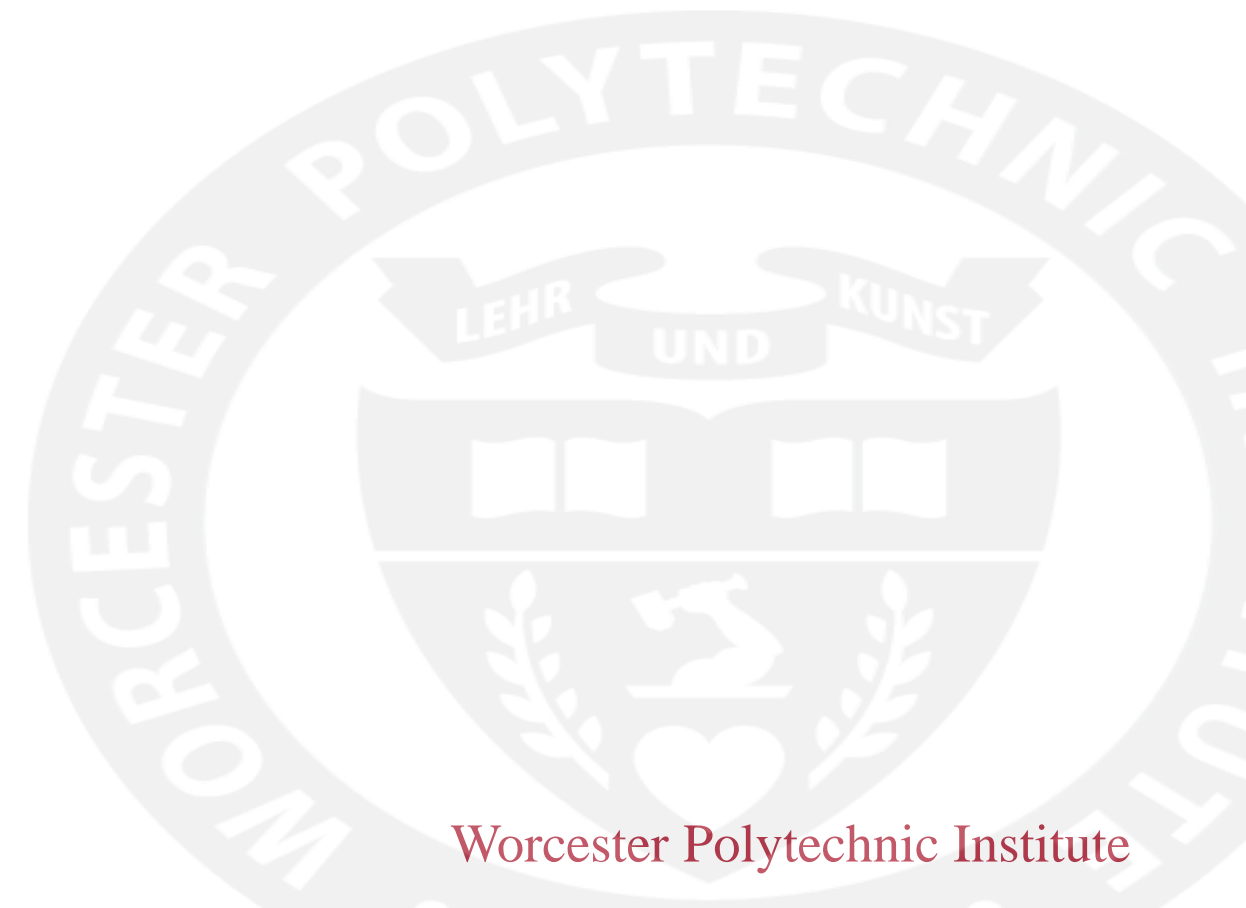
- **Lab Access**

- Lab areas always require card access
- For access forms, see Lynda Hammett
- **MUST COMPLETE LAB SAFETY TRAINING**
(access via CEMS system → Training →
Next training 8/24, 8-10am!)
- <https://www.wpi.edu/offices/environmental-health-safety/laboratory>



Laboratory Safety @ WPI

WPI BME Program Overview and Graduate Degree Details



Program Expectations

- Work more independently than undergraduate research
- Original research is primary focus in thesis- and project-based graduate programs
- GPA > 3.0 to graduate
- No more than two C grades
- Academic Integrity
 - WPI Academic Honesty Policy
 - <https://www.wpi.edu/about/policies/academic-integrity>

Advising

- BME core faculty are eligible to advise
 - Initially assigned an academic advisor in the BME department
 - Thesis/Dissertation Advisor will become your primary advisor
- “Plan of Study” forms help you plan your courses and research to meet degree requirements
 - Useful tool for reviewing course selections with advisor
 - Helpful to ensure that you are staying on track
- Your advisor is a RESOURCE...meet with them!

Master of Engineering (M.E.)



- Course-based degree (no research requirements)
- 33 credits total
- Usually 1-2 year beyond B.S. degree
- Graduate-level coursework that enhances academic backgrounds from undergraduate degrees in BME or related fields.
- Courses can be focused to build on individual professional and academic experiences in preparation for engineering careers.

Course Requirements – Master's of Engineering

BME	12 credits
Life Sciences	3 credits
Advanced Math	3 credits
Life Sciences <u>or</u> Advanced Math	3 credits
Electives	12 credits
BME 591: Graduate Seminar (x 2)	0 credits

TOTAL:

