PRELIMINARY QUALIFYING EXAMINATION GUIDELINES

(Academic Year 2021-2022)

THE GOAL

The primary goal of the Preliminary Qualifying Examination (PQE) in BBS is to ensure that you are able to assemble and defend an effective research proposal. This skillset is essential for the vast majority of research careers that our students pursue after degree completion. Examiners are asked to assess whether you have achieved an appropriately high standard of scientific scholarship and skills that will be critical for successful completion of your Ph.D. thesis and career development. In addition to evaluating your foundation in genetics, molecular biology, cell biology and biochemistry, the PQE will test your ability to:

- Develop hypothesis- or technology-driven research plans likely to advance a field
- Prepare a compelling research plan to test these hypotheses or technologies, including describing the overall strategy, methodology and analyses to be used to accomplish the aims as well as discussing potential problems, and alternative strategies and contingencies
- Develop creative and forward-thinking aim(s) that will advance a given field
- Orally explain and defend these hypotheses and your research plan
- Critically analyze and interpret data, including the application of relevant statistical tests

PROCEDURAL ISSUES

BBS students are required to complete their Preliminary Qualifying Exam by June 30 of their second year (G2). All students are highly encouraged to take *BBS330: Critical Thinking and Research Proposal Writing* course during the fall of their G2 year. In *BBS330*, small groups of students will develop an on-topic proposal, consisting of 2 aims that overlaps with their thesis work, first an outline followed by successive drafts. We also encourage you to take advantage of other courses on experimental design and analytical tools (see attached list of recommended courses available in either G1 or G2 years).

PQE exams can be scheduled in the second half of the G2 year, from January to the end of June.

- For students who take the *BBS330* course, the PQE will be based on the two aims developed during *BBS330* **PLUS** a third aim, derived outside of *BBS330*, and which is specific to the PQE proposal
- For students who develop their proposal in *BBS330*, changes made to Aims 1 and 2 for the PQE version of the proposal are allowed, for example especially if new data are obtained, new paper(s) are published that affect the aims, rationales, or approaches – if major, non-cosmetic changes are made, students must include an introductory cover page that summarizes the changes from the BBS330 proposal to the PQE proposal. This cover page is not included in the final page count.

PQE Proposal Form

Due to the BBS Office before 12:00 PM, November 5, 2021
Students are required to attend an Informational Meeting before submitting the PQE Proposal Form.

PQE Informational Meeting:
Tuesday, September 28, 2021, 10am -12pm
Zoom: https://harvard.zoom.us/j/99308251392

Describe the topic (one concise paragraph)

1. Briefly outline the major question(s) that will be pursued
2. Briefly describe the experimental system and approaches (with a few sentences and by choosing keywords)
3. Identify potential exam chairs and examiners
4. PI must sign the form so plan accordingly

Students are responsible for contacting faculty and scheduling their own PQE committee, date and time.
Try to identify faculty whose expertise fits closely with your topic. For example, if the project involves studying the cell cycle in Drosophila, pick at least one examiner with expertise in the organism and another with expertise in the cell cycle. It may not always be possible to find examiners with closely related expertise. However, and it must be emphasized, this is not a necessary condition for a fair exam. As is common in the NIH grant review system, some committees might include faculty with expertise in the broad area of the student's project but not exactly the same system or topic. You should therefore strive to make the proposal accessible to anyone in the general area of the project.

Once the BBS Program Office receives your PQE Request Form, the office will review the list of chairs and examiners you proposed and determine if any should be excluded due to a conflict of interest; for example, current or recent collaborators of the PI who have been closely involved in the project, recent trainees of the PI (within the last 5 years), your program advisor, BBS330 section leaders, and non-BBS faculty. The office will also ensure that the same faculty are not excessively tapped as examiners; typically, an examiner should only serve on 1-3 exams per year. The list of approved faculty will be submitted back to you within one week of submitting your PQE Proposal Form. **You may only contact the faculty after the proposal has been approved by the BBS office. If additional names are needed, contact the BBS office.**

You should begin scheduling your exam at least one month before you would like to take your PQE; for example, if you are planning on taking your exam in late March you should begin contacting faculty in early February. It is also strongly recommended that you secure a chair first and then use his/her availability as a starting point for scheduling your PQE. Once you've obtained your chair's availability, contact the two examiners you wish to serve on your committee and provide them with the dates and times. The website www.doodle.com is a fantastic tool for aiding in the scheduling process. Please note, the exams are usually two hours and due to COVID-19 will need to be conducted via Zoom. Please refer to the BBS Remote PQE Guidelines for more information.

