Abilene Approval Chart for Curriculum Changes

A = Approve I = Information Item R = Respond In Writing

Course Number: NSE 603 Reactor Thermal Hydraulics **or Degree Plan(s):**

NSE 603 (Reactor Thermal Hydraulics) presents students with the thermofluid behavior of nuclear reactor systems, including heat generation, transport, and removal mechanisms.

	Campus-Level Academic Review[1]	Dept./Schoo	Colleg	Dean	TEC	AUAC/Grad	Provost
	Change to a Course Include signatures from all chairs/program directors for cross-listed courses.[1]						
1.	Title (description unchanged)	A	A	A	I	I	I
2.	Description (not affecting content)	A	A	A	I	I	I
3.	Course term(s)	A	I	A	I	I	I
4.	Content (change of course outcomes)	A	A	A	I	I	A
5.	Number of credit hours	A	A	A	A	A	A
6.	Course number within the hundred	A	A	I	I	I	I
7.	Course number beyond the hundred	A	A	A	A	A	A
8.	Prerequisites	A	A	A	I	I	I
9.	Course restriction (e.g., majors only, junior standing)	A	A	A	A	A	A
10.	Level change (U to G *or* G to U)	A	A	A	A	A	A
11.	Cross list course	A	A	A	A	A	A
12.	Department of record	A	A	A	A	A	A
13.	Open or close a course	A	A	A	A	A	A
	Change to a Degree Plan						
14.	Educational Program — Revise	A	A	A	A	A	A
15.	Educational Program — Adopt/revise admission requirements	A	A	A	A	A	A
16.	GPA — Revise program-required GPA	A	A	A	A	A	A
17.	Minor — Revise	A	A	A	A	A	A

	Full Review	Dept./School	College	Dean	TEC	AUAC/Grad	Provost	Campus Faculty	Senior VPAA	President
	Change to Catalog Information (for Campus)									
18.	General requirements for Bachelor's and Associate Degrees	–	–	–	–	A	A	A	A	I
19.	Policies governing academic probation and suspension	–	–	–	–	A	A	A	A	I
20.	Requirements for graduating with honors	–	–	–	–	A	A	A	A	I
	Change to a Degree Plan									
21.	Educational Program — Add or Discontinue[2] [3]	A	A	A	A	A	A	A	A	I
22.	Educational Program — Discontinue (Provost-proposed)	R	–	R	A	A	A	A	A	I
23.	Minor — Add or Discontinue	A	A	A	A	A	A	–	A	I
24.	Minor — Discontinue (Provost-proposed)	R	–	R	A	A	A	–	A	I
25.	Degree — Add or Discontinue	A	A	A	A	A	A	A	A	I
26.	Degree — Discontinue (Provost-proposed)	R	–	R	A	A	A	A	A	I

	Change to General Education Requirements for Undergraduates (System)	Dept./School	College	Dean	AUAC	Provost	UGEC	University Faculty	Senior VPAA	President
27.	Change course outcomes of an included course	A	A	A	A	A	A	–	A	I
28.	Add or drop a required course from the General Education Requirements	A	–	A	–	A	A	A	A	I
29.	Add or drop a course from a menu within the General Education Requirements	A	–	A	–	A	A	–	A	I
30.	Comprehensive revision of General Education Requirements	–	–	–	–	A	A	A	A	I

Notes

[2] Any change to a cross-listed course requires the signature of both department chairs or program directors overseeing the course to ensure that the courses stay in sync. This includes courses taught at other campuses (e.g. BIBL 101 and BIBO 101).

[3] For undergraduate majors, a minimum of 30 hours is required. These programs must have a minimum of 6 elective hours, unless the requirements of external accrediting bodies make it impossible. Master's programs

must include a minimum of 30 hours, and doctoral programs must include a minimum of 30 hours beyond the master's.

[4] When a department/school or dean proposes closing a program, approval routing follows the typical process beginning with the department/school. An administrative proposal by the provost or senior vice president for academic affairs would follow the "provost-proposed" routing on the chart.

