Changes to this syllabus will be provided via the ELearning/Sakai platform. Such changes may include those required by policy changes, instructor travel, changes in the speed of course coverage, university closure, errors in previous syllabus versions, and other reasons.

1. Description:

Nuclear applications of fluid mechanics, heat transfer and thermodynamics. Two-phase flow and boiling heat transfer. Heat transfer mechanisms in reactor core and sub-channel thermal hydraulics. Steam generator, power cycles, balance of plant. Introduction to thermal design for reactors.

2. Prerequisite:

EML 4140 + (EGN 3353C or ENU 4133)

3. Program Educational Objectives Supported by Course

1. Graduates will have successful careers in Nuclear Engineering or related disciplines.
2. Graduates will pursue advanced degrees or continuing education.

4. Professional Components Supported by Course

1. Provide students with the ability to apply advanced mathematics, computational skills, science and engineering science, including atomic and nuclear physics, to identify, formulate, analyze, and solve nuclear and radiological engineering problems.

2. Provide students with knowledge of the fundamentals of radiation transport, interactions, and detection and with the principles required for the analysis, design, and safe operation of radiation producing devices and using equipment and systems.

4. Provide students with the skills needed to communicate effectively, work collaboratively, and understand their professional and ethical responsibilities and the impact of engineering solutions in a societal and economic context so they can pursue successful, productive careers in nuclear and radiological engineering.

5. Program Outcomes Supported by Course

Outcome a: an ability to apply knowledge of mathematics, science, and engineering.

Outcome c: an ability to design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

Outcome d: an ability to function on multi-disciplinary skills teams.

Outcome e: an ability to identify, formulate, and solve engineering problems.

Outcome f: an understanding of professional, ethical and regulatory responsibility in engineering practice.

Outcome g: an ability to communicate effectively, using both oral and written presentations, in engineering practice;

Outcome i: a recognition of the need for life-long learning and the ability to adapt this to engineering practice;

Outcome k: an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Outcome l: an ability to apply advanced mathematics, science, and engineering sciences, including atomic and nuclear physics, to nuclear and radiological systems and processes

Outcome n: an ability to work professionally in on or more of the areas of: nuclear power systems, nuclear instrumentation and measurement, radiation protection and shielding, and radiation sources and applications

6. Instructor

DuWayne Schubring, Assistant Professor
205 Nuclear Sciences Building
352-392-1401 x314
dlschubring@ufl.edu
Web: Sakai

Office hours: MWF 1300-1400, by e-mail, and appointment. *Due to other meetings I attend/host, please note that office hours begin at 1300, not 1235 or 1255.*

7. Teaching Assistant:

none

8/9/10. Course Meetings:

MF, 1500-1550 ("Period" 8); W, 1500-1655 ("Periods" 8 and 9), MAE-B 229. Final Exam: December 19, 1230-1430. *This is the very last finals slot, on Friday of that week. Under no circumstances will a make-up final be given early.*

11. Material and Supply Fees:

$32.00 (for taped lectures)

12. Text (Required):

Nuclear Systems I: Thermal Hydraulic Fundamentals, N.E. Todreas and M.S. Kazimi, 2011 (2nd edition). (ISBN: 9781439808870). (No, the cheaper 1st edition is not adequate.)

To complete some of the homework and projects in this course, access to a programming/scripting language such as MATLAB, FORTRAN, C, C++ (etc.) and a spreadsheet application will be required. Property look-up software, such as EES, is strongly recommended, though not strictly required.

13. References

1. *Nuclear Heat Transport*, M. M. El-Wakil, 1978 (1st edition). (ISBN: 0894480146). A second book on nuclear-specific thermal issues.

2. Any undergraduate textbooks (typically aimed at mechanical engineering students) on thermodynamics, fluid dynamics, and heat transfer. *Fluid Mechanics*, F. M. White (7th edition) was the text for ENU 4133 and is recommended.

3. As the steam tables in T&K are not particularly comprehensive, especially in SI units, you'll want access to better ones. These could be found in previous textbooks or via software.

14. Course Outline

The course is organized into 16 modules. The materials for each module are in separate folders on the course website. The lecture time for each module, in addition to exam/homework/project coverage, varies considerably.