Once you've confirmed your exam, please email Danny Gonzalez (danny@hms.harvard.edu) the following: chair & examiner names, and exam date, time, and Zoom link.

Role of the PQE Committee Chair
The Chair of the PQE Steering Committee, Alex Toker (atoker@bidmc.harvard.edu), offers an overview meeting each fall semester. In addition, Alex is available to answer questions, clarify expectations, and provide guidance at any point during the exam preparation process.

Role of Examination Committee Chair
PQE chairs are experienced examiners and are responsible for keeping the exam on course and ensuring that examiners pursue an appropriate line of questions.

Martha Bulyk
Alan Cantor
Dipanjan Chowdhury
Pat D'Amore
Victor Hsu
Josh Kaplan
Carla Kim
Galit Lahav

Dan Finley
Lee Gehrke
Anna Greka
Emanuela Gussoni
Steve Gygi
Kevin Haigis
Marcia Haigis
Xi He
Ann Hochschild
Andi McClatchey
Raul Mostoslavsky
Carl Novina
Tom Rapoport
Adrian Salic
Ralph Scully
Ramesh Shivdasani
Bruce Zetter

THE PROPOSAL

You must submit your proposal to your committee (please CC Danny as well) one week before your exam. The BBS Program Office will send your student file and course grades to your committee once your proposal is received.

Topic

As described above, the PQE proposal will follow logically from the on-topic thesis proposal that can be developed in BBS330. If students opt to take this course, the expectation is that 2 aims will be developed as part of BBS330, and will be focused on your thesis topic or related to your thesis project, and a substantial proportion of the work should be hypothesis- or technology-driven. For the PQE proposal, one additional specific aim must be developed that is driven by your own ideas. The additional specific Aim is an opportunity to be creative, so we encourage students to take risks and think 'outside the box', provided the rationale(s) are sound and logically-derived. Even if any of the aims involve screening or other open-ended efforts, at least one aim must test a hypothesis. Technology-driven or screen-based proposals are allowed and encouraged; however for such approaches it is essential to emphasize rationales, as well as efforts directed at validation of data sets and expected outcomes. You should submit your PQE proposal comprising the 2 aims developed in BBS330, plus a new third aim. You are allowed to update the two BBS30 aims for the PQE proposal (e.g., to encompass new preliminary data, or newly-published studies), but if you do so please include a summary paragraph, not more than one half page, as a cover page where you describe the major changes made to the BBS330 proposal to the PQE proposal. The aim(s) are expected to be creative and thought-provoking yet must be balanced with feasibility. They do not necessarily have to be the exact aims of your dissertation research.

While it is anticipated that some of the proposal will be based on the ideas of your thesis advisor, the third aim developed specifically for the PQE proposal must be solely written by you. Again, we encourage students to derive the third aim by proposing creative, 'risky' and forward-thinking hypotheses that if successful, will propel a given field forward. Similarly, students are expected to propose work that will advance understanding within the relevant field, and proposals that restrict themselves entirely to obvious extensions of existing work will not be given a clear pass. For aims that have been inspired by the ideas of others, we expect students to cite the sources of ideas and/or information derived from personal communication. **The proposal should be designed so that you could realistically complete the work in approximately four years.**

Input/Advice

You are strongly encouraged to seek advice and help from post-docs and graduate students as you work to develop and craft the proposal and prepare for the oral exam**.** Students **ARE** also encouraged and expected to continue normal, ongoing discussions about the project, experiments and hypotheses with their PI, as they relate to their PQE proposal. However, students are not allowed to simply abstract or copy aims from their PI's proposals. The PI and any other faculty should **NOT** read proposal drafts, are **NOT** allowed to edit the proposal. You may **NOT** use work that you have submitted for other courses here or at another institution, with the exception of BBS330. Examples of successful proposals **CAN** and should be reviewed in the BBS Program

Office. We also encourage you to get feedback on your written proposal and the proposal presentation from post-docs and students.