Updated 8/1/2023

Department/School(s)

3/18/2026

Engineering Co-Chair Signature Date

March 18, 2026

Physics Co-Chair Signature Date

March 18, 2026

Chair/Program Director Signature Date

College Academic Council(s)

March 18, 2026

Chair Signature Date

Chair Signature Date

Dean(s)

3/19/2026

Signature Date

Signature Date

Teacher Education Council

Signature Date

Campus Academic Council:
Abilene Undergraduate or Abilene Graduate

Signature Date

Provost

Signature Date

University General Education Council

Signature Date

University Faculty

Abilene Faculty Senate Chair signature Date

Dallas Faculty Council Chair signature Date

Senior Vice President for Academic Affairs

Signature Date

President

Signature Date

Abilene New Course Application

You may delete the preceding instructional pages before submitting application.

Course ID (*Subject Code and Number)*	NSE 603

1. Systems and Catalog Information Complete each item.

A	Course Developer	Jim Drachenberg
B	Course Instructor	Robert Brown
C	Course Title	Reactor Thermal Hydraulics
D	Course Abbreviation for Banner if title is more than 30 characters	
E	College	OSE - Onstead Science and Engineering
F	Department or School	PHYS - Engineering & Physics
G	Number of Credit Hours	3
G1	Number of Lecture Contact Hours	3
G2	Number of Lab Contact Hours	0
H	Is the course for a fixed or variable number of credit hours?	Fixed If variable, explain rationale:
I	Is the course repeatable for additional credit?	No
J	Maximum total number of credit hours a student can earn for this course	3
K	Course Schedule Type	Lecture (LEC) See Schedule Type definitions in the Reference section.

L	Number of Faculty Workload Hours	3
M	Grading Mode	Standard
N	Maximum Enrollment	18
O	**Catalog Description** (50 words or less)	Heat generation, transport, and removal in nuclear reactors. Conservation equations applied to single and two-phase flow regimes. Modeling primary coolant loops, heat exchangers, and accident scenarios. Comparison of water-cooled, gas-cooled, and molten salt reactors, highlighting thermal-hydraulic phenomena unique to each design, including fluid properties, heat exchange strategies, and control implications.
P	List any prerequisites (course/s, test scores, class standing, major, etc.)	
Q	List any corequisites (these *must* be taken at the same time; note that a single requirement cannot be both a prerequisite *and* a corequisite)	
R	If the course is cross-listed, specify the subject code and course number of the other course	
S	Does this course require any additional student course fees?	No If yes, attach a completed course fee form (see form "Request to Add or Change Course Fees").
T1	Will the course be offered in **fall** terms?	Yes, every year
T2	Will the course be offered in **spring** terms?	No
T3	Will the course be offered in **summer** terms?	No

U	First semester this course will be offered under new Course ID. *May not be earlier than the coming fall semester.*	Fall 2026
V	Is this course required for a program(s)?	Yes If yes, submit a separate completed curriculum proposal to change the program(s).
W	Should the addition of this course be retroactively applied to the degree plan it supports? *This is rare, and rationale should explain compelling extenuating circumstances.*	No If yes, provide rationale:
X	Has this course been offered as a Special Topics course? *New courses are not required to be taught as Special Topics courses prior to approval.*	No If yes, provide course ID, term, and enrollment:
Y	List any courses in which the content overlaps the proposed course. (Course ID and Name). *Attach a statement from the instructor/dept chair of the existing course justifying the new offering.*	

2. Curriculum

A. Explain any effects of this course on any degree plans. If the addition of the course alters program requirements, submit a separate Approval Chart for Curriculum Change to update the program.

Graduate Nuclear Science and Engineering
NSE 603 added as required course in the new graduate NSE curriculum

B. Justify the addition of this course to the current curriculum, explaining the gap it meets.

3. Course Design

A. Audience and Course Goal
   1. Describe the intended audience, including prerequisite skills.

The intended audience is first-year graduate students in nuclear science and engineering. The course will also appeal to juniors or senior STEM majors interested in careers in nuclear science and engineering. Prerequisite skills involve mastery of introductory physics and understanding how to apply calculus and differential equations to science and engineering problems.