These modules are (# of lecture hours) [Reference]:

1. Nuclear Applications of Fluid Mechanics and Heat Transfer (2) [T&K, Sections 9.6, 10.5.1.1.3)
2. Averaging in Two-Phase Flow (2) [T&K, Sections 5.1 through 5.4]
3. Transport in Two-Phase Flow (2) [T&K, Sections 5.5 through 5.7]
4. Homogeneous Equilibrium Model (2) [T&K, Sections 11.1 through 11.4, 11.5.2]
5. Separated Flow Model and Void Fraction Correlations (2) [T&K, Section 11.5]
6. Pressure Loss in Two-Phase Flow (2) [T&K, Section 11.6]
7. Flow Regimes in Two-Phase Flow (3) [T&K, Section 11.2]
8. Boiling Heat Transfer – Fundamentals (3) [T&K, Sections 12.1 through 12.5, 13.1, 13.2]
9. Boiling Heat Transfer – Correlations (3) [T&K, Section 13.3]
10. Boiling Heat Transfer – Critical Heat Flux (3) [T&K, Section 13.4]
11. Nuclear Heat Transport (3) [T&K, Sections 3.1 through 3.6.1, 3.9, 8.1 through 8.3, 8.5, 8.7]
12. Single Channel Analysis (SCA) Methods (2) [T&K, Chapter 14]
13. Critical Flow (3) [T&K, Section 11.7]
14. Nuclear Power Cycles (4) [T&K, Sections 6.1, 6.3 through 6.7]
15. Steam Generators (3)
16. Thermal Design Principles (2) [Lecture/discussion only – no separated set of notes]

Modules 1-15 are supported by online lecture notes. Since T&K is primarily a graduate-level textbook with relatively few organizational similarities to ENU 4134/6937, these notes are intended to distill the keys points of the modules for use in this class. Particularly for modules 12, 14, and 15, these notes will likely form your primary study material.

Finally, a "Module 0" is provided, as online notes and examples only (no lectures), to address topics in Gas Dynamics that were skipped in some ENU 4133 offerings. You should review this material at your convenience, but prior to Module 13.

Exams

1. Modules 1 through 7
2. Modules 8 through 12
3. Comprehensive, focus on Modules 13-16

Projects

1. Flow Regimes and/or Pressure Drop (TBD)

2. Single Channel Analysis with Your Own SCA Code (Part A: Code Development; Part B: Code Application)

Homeworks

1. Nuclear Applications of Fluid Mechanics and Heat Transfer
2. Averaging in Two-Phase Flow
3. Homogeneous Equilibrium Model
4. Separated Flow Model (Void Fraction Correlations)
5. Pressure Loss in Two-Phase Flow
6. Boiling Heat Transfer (Part 1)
7. Boiling Heat Transfer (Part 2)
8. Nuclear Heat Transport
9. Critical Flow
10. Nuclear Power Cycles

The day-by-day outline must be understood as a draft. Lecture coverage may move forward or back, as necessary. Homework and project deadlines will not be earlier than listed, but may be later. Exam dates will not change (excluding university closure).

Wk.	**Day**	**Date**	**Due**	**Material**
1	M	25 Aug		Introduction and Administrivia
1	W	27 Aug		Nuclear Applications of Fluid Mechanics and Heat Transfer
1	F	29 Aug		Averaging in Two-Phase Flow
2	M	1 Sep		NO CLASS (UF HOLIDAY)
2	W1	3 Sep	HW 1	Averaging in Two-Phase Flow
2	W2	3 Sep		Transport in Two-Phase Flow
2	F	5 Sep		Transport in Two-Phase Flow
3	M	8 Sep		Homogeneous Equilibrium Model
3	W1	10 Sep	HW 2	Homogeneous Equilibrium Model
3	W2	10 Sep		Separated Flow Model and Void Fraction Correlations
3	F	12 Sep		Separated Flow Model and Void Fraction Correlations
4	M	15 Sep		Pressure Loss in Two-Phase Flow
4	W	17 Sep	HW 3	Pressure Loss in Two-Phase Flow
4	F	19 Sep		Flow Regimes in Two-Phase Flow
5	M	22 Sep		Flow Regimes in Two-Phase Flow
5	W1	24 Sep	HW 4	Flow Regimes in Two-Phase Flow
5	W2	24 Sep		Assignment of Project 1
5	F	26 Sep		Boiling Heat Transfer – Fundamentals
6	M	29 Sep		Boiling Heat Transfer – Fundamentals
6	W1	1 Oct	HW 5	Boiling Heat Transfer – Fundamentals
6	W2	1 Oct		Boiling Heat Transfer – Correlations
6	F	3 Oct		Boiling Heat Transfer – Correlations