Guidelines for Organization and Writing of the Proposal

Contents

Your PQE proposal should contain the following elements:

- Succinct summary of the current state of knowledge in the field
- Discussion of how the proposed studies will address key questions in the field
- Clearly stated and testable hypotheses
- Individual aims (an aim should NOT be based on the outcome of one specific experiment, or fully dependent upon results obtained in a previous aim).
- A well-reasoned and feasible set of experiments to test the key hypotheses
- A thorough understanding of the tools and techniques necessary to carry out the experimental plan
- A discussion of potential pitfalls that may arise and possible solutions/alternative approaches
- A guide to quantitative analysis and interpretation of anticipated results.
- A discussion of how the results obtained will contribute to the state of knowledge and conceptual understanding in the field.

Format

Cover page of the PQE exam must include student's name, email address, date and location of exam, and committee members; if applicable, it should also include your summary of any substantive changes from the BBS330 proposal to the PQE proposal. You should also designate on the cover page which aim(s) you specifically derived (it may not always fall chronologically as Aim 3).

The proposal should conform to the same formatting requirements and guidelines as for an NIH F31 fellowship application (Ruth L. Kirschstein National Research Service Award (NRSA) Individual Predoctoral Fellowship). This is to allow you to use the PQE proposal as a framework for future submission as an NIH F31 application, or other for other international fellowships with similar proposal formats. Details regarding F31 fellowship application, guidelines, due dates, advice etc can be found online at:
https://grants.nih.gov/grants/guide/pa-files/PA-19-195.html
https://grants.nih.gov/grants/how-to-apply-application-guide/forms-e/fellowship-forms-e.pdf
It is neither required nor necessary to view the above NIH guidelines to prepare your PQE Proposal (although this will be essential if/when you prepare an F31 application). For your PQE proposal, simply follow the formatting requirements, in the following order:

1. Use 0.5 inch margins throughout, single spacing, Arial 11 point font. Embed all figures in the main text, and include figure legends.
2. Cover page (see above)
3. Abstract. 30 lines of text. Succinctly describe the overall hypothesis, background and significance and aims of the proposal, and if applicable, public health relevance.
4. Specific Aims: one page of text. Outline overall hypothesis, background and significance, brief description of Aims and hypotheses to be tested, statements of impact and innovation.
5. Research strategy: 6 pages. Sections include Background and Significance, Preliminary Data, Experimental design, Expected Outcomes and Interpretation, Pitfalls and Alternatives.
6. Literature Cited (full references with titles). This does NOT count towards the 6 page limit.

   Other documents that are required for an actual F31 application (such as training plan, biosketch, letters, project narrative etc.) are not required for the PQE proposal. Examples of awarded F31 applications submitted by former BBS students are available in the BBS office, as an additional guide.

ORAL EXAM

The oral exam will last approximately 2 hours. You should prepare a presentation of your entire proposal (that is, the aims developed in BBS330 plus your new aim) including an abbreviated Background and with a focus on the Experimental Design and Expected Outcomes and Interpretation. 10-15 slides will likely be sufficient. During the exam, you will defend and explain your hypotheses, methodology, and expected outcomes. At the beginning of the exam, you will be expected to present and discuss all three Aims including those that were developed during BBS330, and also indicate and present the additional third aim that was developed independently.

You are expected to have a strong command of the primary literature related to your field. You are also responsible for the materials covered in the core courses, including fundamental principles and experimental approaches in the fields of genetics, molecular biology, biochemistry and cell biology. Questions testing your knowledge in these areas may be framed within or outside the context of your proposal. You are strongly encouraged to give practice presentations to students and post-docs to help you prepare for the oral exam. No input from faculty is allowed.

THE OUTCOMES

You will be informed of the outcome (pass, conditional pass, or fail) at the end of the exam (see below). Within 1 week and in rare cases 2 weeks, a written evaluation will be provided.

- **Pass**. No further work on the PQE will be required

- **Conditional**. A student will receive a conditional pass if the committee feels that he/she would benefit from additional preparation or work. This may be due to issues that arise in the written proposal, oral exam, or both. ***The conditions for changing the grade to "pass" will be determined by the exam committee. If possible these recommendations will be given to the student at the end of the exam, but may be provided at a later date. The plan will be noted in the evaluation form, along with the expected time frame for when the condition will be due.*** It may be helpful for the student and the chair to communicate by email shortly after the exam in order to make sure that it is clear what the student will be expected to do. The work required to fulfill any conditions should be performed in parallel with your thesis project. A written condition is typically 30 days.