2. State the overarching course goal(s) in performance terms.

Students completing this course will demonstrate a solid understanding of the thermofluid behavior of nuclear reactors by solving problems in heat generation, transport, and removal. They will analyze single- and two-phase flow regimes by applying conservation equations for mass, momentum, and energy. Students will distinguish the unique thermal-hydraulic phenomena associated with water-cooled, gas-cooled, and molten salt reactors.

B. Student Learning Outcomes and Measurements

	Student Learning Outcome	**Measurement**
1	Students solve problems in heat generation, transport, and removal	Homework, Exams
2	Students apply conservation equations to analyze single- and two-phase flow regimes	Homework, Exams
3	Students distinguish unique thermal and hydraulic phenomena for different reactor technologies	Homework, Exams
4	Students analyze heat conduction through reactor fuel and structural materials	Homework, Exams

C. **Text and Resources**

Give the full publication information of the textbook/s and other required resources and outside readings. For **combined undergraduate/graduate** courses, make two lists:

A. full publication information; label **Undergraduate**.
B. full publication information; label **Graduate**.

Nuclear Reactor Thermal Hydraulics: An Introduction to Nuclear Heat Transfer and Fluid Flow, Robert E. Masterson, CRC Press, 2019, ISBN 978-1138035379

4. Supporting Documentation

Required of all applications	
1	**Approval Chart for Curriculum Changes**

2	**Syllabus** — **Attach** the syllabus for the course based upon the anticipated first-semester offering.
4	**Library** — Submit new course application and syllabus to the Library dean's office. **Attach** the Library's memo.
Attach if applicable	
5	**Content Overlap** — Include one document for each course you listed in Section 1Y. **Attach** statement from instructor/dept chair of existing course justifying the new offering.
6	**Departmental Resources** — List the resources that support the course and are available only through the department, if applicable. **Attach** the list of the holdings and the location(s).
7	**Resources** — List resources (other than library or departmental resources) that are needed to support this course (computers, lab equipment, other technology, etc.). **Attach** a complete list of all items and indicate possible sources or estimated cost of each. List the sources of any needed funds.
8	**Expenses** — List additional expenses needed to implement this course (full-time or part-time faculty, graduate or lab assistants, student employees, travel, special student costs, room renovation, storage facility, etc.). **Attach** a complete list of all items, the estimated cost of each and the source of the funds.
9	**Justification** — **Attach** any documents to which you refer in Section 2B.

Reactor Thermal Hydraulics

Instructor: Dr. Robert Brown (rlb16c@acu.edu)

About the Course

In this course, we discuss the thermofluid behavior of nuclear reactor systems. You will develop an understanding of heat generation, transport, and removal mechanism across multiple reactor types.

Course number and title: NSE 603 – Reactor Thermal Hydraulics

Credit hours: 3

Semester and year: Fall 2026

Meeting time: Tuesdays and Thursdays at 9:30-10:50 AM
Meeting place: Onstead Science Center (OSC) 345
For your convenience, here is a link to the ACU campus map

Prerequisites/corequisites: PHYS 222, MATH 286, MATH 361 or equivalent

Catalog description: Heat generation, transport, and removal in nuclear reactors. Conservation equations applied to single and two-phase flow regimes. Modeling primary coolant loops, heat exchangers, and accident scenarios. Comparison of water-cooled, gas-cooled, and molten salt reactors, highlighting thermal-hydraulic phenomena unique to each design, including fluid properties, heat exchange strategies, and control implications.

Intended audience: First-year graduate students in nuclear science and engineering.

About the Teacher

Instructor: Dr. Robert Brown, Associate Professor

Office location: Onstead Science Center (OSC) 123C

Phone number(s): (325) 674-6540

Email address: rlb16c@acu.edu

Office hours/Contact expectations: MWF 3:00 – 4:00 PM or by appointment

Mission Statements

ACU Mission: The mission of Abilene Christian University is to educate students for Christian service and leadership throughout the world.