33 credits

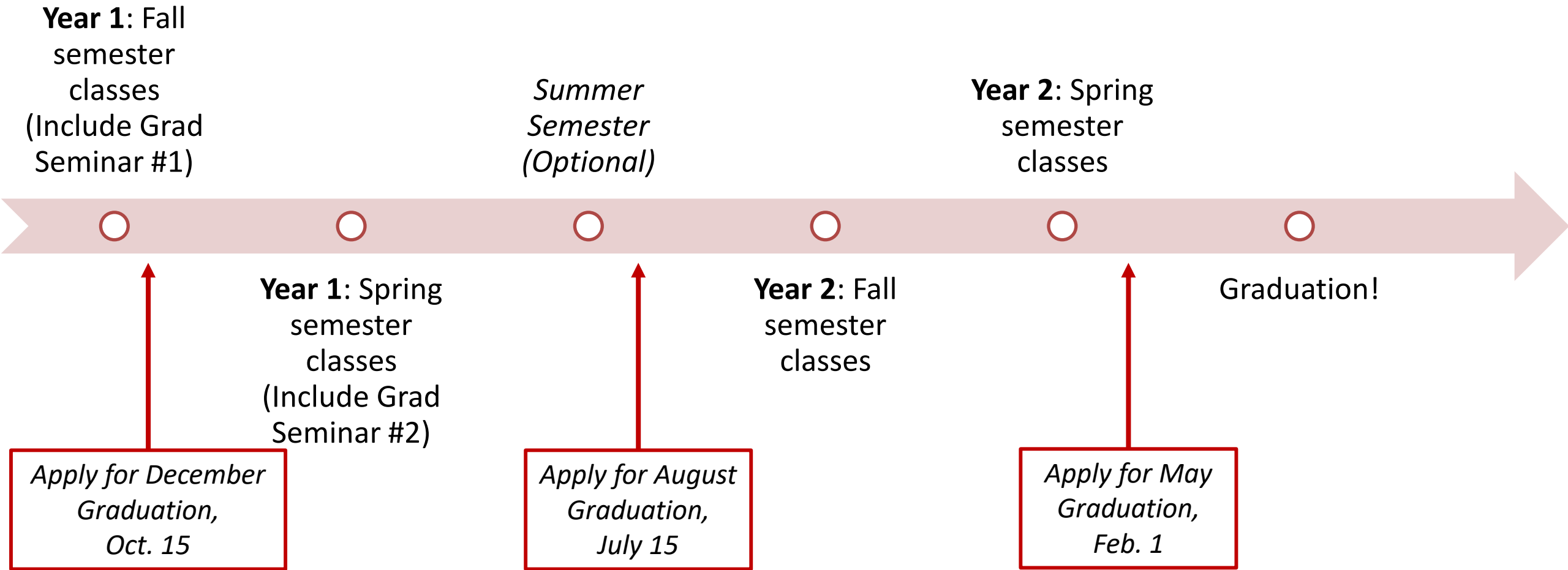
A 1/3 unit WPI undergraduate course taken for graduate credit is 2 credit hours of graduate credit

May take directed research (max 6 credits), but not required

- 0-3 credits can count for BME*
- 0-3 credits can count for Elective*

Timeline to Graduation: MENG

*Assuming a Fall start for the MENG program



NOTE: Timeline may be faster for combined BS/MENG students or students with significant prior graduate coursework.

Master of Science (M.S.) – Project OR Thesis

- 30 credits total
- ~ 2+ years beyond B.S. degree
- **Project:** Focused, credit-based independent project experience that builds on individual professional and academic experience.
 - Facilitates development of experience, skillset, and mindset to contribute and lead in industry as engineers in various BME roles.
- **Thesis:** Deeper, open-ended inquiry into a research area, in preparation for:
 - Advanced research training (e.g., Ph.D. degree)
 - Research-focused careers in a medical, academic, government, or industry laboratory settings.



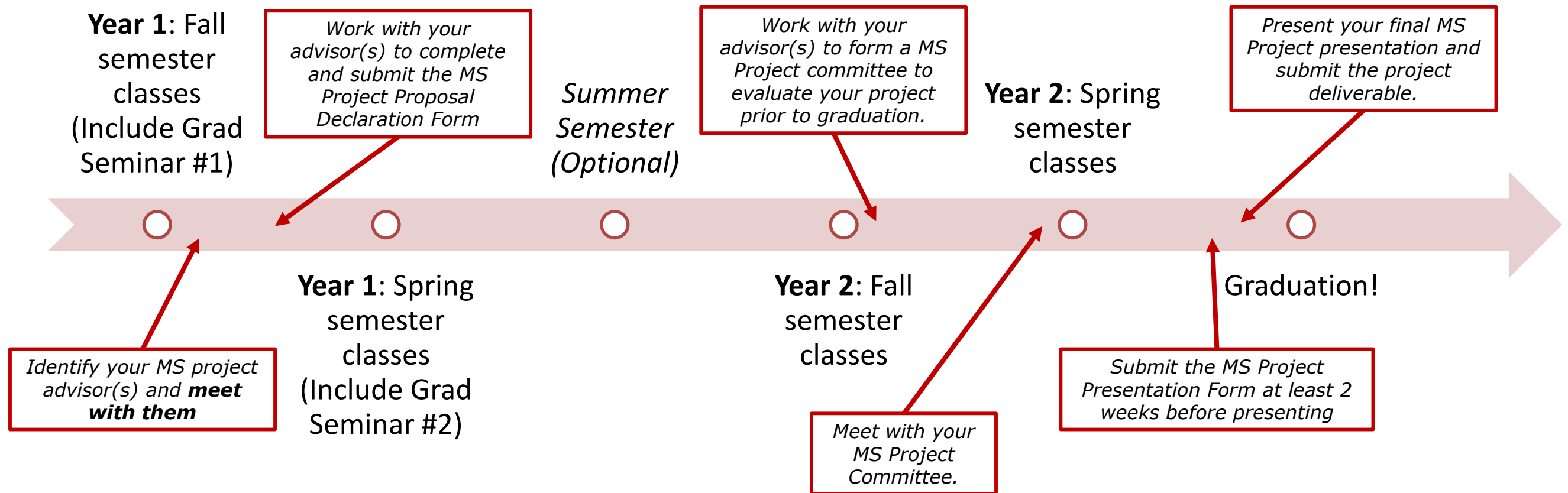
Course Requirements – Master’s of Science (Thesis or Project)

<i>Thesis-based</i>		<i>Project-based</i>	
BME	12 credits	BME	12 credits
Electives	12 credits	Electives	12 credits
BME 599 (MS Thesis)	6 credits	BME 597 (MS Project)	6 credits
BME 591: Graduate Seminar (x 2)	0 credits	BME 591: Graduate Seminar (x 2)	0 credits
<hr/>		<hr/>	
<i>TOTAL:</i>	<i>30 credits</i>	<i>TOTAL:</i>	<i>30 credits</i>