- It is important to emphasize that the PQE is not just an exam, but it also is an academic exercise in which the student learns how to write and defend a research proposal. Students come to the exam with different backgrounds, and for most the PQE will be an experience and test like no other they have encountered before. Accordingly, receiving a conditional or even a fail should not be considered necessarily to be a judgment on a student's innate or ultimate abilities. It is extremely important that students begin to master the skills involved in the PQE, a process that will continue even after they graduate. Students should consider a grade of "conditional" simply to mean that they need to acquire additional expertise before they can be considered to have developed these skills to the level expected for passing the PQE. ***The student will receive a "pass" once this conditional work is completed to the satisfaction of the exam committee. If it is not completed satisfactorily, the student will receive a fail and be asked to repeat the entire exam.***

- **Fail.** A student will receive a fail if there are serious concerns based on the written proposal and the oral exam. In this case, a follow-up meeting with the exam chair, PQE committee chair, program head, program advisor, and thesis advisor will be scheduled. After this meeting, a set of recommendations will be made to address the identified issues. The student will be given the opportunity to rewrite the proposal and retake the oral exam following completion of the recommended work. Students are typically given 1 year to retake their exam.

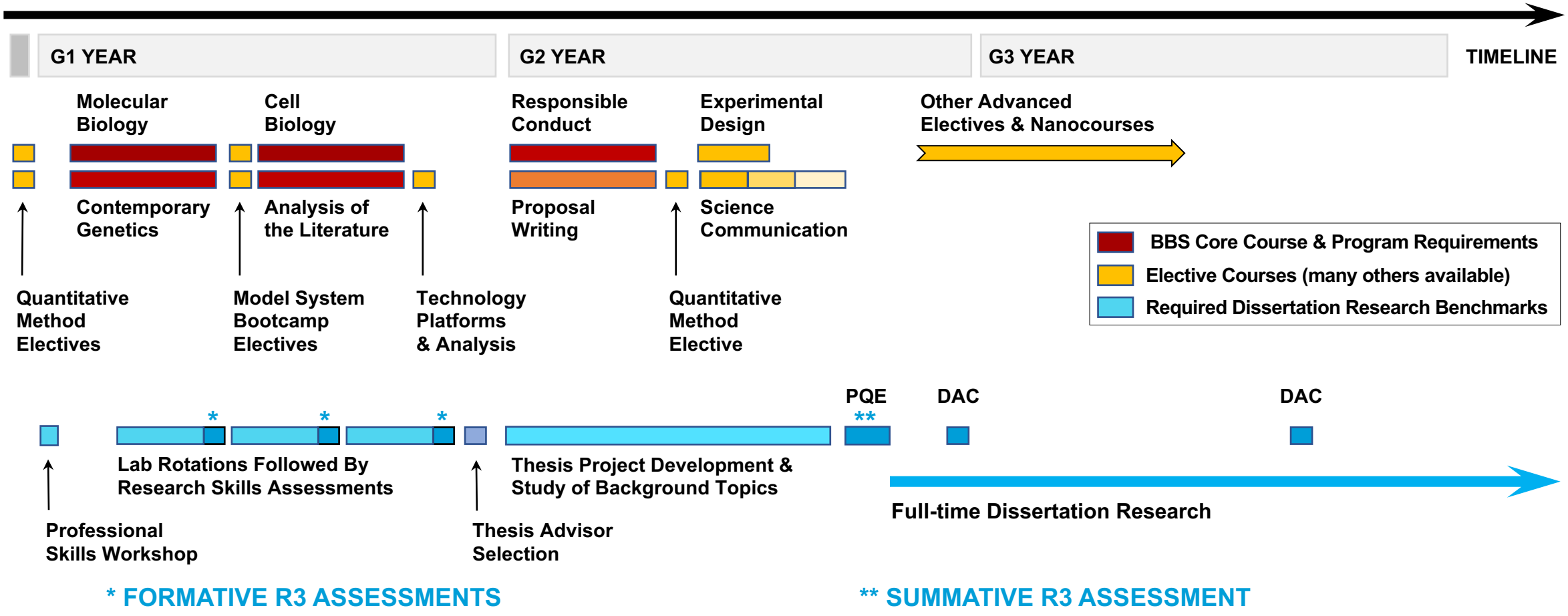
- **Feedback.** In addition to determining the outcome of the exam, examiners will be asked to provide students with short comments on their strengths and weaknesses in the following areas. These criteria will be important for determination of the overall outcome:

    - Experimental approach and written proposal
    - Predicted impact of the proposed work
    - Innovation and creativity
    - Oral exam
    - Knowledge base (proposal-related and general)

THE NEXT STEP

After passing the PQE, you will assemble a Dissertation Advisory Committee (DAC). This meeting must happen within 3-4 months after passing the PQE. In order to encourage students to apply the constructive critique that they receive during the PQE and address key weaknesses in the original proposal, all BBS students are required to submit a revised version of the PQE proposal to their DAC in preparation for the first DAC meeting. If your aims have changed, you should prepare and submit a new thesis proposal to your DAC. Please see the DAC Guidelines for more information.