Wk.	Day	Date	Due	Material
7	M	6 Oct		Review for Exam 1
7	W	8 Oct		Exam 1
7	F	10 Oct		Boiling Heat Transfer – Correlations
8	M	13 Oct		Boiling Heat Transfer – Critical Heat Flux
8	W	15 Oct	Pr. 1	Boiling Heat Transfer – Critical Heat Flux
8	F	17 Oct		NO CLASS (UF HOLIDAY)
9	M	20 Oct		Nuclear Heat Transport
9	W	22 Oct	HW 6, 7	Nuclear Heat Transport
9	F	24 Oct		Single Channel Analysis (SCA) Methods, Project 2 Assign
10	M	27 Oct		Single Channel Analysis (SCA) Methods, Project 2 Assign
10	W	29 Oct	HW 8	Critical Flow
10	F	31 Oct		Critical Flow
11	M	3 Nov		Review for Exam 2
11	W	5 Nov		Exam 2
11	F	7 Nov		Exam 2 Return & Catch-up (if necessary)
12	M	10 Nov		ANS (Catch-up Lecture, if necessary)
12	W	12 Nov		ANS (Catch-up Lecture, if necessary)
12	F	14 Nov	Pr. 2A	Nuclear Power Cycles
13	M	17 Nov		Nuclear Power Cycles
13	W	19 Nov	HW 9	Nuclear Power Cycles
13	F	21 Nov		Steam Generators
14	M	24 Nov		Steam Generators
14	T	25 Nov	Pr. 2B	(due at 5 pm to my mailbox)
14	W	26 Nov		NO CLASS (UF HOLIDAY)
14	F	28 Nov		NO CLASS (UF HOLIDAY)
15	M	1 Dec		Steam Generators
15	W	3 Dec	HW 10	Thermal Design
15	F	5 Dec		Catch-up Lecture, if necessary
16	M	8 Dec		Catch-up Lecture, if necessary
16	W	10 Dec	Pr. 3	Review for Exam 3

15. Attendance and Expectations

Attendance & Class Conduct

Skip at your peril. Attendance is not considered in the grade. However, some materials in the course will not be covered in the textbook or in the notes provided online – only in class. Some example problems and complex figures (hard to digitize, easy to make on chalkboard) fall into this category. Students are responsible for these materials.

If a student arrives late or leaves early, he/she is expected to do so with minimum level of disruption to the class in progress. There is no tolerance for mobile phones or other electronic

disruptions. Such disruptions will lead to the student being told to leave the room for the duration of the class period, *including during examination periods.* The same principle applies to office hours or appointments – if you stop by my office and your phone rings, you will be told to leave the room for the duration of that day's office hours (or your appointment considered over).

The instructor reserves the right to take attendance to prioritize e-mail assistance for on-campus (non-EDGE) students.

Recorded Lectures

The lectures from 2013 are available for your use, should you need to miss class. Please keep the following notes in mind:

- Several lectures from 2013 were corrected, via online note correction, e-mail message, and/or in-class announcement (at a later date). These changes are listed on Sakai.
- The quality of lecture videos is somewhat variable (and largely beyond my control).
- In the event of conflicts between the instructions in 2013 lectures and the 2014 syllabus, e-mail messages, assignments, other administrative documents (etc.), the 2014 versions will prevail. Several course policies have been changed for 2014 (though the content of the course is 90% the same).
- The specific slides/materials covered by each online lecture are listed, but please note that 2013 and 2014 lectures will usually not match up one-to-one. That is, a "hybrid" strategy of attending some lectures live and some via video will likely cause on-campus students to miss some material and hear others twice.