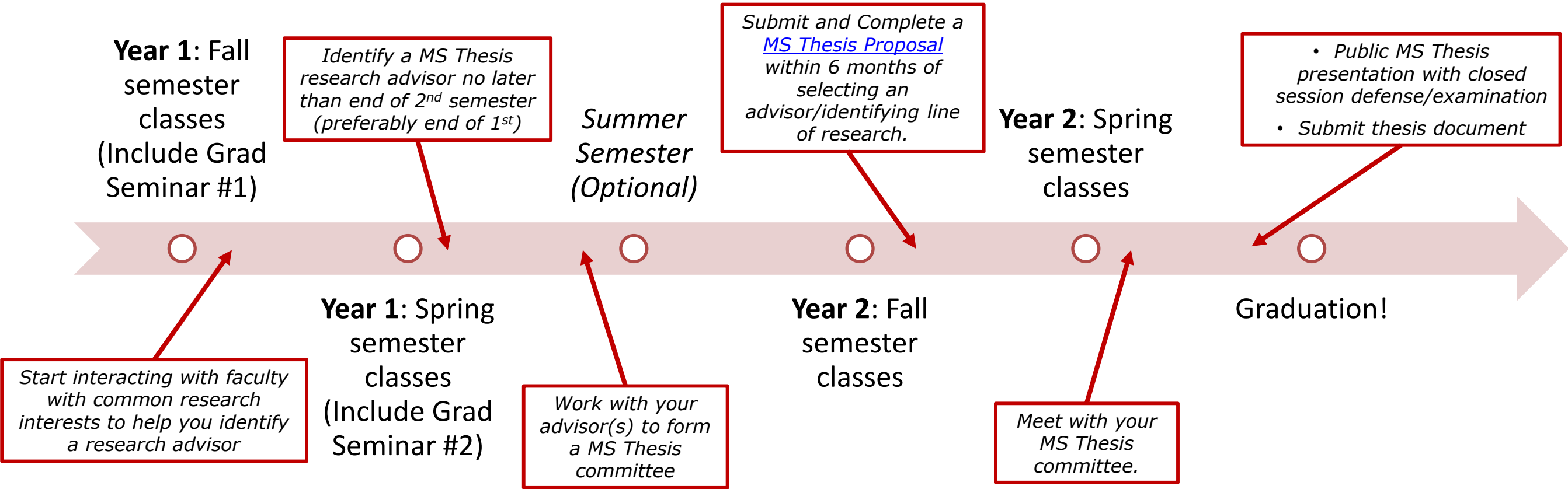
In addition, the following requirements must be met for both MS Degree Programs

Technical Depth Requirements	15 credits	(grad semester = 3 credits typically)
BME Core Competencies (5) <i>(See grad handbook for details)</i>	<ul style="list-style-type: none"> ✓ Mathematics ✓ Life science ✓ Clinical needs analysis 	<ul style="list-style-type: none"> ✓ Regulation and controls ✓ Value creation, innovation, technology, commercialization

Timeline to Graduation: MS Project (2 year)



Timeline to Graduation: MS Thesis (2 year)



MS Project vs Thesis Recap

	Thesis	Project
Credits	30 credits	30 credits
Scope	<ul style="list-style-type: none">• Hypothesis-driven research• Conducted in one the faculty research labs	<ul style="list-style-type: none">• May be more applied, design and/or objective driven• Not limited to research questions• Can be done in faculty research lab or outside of research lab (e.g., Co-op/Internship, Clinician)
Final Deliverables/ Outcomes	<ol style="list-style-type: none">1. Public thesis presentation and private examination2. Thesis document	<ol style="list-style-type: none">1. Public presentation* and private examination2. Written document relevant to project (e.g., report, technical manual, SOP, etc.)

**If MS Project is conducted with a company or entity where confidentiality is required, arrangements can be made for a private presentation with appropriate confidentiality measures put in place.*

FAQ: Project-Based MS or Thesis MS - https://wp.wpi.edu/bme/files/2022/05/Frequently-Asked-Questions-about-the-BME-MS-Program-Updated_5_2022.pdf

Doctor of Philosophy (PhD)



- **Two pathways**
 - 90 credits beyond B.S. degree (~5+ years)
 - OR**
 - 60 credits beyond Master's degree (~3+ years)
- Independent, in-depth open-ended inquiry and technical skill-building toward an expanded study in an area of research specialization
 - Allows graduates to apply to highly specialized career opportunities, including the pursuit of original research in advanced academic, industry-based, or government careers.

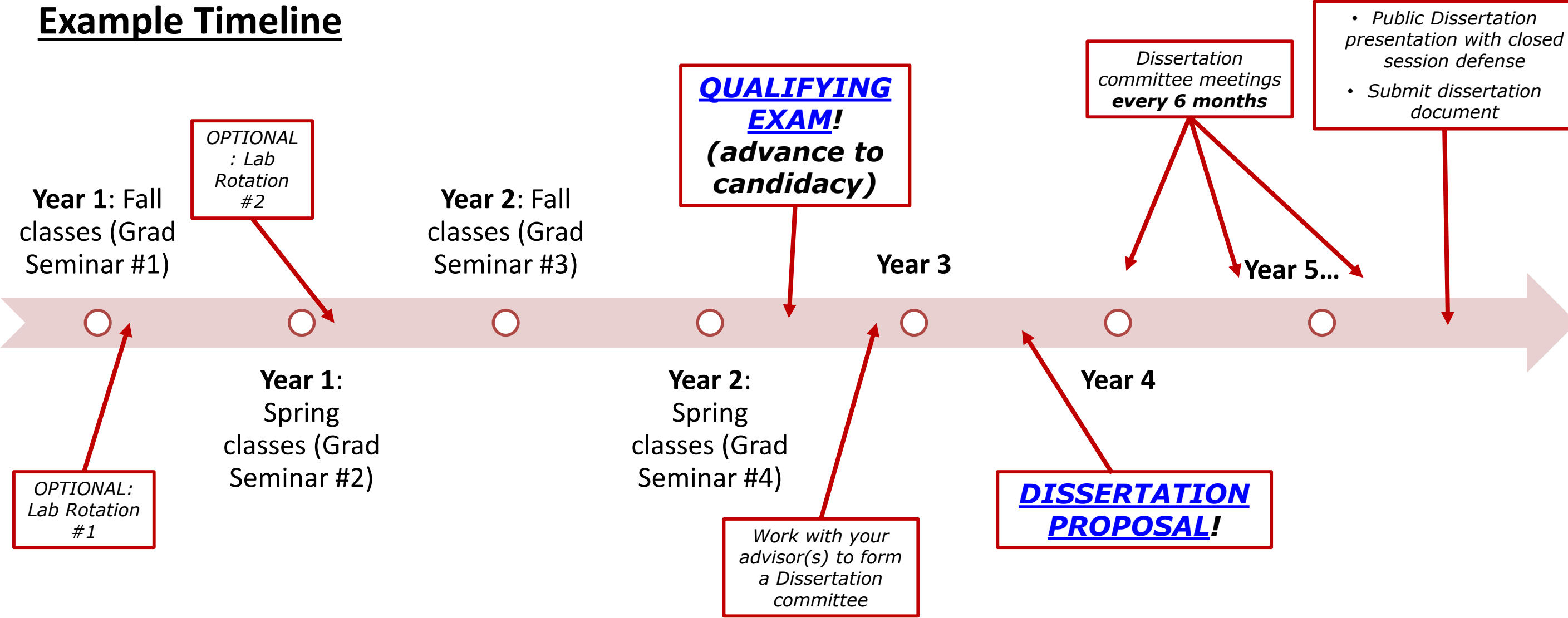
Course Requirements – PhD (90 credits beyond BS)

BME	12 credits	} MEng
Life Sciences	3 credits	
Advanced Math	3 credits	
Life Science or Advanced Math	3 credits	
Electives	12 credits	
Responsible Conduct of Research <i>(usually satisfied by taking BB 551)</i>	1 credit	
Dissertation Research (BME 699)	30 credits	
BME 591: Graduate Seminar (x 4)	0 credits	

Lab Rotations (optional)

Timeline to Graduation: PhD (90 credits beyond BS)

Example Timeline



NOTE: Qualifying exam must be completed by end of 5th semester in the program.