College Mission: The mission of the Onstead College of Science and Engineering is to explore and understand God's creation in the natural world and apply the acquired knowledge and principles to address its issues and challenges. The college offers programs in the natural sciences, engineering, and mathematics. These programs combine the rigor of scientific and technical disciplines with the critical thinking, ethical reasoning, and spiritual perspectives that are central to a Christian liberal arts education.

Department Mission: To prepare graduate students for impactful careers across the spectrum of nuclear science and engineering by equipping them with deep scientific knowledge, cutting-edge research experience, and versatile technical and professional skills. The program emphasizes integrity, leadership, and service, modeled through rigorous academic standards and Christian values, while promoting innovation, interdisciplinary collaboration, and professional excellence within the evolving field of nuclear science and engineering.

Unique Christian Perspective:

"For I, the Lord, do not change; therefore you, the sons of Jacob, have not come to an end."

–Malachi 3:6

In NSE 603, conservation laws are foundational, in particular, conservation of mass, energy, and momentum. These are among the most beautiful and useful laws in all of nature, reflecting fundamental symmetries knit into the fabric of the universe and providing reference points for solving some of the most difficult problems. Without these conservation laws, our ability to perform science and design systems such as nuclear reactors would be at best severely limited and more likely nonexistent. Yet, to the Christian, it is fitting that our universe would be created with laws such as these. God is faithful and unchanging. Jesus Christ is truth. When we observe a world with symmetry and conservation laws, we are reminded of the nature of the God Who created it. As we study courses like NSE 603, we see vividly how the application of this these laws enables us to design systems that can bless the world. May we be good stewards of this opportunity to experience the wisdom He shares with us through this study!

Course Content

Outline of topics:

- Heat generation, transport, and removal mechanisms
- Conduction through fuel and structural materials
- Convective heat transfer to coolant and system-level thermal performance
- Conservation of mass, momentum, and energy
- Application to single-phase and two-phase flow regimes
- Boiling heat transfer and flow instabilities
- Pressure drop, critical heat flux, flow regime transitions, and thermal limits
- Modeling primary coolant loops, heat exchanges, and accident scenarios
- Comparative analysis of water-cooled, gas-cooled, and molten salt reactors

Format of Class

Format of Class: Reactor Thermal Hydraulics is delivered in a traditional, face-to-face lecture format. You will be given readings to complete prior to class time. We will present example problems as well as questions designed to generate discussion with your peers. Come ready to ask questions and engage class discussion!

On-line: If we ever need to meet on-line, we will use Zoom. In such instances, we will generally meet during our normal class times and do our best to recreate the face-to-face experience. In light of this, it is extremely important that you continue to come prepared.

Instructional Materials

Course texts:

Nuclear Reactor Thermal Hydraulics: An Introduction to Nuclear Heat Transfer and Fluid Flow, Robert E. Masterson, CRC Press, 2019, ISBN 978-1138035379

Learning Outcomes

	Student Learning Outcome	Measurement
1	Students solve problems in heat generation, transport, and removal	Homework, Exams
2	Students apply conservation equations to analyze single- and two-phase flow regimes	Homework, Exams
3	Students distinguish unique thermal and hydraulic phenomena for different reactor technologies	Homework, Exams
4	Students analyze heat conduction through reactor fuel and structural materials	Homework, Exams

Assessment and Grading

Assessment activities: Your course grade is determined from assignments and exams. Approximate weights are as follows:

Weekly Homework Assignments	25%
Exam 1	25%
Exam 2	25%
Final Exam	25%

Final grade calculation:

Range of Points	Final Letter Grade
90%-100%	A
80%- 89%	B
70%-79%	C
60%-69%	D
Below 60%	F

Rules for discussing grades: Please respect the privacy of your peers and do not pressure your classmates to discuss their grades with you. I welcome the opportunity to discuss any of your grades. Grades are considered set two weeks after the grades have been posted to Canvas. Any objection must be received prior to conclusion of the two-week period, otherwise I will assume you consent to the posted grade.

Weekly Homework: Each week you will be assigned a set of homework problems to complete. You will generally be given one week to complete the assignment. Problems will be drawn from a variety of sources, including the course textbook, original problems written by your instructor, and real-life scenarios. By attaching your name to the assignment, it is expected that you are capable of reproducing the solution independent of your classmates or other tools such as AI.