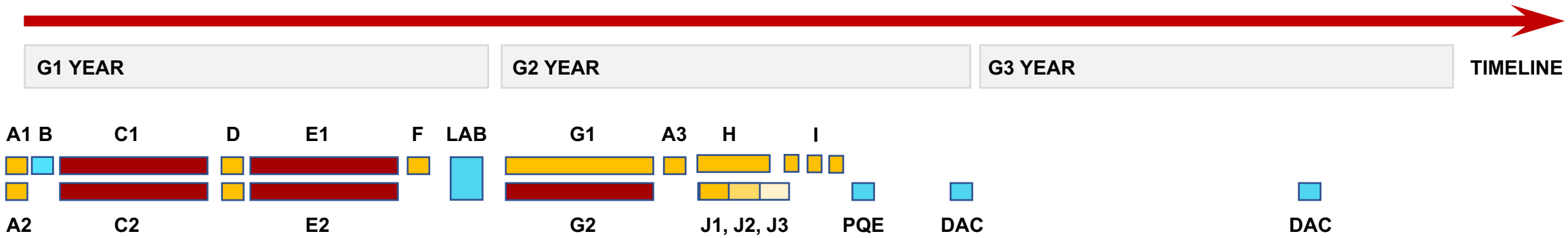
BBS CORE SKILLS CURRICULUM and EXPERIENTIAL RESEARCH IMPLEMENTATION



* FORMATIVE R3 ASSESSMENTS

** SUMMATIVE R3 ASSESSMENT

BBS RESEARCH SKILLS TRAINING CURRICULUM & COMPETANCY EVALUATION BENCHMARKS



A Quantitative Methods Bootcamps
- 1) R - Algorithmic Thinking and Toolkit
- 2) MATLAB - Algorithmic Thinking and Toolkit

B Professional Skills Workshop (Mentoring Up +)

C Molecular Biology & Contemporary Genetics
- 1) BCMP200 Fundamental Experimental Design
- 2) GEN201 Experimental Data Analysis

D Experimental Approaches Bootcamps
Experimental Model Systems and Methods

E Cell Biology & Critical Literature Analysis
- 1) CB201 Dissection of Experimental Approaches in the Literature
- 2) BBS230 Critical Analysis of Literature and the Peer Review Process

F Experimental Platforms and Analytics
CB321qc Data Management, eNotebooks, Advanced Technology Platforms/Cores, Backward Experimental Design and Expert Consultancy to Optimize Planning

LAB *DECLARATION OF THESIS LAB*

G Conduct of Science & Project Development
- 1) BBS330 Project Proposal Writing
- 2) MEDSCI300 Responsible Conduct of Science

A Quantitative Methods Bootcamp:
- 3) Python and Jupyter Notebooks

H Advanced Experimental Design
CB302qc Project Framework, System Validation, Data Interpretation, Decision--making, Flowchart Planning

I Methods Nanocourses

J Science Communication Series
- 1) Science Writing and Publication
- 2) Data Visualization
- 3) Scientific Presentation

Preliminary Qualifying Exam (PQE)
Comprehensive Internal Assessment of R3

Dissertation Advisory Committee (DAC): Mtg1
(subsequent frequency: 6-9 month intervals)

FULL TIME THESIS RESEARCH (G3 and Beyond)

R3 Benchmarks & Evaluations

internal:
- DAC Meetings (annual or bi-annual)
- Lab meeting presentations
- Data club presentations
- MCDM Retreat & Symposium talks
- Dissertation Outline Approval
- Dissertation Examination

external:
- Conference Presentations
- Peer-Review Publications
- Grant/Fellowship Applications

BBS Core Course & Program Requirements
Elective Courses (many others available)
Required Dissertation Research Benchmarks