Course Requirements – PhD (60 credits beyond MS)

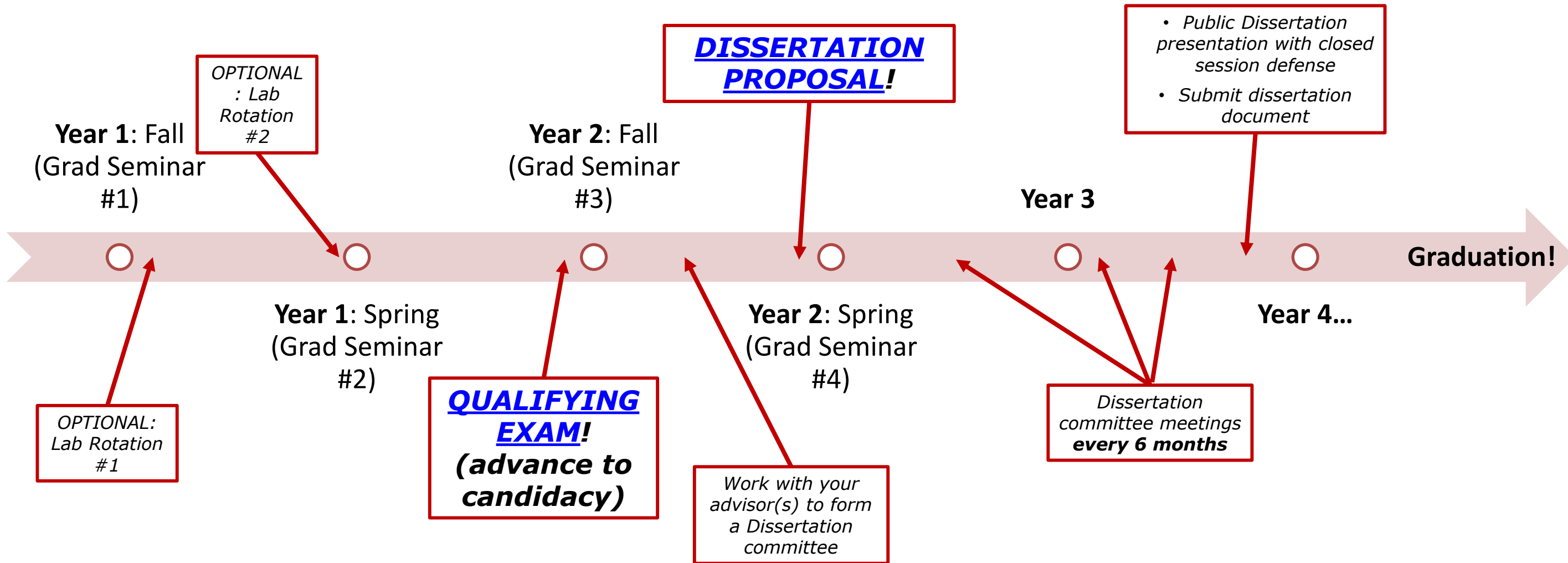
These classes are not required if you already have a Masters degree in engineering

BME	12 credits
Life Sciences	3 credits
Advanced Math	3 credits
Life Science or Advanced Math	3 credits
Electives	12 credits
Responsible Conduct of Research <i>(usually satisfied by taking BB 551)</i>	1 credit
Dissertation Research (BME 699)	30 credits
BME 591: Graduate Seminar (x 4)	0 credits

Lab Rotations (optional)

**60 credit PhD students should document prior graduate-level coursework and consult their advisor about specific classes that may be beneficial to take.*

Timeline to Graduation: PhD (60 credits beyond MS)



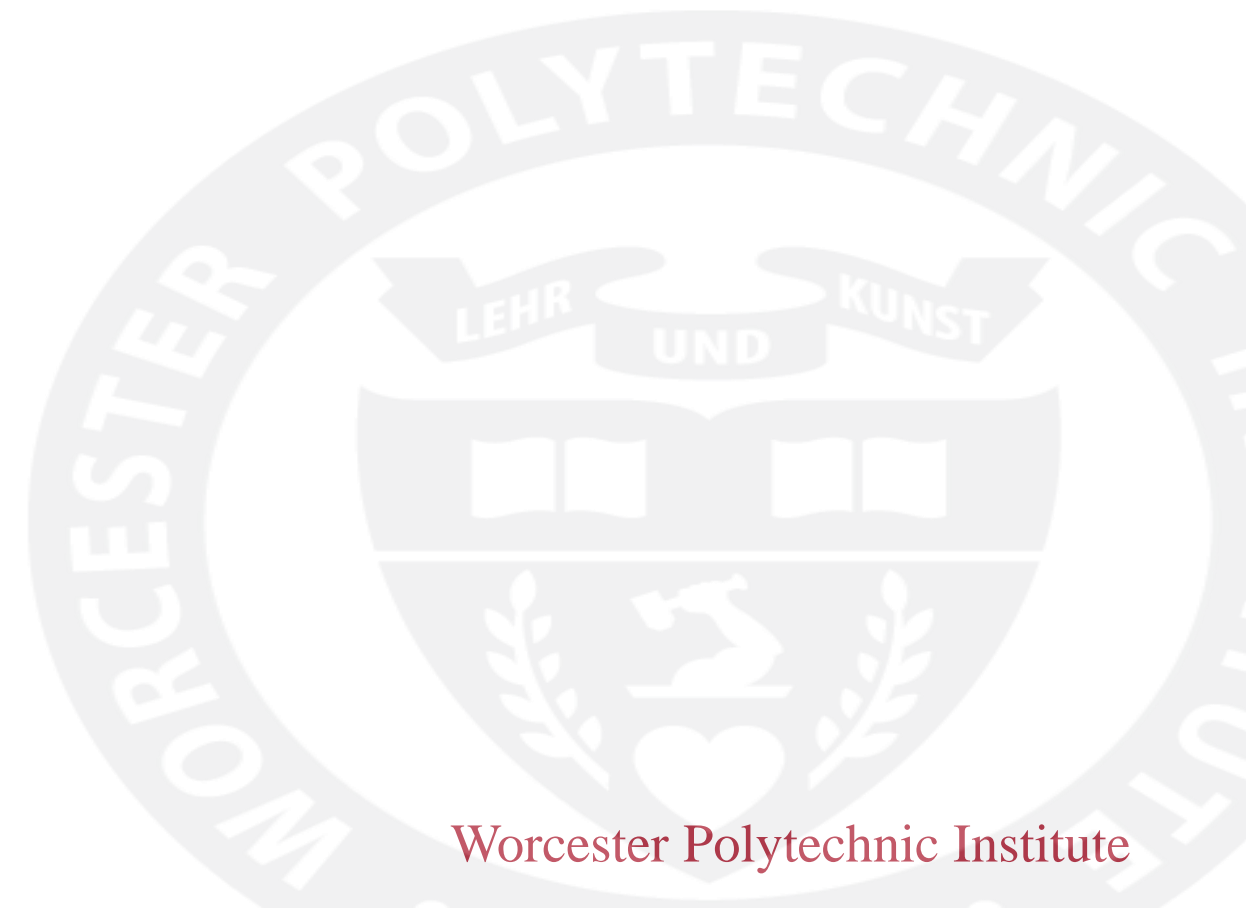
*NOTE: 60 credit PhD students **may** end up taking their qualifying exam earlier than their second year because of needing to take fewer courses; Qualifying exam still has to be completed by end of 5th semester in the program.*