In-class Exams: Twice during the semester, you will be given a written exam to be completed in class. The exam will draw from assigned problems, example problems, lectures, and outside readings. The exams are to be completed without assistance of your classmates. You will be provided instructions on any approved external aids.

Final Exam: You will be given a cumulative final exam during the standard final exam time for the class. You will complete the exam without assistance of your classmates. You will be provided instructions on any approved external aids.

Use of unapproved external aids on homework or exams is a violation of academic integrity.

University Resources

I care about your class experience. The university also has a number of resources in place to support the ACU community both in this class and all aspects of university life.

Reporting Violations / Concerns / Complaints
Incident reports alleging violations of Student Conduct or concerns/complaints can be submitted here. Please use the form to submit information about an incident to Student Life / Office of the Dean of Students.

SOAR (Student Opportunities, Advocacy, and Resources):
SOAR partners with faculty, staff, parents and students to assist ACU students and connect them to resources available to support their path to success. For more information about SOAR or to make a SOAR recommendation, see https://acu.edu/soar-program/.

Mental Health Resources
As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. Abilene Christian University is committed to supporting students addressing any of these concerns.

You can contact the Medical and Counseling Care Center at counseling@acu.edu, or by calling 325-674-2626. In addition, you can access free confidential counseling services through the Timely Care app by downloading their app on any device. In a crisis situation contact the National Suicide Prevention Hotline open 24/7 by dialing 988, or call the Police at 911.

University Policies

ADA Compliance Policy:

Abilene Christian University is dedicated to removing barriers and opening access for students with disabilities in compliance with ADA and Section 504 of the Rehabilitation Act. The ACU website provides more information at https://acu.edu/about/uap/overview-2/about-2/. Please contact me to discuss any approved accommodations that you require for this class.

Title IX Policy:

At ACU, we strive to comply with all applicable legal requirements prohibiting, preventing, and responding to sexual misconduct against any member of the ACU community. The full Title IX policy and process can be found at https://acu.edu/human-resources/title-ix-and-sexual-misconduct-information/.

Academic Integrity Policy:

Academic integrity is demonstrated by behavior that honors the learning environment, regardless of setting, context, location or modality. ACU's Academic Integrity Policy can be found at https://acu.edu/office-of-the-provost/academic-policies/.

Anti-Harassment Policy:

As a professor, one of my responsibilities is to help create a safe learning environment on our campus. I also have a mandatory reporting responsibility related to my role as a professor. It is my goal that you feel able to share information related to your life experiences in classroom discussions, in your written work, and in our one-on-one meetings. I will seek to keep the information you share private to the greatest extent possible. When I am not able to keep your information confidential, I will only share it with responsible administrators on campus who can provide you with services and resources. I am required to share with the Title IX Coordinator information regarding sexual misconduct or harassment, dating or domestic violence or stalking that you report to me. If you would prefer to share information in a confidential setting, I encourage you to speak with someone in the ACU Counseling Center. All of your options are available for review by clicking on the link to ACU's policy.

Course Policies

Attendance/tardiness: Please do not attend in person if you feel ill, are experiencing symptoms of illness, or have a confirmed exposure to someone with a contagious illness, e.g., COVID-19. At your earliest convenience, please let me know that you need to join, remotely. Our class will be accessible to you in a virtual environment, and I will work with you to ensure you have access to the necessary course material and a reasonable opportunity to submit assignments for full credit. Unless you are ill, taking precautions for illness, or engaged in a university-approved activity, daily attendance is *essential*. If you need to be absent, notify me **beforehand**. If you cannot notify me beforehand, contact me as soon as possible to let me know the reason. Regardless of absence, you are responsible for the material. If absent from a presentation, your grade will be zero unless I grant prior approval. You must be on-time to class. Persistent tardiness is grounds for a reduction in your overall grade.