In general, I encourage on-campus students to attend class live-and-in-person, as ENU 4134/6937 is optimized for this experience, with accomodations for distance education.

Make-Up Work Policies

Absences and late-work excuses can be grouped into the categories of *professional, medical,* and *personal.*

Professional: Reasonable extensions for job/internship interviews, technical conferences, or other professional/career development reasons should be requested. Requests are typically granted, at instructor's discretion, unless they would grant a student or group of students an unfair advantage over their peers, cause significant disruption to the course or grading schedule, or violate some UF policy.

Medical: Extensions will also be granted for (your own) medical reasons – please do not come to class if you are ill. Per UF policy, in the case of medical absences that are frequent or suspiciously-timed (*e.g.;* you are repeatedly, suddenly ill at deadlines), the instructor may request a signed note from a physician or similar professional practitioner.

Personal: In addition, UF policies require accommodation for several non-academic, non-medical reasons. *Extensions for these personal issues are strictly limited to those mandated by the letter of UF policies.* UF-authorized extensions include UAA competitions, religious observances, and serious illness or death of specified relatives. There is no single document listing all UF-approved personal reasons for absence/extension; further, the list of reasons changes from time to time. If you have a question regarding your personal issue and if it qualifies under one of the excused absence policies, contact the instructor in advance.

Homework

Homework will collected at the beginning of the class period at which it is due. All homework assignments will require submission of hard copy (for regular students) or submission through the EDGE electronic system (for EDGE students only). If your homework was completed by a group with both on-campus and EDGE students, the turn-in requirements for on-campus students will prevail. No type of paper or writing utensil is preferred over others (within reason). You must include your full first and last name on all homework (as well as projects and exams).

Direct electronic submission of files used on homework (spreadsheets, etc.) may be required for some assignments, as indicated on the assignment sheet. The allowable level of collaboration on homework assignments may vary throughout the course and is indicated clearly on each assignment.

Homework handed in after the release of solutions (as early as 8 am the Monday after the due date) will receive no credit. Homework handed in between the due date and the release of solutions is worth 50% credit. If your homework is late, the onus is on you to provide it to me; *the clock does not stop until I have homework in hand.*

In addition to the required homework assignments noted above, recommended homework problems will be given during the semester. You will be responsible for the technical content of these homework problems (*i.e.*, they may contribute knowledge needed to perform well on projects or exams), but will not be included in the grade. Solutions to both required and recommended homework problems will be provided.

Projects

Electronic submission of project narratives is not accepted (for regular students) or accepted only through the EDGE electronic system (for EDGE students only). If your project was completed by a group with both on-campus and EDGE students, the turn-in requirements for on-campus students will prevail. Electronic submission of other project components follows the same rules as for homework. You will need to collaborate with and divide labor among the members of you team, but no collaboration among teams is permitted.

Late projects will lose 10% of their value each calendar day, rounded up (so 3 hours late is considered 1 day late). Projects 4 or more calendar days late have no value. If your project is late, the onus is on you to provide it to me; *the clock does not stop until I have project in hand.*

Certain professional document and figure standards will be enforced on these projects; *the onus is on you to figure out how to meet these standards in whatever programs you use to write the document and make figures.* Your instructor has little sympathy for those who select a word processor without knowing how to format their text using it – complaints that the standards are not the same as a particular piece of software's defaults will fall on deaf ears.

All projects are to be done in groups. The instructor will assign the groups. A peer review system is in place to assure equitable workload. In the event the workload is not equitable, the instructor reserves the right to adjust individual grades to accurately reflect contributions to the work.

Examinations

For each exam, you will receive an Exam Preview, intended to prepare you for taking the exam (both technically and procedurally). Detailed examination (including grading/curving) policies are

included on this document. The preview will also include the specific topics addressed by the problem (for most problems), the way points are distributed among problems, and a brief list of topics within the scope of the exam.

Examinations are due at the end of the examination period. No collaboration is permitted during examinations, although you may prepare for these however you choose. Use of any unathorized materials or any communication (including mobile phones, laptops, or face-to-face with classmates in the room) is grounds for *immediate and final* collection of your exam with no more work permitted and any work already completed that, in the instructor's judgement, was aided by said materials/communication not considered in grading. Examinations consist of two stages: a closed-book/note conceptual and open-book/note problem solving.