Submitting Forms for Milestones

- Be proactive and submit early!
- Ensure you understand which forms are needed and when they should be submitted
 - Consult with your academic advisor first
 - Consult with the Graduate Committee second
- Send all forms to BMEGradProgram@wpi.edu
 - Copy your advisor on these emails!
- Check that all signatures are in place first!
- Check that the form is complete!

**2 most
common
delays!**

Course Information



Worcester Polytechnic Institute

Course Registration: How do I register for courses?

- Register Online (Workday) for most courses
- Some BME courses require special permission (e.g., BME 562, Small Animal Surgery)
- If a class is closed, you will need an “Add form” signed by the instructor (online form)
 - Suggest to contact the instructor
- See Registrar’s website for additional information and forms
 - <https://www.wpi.edu/offices/registrar>

Course Registration: Which courses should I take?

- Graduate Catalog (online) lists graduate course descriptions
 - <http://www.wpi.edu/academics/catalogs/grad.html>
- Special Topics courses (BME595*):
 - <http://wp.wpi.edu/bme/grad/>
- Some courses may be offered every other year (“Cat II”, e.g. BME 550, Tissue Eng.)
- Undergraduate 4000-level courses:
 - Up to 6 credits of 4000-level courses can be taken for graduate program credit
 - Usually 7 week courses (ABCD term v. semester)
 - 1/3 unit (3 credit) undergraduate course = 2 credit graduate course

BME Courses – AY 23-24

- **BME (Fall 2023):**

— BME 523	Biomedical Instrumentation	Shazeeb, Mohammad
— BME 530	Biomedical Materials	Levey, Fiona
— BME 532	Medical Device Regulation	Ferguson, Doug
— BME 562	Laboratory Animal Surgery (LIFE SCI)	Flegal, Matthew
— BME 591	Graduate Seminar	Ji, Songbai
— BME 592	Healthcare Systems & Clinical Practice	Page, Ray
— BME 593	Scientific Communication	Faber, Brent
— BME 595	ST: Value Creation for Graduate Research	George Pins
— BME 595	ST: Mechanobiology	Mensah, Solomon

BME Courses – AY 23-24

- **BME (Spring 2024):**

— BME 531	Biomaterials in the Design of Medical Devices	Cornwell, Kevin
— BME 533	Medical Device Innovation & Development	Zheng, Yihao
— BME 550	Tissue Engineering	Whittington, Catherine
— BME 552	Tissue Mechanics	Hera, Adriana
— BME 560	Physiology for Engineers (LIFE SCI)	Shazeeb, Mohammad
— BME 580	Biomedical Robotics (Online)	Hata, Nobukiko
— BME 580	Biomedical Robotics (In-person)	Fischer, Gregory
— BME 583	Biomed Microscopy & Quant Imaging	Albrecht, Dirk
— BME 591	Graduate Seminar	Pins, George

