

407.403 Advanced Nuclear Lab

Spring 2018 Tentative Course Syllabus

The course outline given here is tentative and is subject to change as needed.

As currently structured, we plan to have a combination of two (2) reactor demos and four (4) formal reactor labs over the course of the semester. The course plan assumes that 12 classes will be offered each semester with one nominal 3-hr meeting per week. Class times might be slightly shorter or longer on lab days, depending on the time needed to complete the specific reactor operations sequence for the given lab/demo. The formal reactor experiments will occur roughly every other class meeting after the first few introductory classes. This schedule allows time for the students to do the assigned pre-lab and post-lab work for each lab experience. A short “review period” will occur at the beginning of each class to make sure everyone is sufficiently knowledgeable concerning previous discussions and labs and, on a lab day, that everyone is properly prepared for what is to occur during the subsequent reactor lab. This review will involve informal oral discussions and/or short student presentations on their pre- or post-lab analyses. On the non-lab weeks, after the review period, the course instructor will lead a formal pre-lab lecture/discussion on next week’s lab. These non-lab classes will focus on the description, background theory, and any other preparations that may be needed for the following week’s lab. The details of this structure, along with tentative titles and dates for the labs/demos to be performed this semester, are summarized in Table I.

The students will be required to work together in small two-person teams when collecting and analyzing data for the pre- and post-lab homework (HW) assignments, and for the brief student presentations during the “review period”. Only a single HW assignment will be submitted per team, but each team member is expected to be knowledgeable about each of the assigned tasks and have contributed equitably to help complete the assignment.

Some form of HW assignment will be required each class. These will alternate between preparations for the upcoming experiment (these HWs can take on a variety of forms such as reviewing the assigned reading material, answering some questions, or doing some preliminary calculations to predict the behavior to be observed, etc.), and post-processing and analysis of the data collected from the most recent lab, along with the preparation of a post-lab report that summarizes your observations and results, and answers the questions posed in the lab description/procedure. This HW schedule will keep the students consistently engaged within the course throughout the semester so that they can get as much as possible from this experiential experience -- but the HW assignments will be structured to keep the total workload manageable (about 4-6 hours per week on the average outside of class time).

Table I contains a tentative summary outline of the overall schedule and the specific labs/demos for the current semester -- but please note that this is subject to change, as needed, as the semester progresses.

Table I Spring 2018 tentative syllabus/class schedule for the Reactor Experiments/Advanced Nuclear Lab course.

Class # -- Date	In-Class Activities (Tuesdays from 8 am to 11 am -- local UMass-Lowell time)		Assigned Homework
1 -- Jan. 23	Course overview, objectives, expectations, lab schedule, etc.	Introduction/overview of the UMass-Lowell research reactor (UMLRR) including a brief introduction to the UMLRR Online application and the available Matlab-based data acquisition and data processing tools. Reactor Demo #0: Introduction/Overview of the UMLRR	HW #1: Address questions about UMLRR and become familiar with umlrr_data GUI. Preliminary review of some Reactor Kinetics material.
2 -- Jan. 30	Review features of UMLRR and discuss experience and/or issues with HW #1 tasks.	Review/overview of Reactor Kinetics and Dynamics. Reactor Demo #1: Typical Reactor Startup Procedure	HW #2: Answer questions on Reactor Kinetics and process data from Demo #1 using the umlrr_data GUI. Preliminary review of some Matlab-based simulation tools.
3 -- Feb. 6	Review concepts from Reactor Kinetics and address questions related to HW #2.	Discuss Matlab-based Point Kinetics simulation tools for UMLRR. These simulations will be used to help design and evaluate the actual reactor labs performed later in the semester. Reactor Demo #2: Typical Operational Reactor Transients	HW #3: Perform point kinetics simulations and answer questions related to Demo #2. Preliminary review of subcritical multiplication.
4 -- Feb. 13	Review simulation results and address questions on HW #3.	Lab #1 pre-lab lecture: Theory and application of subcritical multiplication.	HW #4: Review material on subcritical multiplication and do Lab #1 pre-lab exercises.
5 -- Feb. 20	Lab #1 pre-lab review discussion & questions	Reactor Lab #1: An Approach to Critical Experiment	HW #5: Lab #1 post-lab exercises and summary report.
6 -- Feb. 27	Lab #1 post-lab review discussion & questions	Lab #2 pre-lab lecture: Theory for reactivity evaluation during critical and subcritical operation.	HW #6: Review material on reactivity evaluation techniques and do Lab #2 pre-lab exercises.
7 -- Mar. 6	Lab #2 pre-lab review discussion & questions	Reactor Lab #2: Reactivity Measurement Techniques	HW #7: Lab #2 post-lab exercises and summary report.

Table I Spring 2018 tentative syllabus/class schedule for the Reactor Experiments/Advanced Nuclear Lab course (continued).

Class # -- Date	In-Class Activities (Tuesdays from 8 am to 11 am -- local UMass-Lowell time)		Assigned Homework
8 -- Mar. 20	Lab #2 post-lab review discussion & questions	Lab #3 pre-lab lecture: Techniques for determining the worth of a partially inserted control rod.	HW #8: Review material on rod worth evaluation techniques and do Lab #3 pre-lab exercises.
9 -- Mar. 27	Lab #3 pre-lab review discussion & questions	Reactor Lab #3: Blade Worth Calibration within the UMLRR	HW #9: Lab #3 post-lab exercises and summary report.
10 -- Apr. 10	Lab #3 post-lab review discussion & questions	Lab #4 pre-lab lecture: Inherent reactivity feedback effects during power operations.	HW #10: Review material on reactivity feedback effects and do Lab #4 pre-lab exercises.
11 -- Apr. 17	Lab #4 pre-lab review discussion & questions	Reactor Lab #4: Measuring and Interpreting Feedback Effects within the UMLRR	HW #11: Lab #4 post-lab exercises and summary report.
12 -- Apr. 24	Lab #4 post-lab review discussion & questions	Course wrap-up, evaluation, and final question-answer period (written responses will be required this semester).....	---