Grade Appeal

All appeals of grades, including those from clerical/grade-calculation errors, must be made within 1 week of return. (This may be modified for specific assignments. I will announce this via e-mail if needed.)

Grade appeals must be provided in the following format:

- Include your entire assignment *unmodified*.
- Attach (paper clip preferred) a written summary of which problem(s) or part(s) you believe were graded inaccurately. Be as specific as possible.
- Turn in your appeal to me at class time or during office hours.
- The instructor will review your grade appeal, contact you via your ufl.edu e-mail address, and return the assignment in class. Fairly simple appeals provided to me during office hours may be decided upon while you wait, at my discretion.

Appeals will be considered for clerical errors, addition errors, and inconsistent scoring. Grade appeals will not be entertained if you simply do not like that (for example) Part A was worth only 2 points with Part B worth 5. Repeated frivolous appeals may lead to revocation of grade appeal privilege on an individual basis.

File Formats

The electronic components of homework submissions *must* be in the formats requested. If you do not know how to convert your files to these formats, contact the instructor in advance of the deadline. Not knowing your software is not an excuse for late homework. Acceptable formats may include plain text, .pdf, .csv, and EES files, as well as other file formats at the instructor's discretion.

In particular, the instructor will not open files from students in the following formats: .ppt, .pptx, .doc, .docx. Presentation and word processing documents are best converted to .pdf.

The instructor will open spreadsheets in .csv, .xls, or .xlsx format. Please be aware that .xlsx format has remaining compatibility issues with free office software; .xls is usually a wiser choice.

E-mail

The primary means of communication with the class outside of class time will be e-mail listserv. These listservs (1 for on-campus 4134, 1 for EDGE 4134, 1 for 6937) will send to your @ufl.edu

address only. Any inquiries regarding grading will be directed towards your @ufl.edu address only, per FERPA compliance regulations.

Technical and procedural questions will be answered as a reply to whatever e-mail address you used to send them. If the entire class will benefit from the answer, I may send to the class list (either in lieu of or in addition to a direct reply to you, at my discretion). If you do not wish to have a specific e-mail to me regarding technical content or course procedures replied to through the class list, you must explicitly state this in that e-mail. In such a case, I will reply directly to you and send a general-purpose announcement to the class list, not indicating who caused me to send it.

Notes on Workload

This may well be the most conceptually difficult course you will take in your undergraduate career. Two-phase flow, particularly, is a challenging subject – in other fields, it is a graduate-level subject. However, it is sufficiently relevant to nuclear reactors and must be included in the curriculum.

This is likely also the first class you've taken with any appreciable level of engineering judgement. Often, there is not a single "right" way to analyze a problem in two-phase flow and nuclear TH. Instead, there are two or three or ten "good" ways, from which you must select the *best estimate* (under constraints; *i.e.*, the five-minute vs. five-day analysis) and be able to articulate *why* your analysis is good. Critical thinking and communication skills are no longer "extras", but absolutely essential. For many students, this transition in approach is more difficult than any two-phase analysis.

The instructor is well-aware that senior students have extremely busy fall semesters. Reasonable accommodations on homeworks and projects will be made for professional commitments (conference attendance, taking the GRE, grad school visits, etc.). Some deadlines may be moved back due to other courses. You should always consider yourself free to request an extension, just as I will always consider myself free to deny a request.

Further, the instructor is aware that the senior year workload is bimodal – four-year vs. five-year plans. Depending on your career goals, either plan may be best for you; hopefully, you've picked the correct one. *However, no differentiation in workload is to be made in this course between four-year and five-year plan students.* If your project groups include both sorts of plans, *work should absolutely not* be dumped on the five-year plan students. Instances of this will be dealt with severely on peer adjustments.

As a 4 credit course, ENU 4134/6937 will require a time commitment of approximately 180 hours during the semester (4 credits times 15 weeks times 3 hours per week-credit). A typical breakdown might be:

- Attending lectures (50 hours)
- Completing 10 HW assignments (50 hours, 5 each)
- Completing Project 1 (20 hours)
- Completing Project 2A/2B (30 hours)
- Studying/Reviewing for exams (30 hours, 10 per exam)

These estimates refer to reasonably focused hours (hours spent playing on TwitBook or FaceSpace with an online lecture playing in the background don't count) and are for the average student.