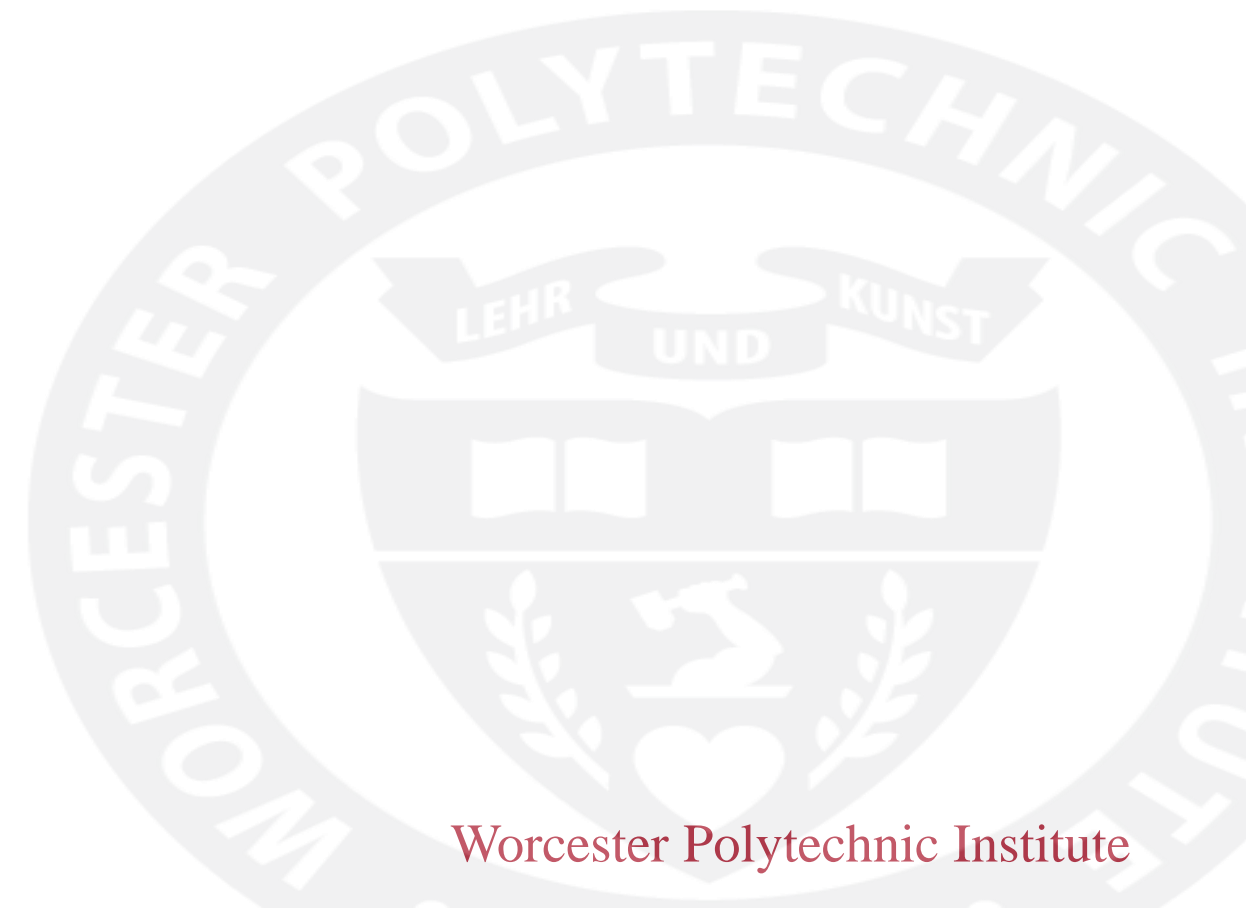
Independent Research Credits

- Includes Directed Research, Lab Rotations, and Thesis/Dissertation Credit
- Must be arranged individually with faculty research advisor
- Register online: <https://www.wpi.edu/offices/registrar/forms>
- “Courses”
 - BME 598 = Directed Research
 - BME 599 = Master’s Thesis
 - BME 699 = PhD Dissertation (only after passing Qualifying Exam)

Laboratory Rotations

- No formal rotation program
 - OPTIONAL!!
 - Must be arranged individually with faculty research advisor for timing and number of credits
 - Usually 2 rotations (1 rotation per semester)
 - Identify research advisor at end of 2nd rotation

Additional Program Information and Final Thoughts



Worcester Polytechnic Institute

Financial Aid, Fellowships

- Apply for graduate funding if eligible!
 - Gives you flexibility: conference travel, research directions, materials, etc.
 - Great for your CV!
 - Lists available on.... <https://wp.wpi.edu/bme/grad>
- BS/MS – consider your courses to ensure maintaining status required for financial aid
- Teaching Assistantship and Peer Learning Assistant opportunities

Expectations & Advice

**Nothing worth
having comes
easily.**

**Keep your eyes on
the prize.**

**Follow through to
tangible
milestones.**

**Socialize and build
friendships and
work colleagues.**

**Difficult
experiences are
learning
experiences.**

**Hang in there. It
will get tough, and
will get better!**

**Best students will
feel the most
pressure.**

**Consider every
opportunity and
take advantage.**

**Ask for help, but
be mindful of
others**

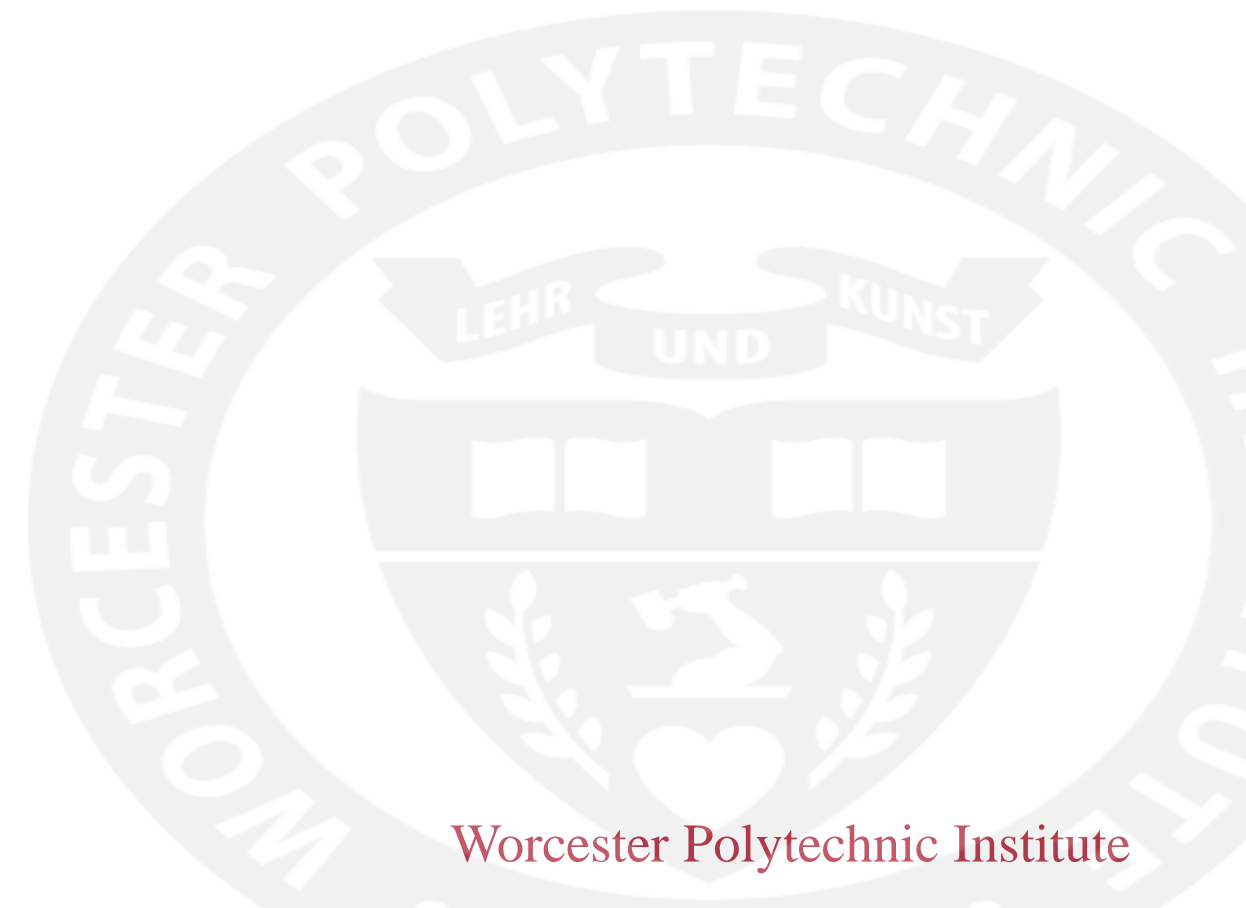
Questions??



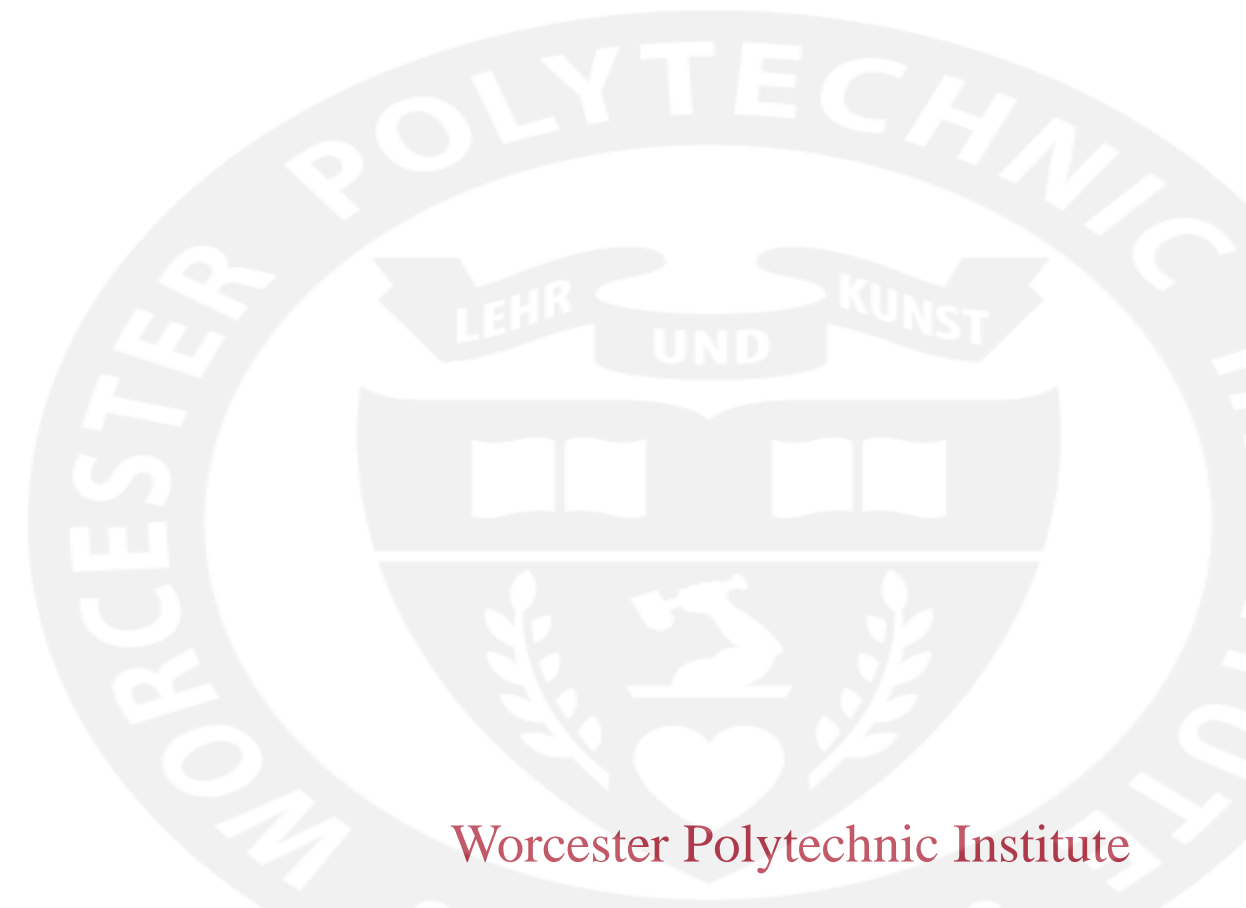
- Don't forget to check FAQ's on http://wp.wpi.edu/bme/grad_!
 - Bookmark this!
 - E.g. BS/MS what to double count, etc.



Extra Slides



Degree Milestones, Graduation Requirements, and Additional Information



Master's Thesis Proposal

Purpose: Committee approves plan for completing MS Thesis

Prepare a document and presentation with proposal of plans (within 6 months of identifying research advisor)

Present plans to committee for review and undergo examination from committee

Outcomes: Pass or Repeat

PhD Qualifying Examination (QE)

- **Prepare an original NIH-style research proposal and presentation to defend to your Qualifying exam committee**
 - Demonstrate proficiency in: Biomedical Engineering (2 areas), Life Science (1 area), and Mathematics (1 area)
- **Outcomes:** Unconditional Pass, Conditional Pass, Fail (with opportunity to re-take exam within 6 months)
- Other details:
 - Must pass QE to advance to candidacy
 - Taken before start of 5th semester enrolled (usually by summer after 2nd year)
 - 4 QE committee members selected by the Graduate Studies Committee

PhD Qualifying Examination

• Process

Step 1: Specific Aims meeting

- Aims page sent 24 hours prior to meeting
- Meet with QE committee
- 1 hr session – 15-20min Presentation with feedback (not Q&A)

Step 2: Send full proposal

- 3 weeks after initial Aims meeting
- Submit Aims page + 12 page proposal

Step 3: Examination

- ~1 week after submitting proposal document
- 2 hr session – 20-30 min Presentation + Proposal defense/Q&A

PhD Qualifying Examination

- Possible outcomes
 - **Pass** – advance to candidacy
 - **Conditional Pass** – must fulfill some requirement, as determined by the committee, before advancing to candidacy
 - E.g., Take an additional course; Update document, etc.
 - **Fail** – repeat the QE process entirely within 6 months
 - Only possible outcomes after re-do are Pass or Fail
 - If QE is unsuccessful the 2nd time, student will exit the PhD program
- Detailed information in the BME Graduate Program Handbook (<https://wp.wpi.edu/bme/grad/>)

Additional PhD Milestones/Requirements

Committee Meetings

- **Feedback opportunities**
- Within 6 months of QE
 - Select committee members
 - Have first committee meeting
- Meet with committee every 6 months

Dissertation Proposal

- **Sign-off on dissertation plan**
- Meet within 1 year of QE
 - Prepare NIH-style proposal of plans
 - Present plans to committee for review
- Outcomes: Pass or Repeat

Publication Requirement

- **1 publication under review before graduating**
- First author
- Topic – Related to your dissertation work
- Review papers are great but do not count toward the requirement

Dissertation Defense

- **Time to graduate!**
- Submit dissertation document to committee
- Public presentation + Q&A (1 hour)
- Private defense with committee (~2 hours)

Getting Around Gateway (50 & 60 Prescott)

- Visitor parking lot next to Life Sciences and Bioengineering Center (LSBC) building (West Lot next to 60 Prescott)– *but can't park there!*
- Gateway parking lot & garage, with permit
 - <https://www.wpi.edu/offices/police/vehicle-registration-permits>
- Gateway Shuttle runs to main campus during business hours and picks up behind LSBC (between building and parking garage)



Getting Around...