ENU 4134 vs. 6937

The undergraduate (ENU 4134) and graduate (ENU 6937) share common lectures and a fraction of common coursework.

Letters of Recommendation/Evaluation Policy

To request a letter of recommendation/evaluation (for graduate school or otherwise), you must provide:

- A hard copy of your UF transcript.
- A hard copy of a résumé (or CV).
- A hard copy of the following form: `http://www.registrar.ufl.edu/pdf/ferparelease.pdf`. You *must* check all four circles.

Letters are typically filed once per week. For students whom I know only through coursework, my letter typically focuses on an estimate of their rank-in-class and on their performance on projects and challenging problems.

I will only file *one batch* of letters per student during the term, for any student currently enrolled in a class with me. (This policy is designed to keep me from looking up slight changes in your rank/performance multiple times for multiple batches of letters.) Given the schedule of ENU 4134/6937, I recommend that this batch occur not earlier than late November (after Project 2 and Exam 2) to allow me sufficient information (sample size) on your performance to write a useful letter.

16/17. Grading

There are 1050 total points in the course.

- Exam 1 (150)
- Exam 2 (150)
- Exam 3 (150)
- Project 1 (150)
- Project 2a (50)
- Project 2b (150)
- Homework (250 – 10 assignments, 25 each)

Note that each major item (3 exams and 2 main projects) are worth just 1/7 of your grade. Achieving a high grade in this course requires a consistent performance, rather than a "9th inning rally" (on the final).

Each exam is individually curved. The details of this curve and how graduate (6937) students will be affected are included as part of the Exam Previews.

The final grades will be assigned based on:

- A: $> 85\%$ (893+ points)
- B: 78-84.99% (819-892 points)
- C: 70-77.99% (735-818 points)
- E: $< 70\%$ (0-734 points)

The instructor reserves the right to grant higher grades at the end of the course at his sole discretion, including the use of A-, B+, B-, and C+.

Typically, the average GPA in ENU 4134, including graduate students in ENU 6937, is between 2.9 and 3.2.

Under no circumstances will grades of C- or any flavor of D be used. Regardless, the following statement is required by COE policy: "A C- will not be a qualifying grade for critical tracking courses. In order to graduate, students must have an overall GPA and an upper-division GPA of 2.0 or better (C or better). Note: a C- average is equivalent to a GPA of 1.67, and therefore, it does not satisfy this graduation requirement. For more information on grades and grading policies, please visit:

`http://www.registrar.ufl.edu/catalog/policies/regulationgrades.html`"

18. Make-up Exam Policy

The make-up exam policy is covered by the Make-Up Work Policy in Item 15. All make-up exams will be held after the regular exam, as organized with the instructor. Note that conflicts in instructor-proposed make-up times with your personal business will not, in general, be accommodated.

19. Honesty Policy

All students admitted to the University of Florida have signed a statement of academic honesty committing themselves to be honest in all academic work and understanding that failure to comply with this commitment will result in disciplinary action. This statement is a reminder to uphold your obligation as a UF student and to be honest in all work submitted and exams taken in this course and all others.

Addendum to 19: Violations of UF Academic Honesty policies in this course will be reported through appropriate channels. If you choose to commit academic misconduct in this course, expect to receive a failing grade for the course.

20. Accommodation for Students with Disabilities

Students requesting classroom accommodation must first register with the Dean of Students Office. That office will provide the student with documentation that he/she must provide to the course instructor when requesting accommodation.

21. UF Counseling Services

Resources are available on-campus for students having personal problems or lacking clear career and academic goals. The resources include:

- UF Counseling & Wellness Center, 3190 Radio Rd, 392-1575, psychological and psychiatric services.
- Career Resource Center, Reitz Union, 392-1601, career and job search services.

22. Software Use:

All faculty, staff and student of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

23. Course Evaluations

The University of Florida expects students to provide feedback on the quality of instruction in this course based on 10 criteria. These evaluations are conducted online at

`https://evaluations.ufl.edu`

Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at

`https://evaluations.ufl.edu/results`