- Shuttles
 - Gateway Shuttle, 7a – 6p to main campus
 - SNAP: Nightly within 1 mi, 5 or 6p til 3am, between campus locations, pharmacies, Union Station via TransLoc app
 - Price Chopper supermarket, 4 – 8p
 - South Village, 7a – 6p
- Zipcar
- Bikeshare



Courses – Examples

New courses are always being added across campus, so if you have questions on if something counts, just ask!

See BME Grad Handbook!

- Life Science Requirements:

- BME562* Laboratory Animal Surgery (Fall)
- BME560* Physiology for Engineers (Spring)
- BME564* Cell and Molecular Biology for Engineers (Spring)
- Graduate courses in biology (BBT) or biochemistry (CBC)

**Note: these courses count as Life Science, not BME or Engineering!*

- Math Requirements:

- MA501 Engineering Mathematics
- MA511 Applied Statistics for Engineers and Scientists

- Other Engineering:

- Graduate (500-level) courses in Materials Science, Mechanical Engineering, Manufacturing, Chemical Engineering, Electrical Engineering, etc.

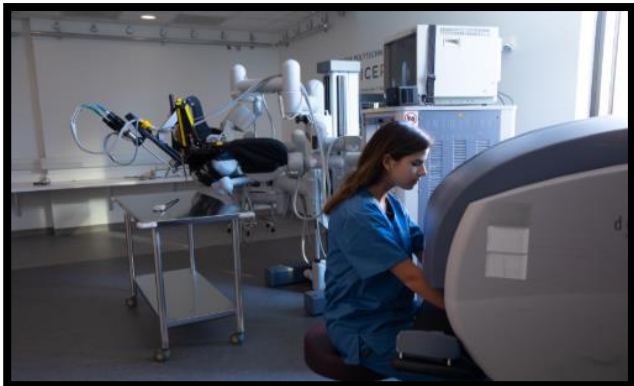
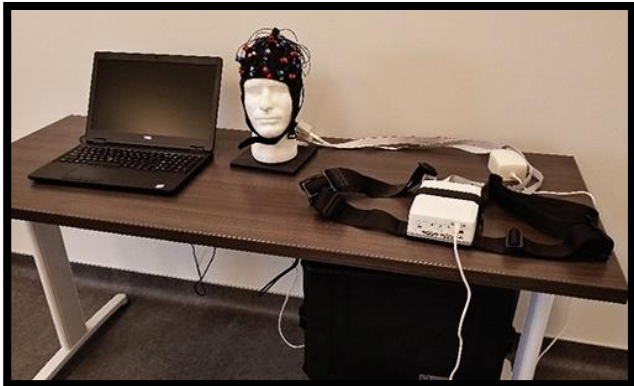
- Other Electives:

- MIS576 Project Management
- BB551 Research Integrity (1 credit seminar)
- Business/management courses, computer science, any grad course

Applying for Graduation

- Download and fill out a “WPI Graduate Student Application for Graduation”
- Registrar’s web site – Forms/Graduate Forms/Graduate Student Application for Degree
- Must be signed by Academic Advisor and Graduate Program Director
- Note Deadlines!!!
 - You are responsible, don’t wait for your advisor or the department to tell you

Research Spaces: Practice Point



“A space for engineers and researchers to test and iterate on new devices and health technologies in simulated point of care environments.”

- MRI Imaging Suite
- Patient Clinical Care Suites
- Home Health Suite
- Motion Capture Suite
- Neurotech Suite
- Manufacturing and Testing Instrumentation

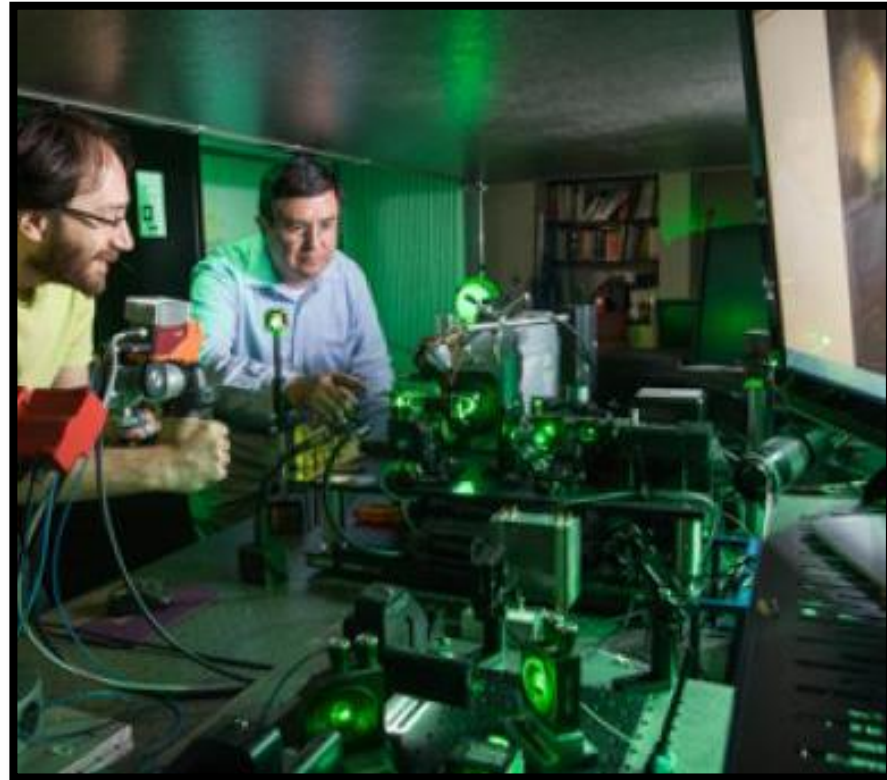
Research Spaces: CERES

“State-of-the-art equipment for all of your cell engineering research needs.”

- Automated liquid dispensing systems
- Automated cell imaging and multimode plate reading
- Quantitative analysis of gene expression
- Flow cytometry (3-laser and 4-laser cytometers; analysis only, no sorting)



Other facilities around WPI



Lab for Education & Application Prototypes (LEAP)

*Part of the national AIM Photonics initiative,
LEAP@WPI/QCC supports the integrated
photonics manufacturing sector*



Rapid Prototyping (RP)

*Includes technologies, including 3D printing.
WPI has executive level RP machines
managed by Academic & Research Computing
(ARC) Center staff.*

UMass Chan Medical School



- Less than 2 miles from LSBC
- Collaborative research groups
- BME graduate students can take classes (transfer credits)
- Core research facilities
 - 3D printing
 - Advanced MRI
 - Bioinformatics
 - Microscopy
 - Genomics
 - Flow cytometry
 - AND MANY MORE!