Participation: Participation in class is critical for you, your peers, and for me to be the effective instructor you deserve. Participation is considered in your final grade assessment. Misconduct in class will not be tolerated. Mistreatment of others, including breech of verbal decorum, is grounds for removal from class. Refer to the ACU student handbook for more information on such policies.

On-line Decorum: Just as you treat people with respect in the classroom, I expect you to extend that respect to on-line forums, as well. Exercise the Golden Rule with liberality and give each other the benefit of the doubt, when possible.

Dress Code: Please follow the student guide. If you are unsure, do not wear it. Respect your classmates. I reserve the right to ask you to remove hats, e.g., during exams.

Drop Policy: All university policies and deadlines must be followed.

Technology use: Cell phones, laptops, iPods, or other electronic devices are not allowed in face-to-face class unless we use them corporately. If I determine your electronic device is disturbing the class or distracting you or others, whether in a face-to-face or virtual setting, you will be dismissed. If such distractions become a pattern, I will not hesitate from further action, including expulsion from the course.

Academic Integrity: DO. NOT. CHEAT. All university policies concerning academic misconduct—including plagiarism and cheating—apply implicitly to all assessment activities whether or not it is explicitly stated on the assignment. Additionally, I expect you to report academic misconduct if you witness it. ***Failure to report academic dishonesty is considered academic dishonesty, at my discretion***. Assignments submitted in your name must reflect your original work. Copying the work of *anyone*, past or present, is a violation of Academic Integrity and will lead to disciplinary action including but not limited to loss of credit, course grade reduction, and automatic course failure.

AI: Machine learning and artificial intelligence are increasingly important tools that show up in ways we may not even realize. Generative AI, e.g., Chat-GPT, has raised challenging questions related to education and ethics. It will likely be many years before we begin to understand the impact on student learning. While there is no one-size-fits-all solution and policies will surely evolve, at this time, the use of generative AI, e.g., Chat-GPT, is not authorized as a tool in my class. The goal in my course is not to get you to the point where you can tell a bot to solve or write something for you. My goal is to help you develop the skills to think critically and write scientifically, yourself. In general, generative AI is also not authorized as a tool for writing code or solving problems. If you believe that use of generative AI is essential to your assignment, you must discuss it with me before using it as a tool. In your professional life, you will almost certainly use AI as an aide. We want you to be fully equipped to understand and evaluate the quality of the information it provides you. To that end and at this time, use of generative AI is a violation of academic integrity.

Calendar

Refer to Canvas Calendar for the most up-to-date information. Modules are already in place for each week's activity. Please refer to the university academic calendar for key dates relevant to our campus.

DATE	TOPICS COVERED	Assignment
Week 1	Survey of reactor technologies and thermal energy production in reactors	HW 1
Week 2	Laws of thermodynamics and equations of state	HW 2
Week 3	Heat transfer in reactors	HW 3
Week 4	Reactor fluid mechanics	HW 4
Week 5	Single-phase flow in reactors	HW 5
Week 6	Laminar and turbulent flows with friction	Exam 1
Week 7	Core and fuel assembly fluid flow	HW 6
Week 8	Single-phase heat transfer in reactors	HW 7
Week 9	Two phase flow and heat transfer in reactors	HW 8
Week 10	Core temperature fields	HW 9
Week 11	Hot channel factors, critical heat flux, and the DNBR	Exam 2
Week 12	Equilibrium, non-equilibrium, compressible, and choke flows	HW 10
Week 13	Reactor accidents	HW 11
Week 14	Flow oscillations, density waves, and hydrodynamics instabilities	HW 12
Week 15	Containment strategies, design limits, and safety	
Finals Week	Final Exam during the scheduled time	

January 8, 2026

Dr. Mark DeHart
Associate Professor
Director, Nuclear Science and Engineering Graduate Program
Onstead College of Science and Engineering
(325) 674-2066

Re: Review of Reactor Thermal Hydraulics (NSE 603)

Dear Dr. DeHart,

Thank you for submitting Reactor Thermal Hydraulics (NSE 603) to us for review. I have reviewed it based on the ACU Syllabus Guidelines. I found the syllabus to meet all aspects of the checklist.

Please note that this letter is intended as a reference, which will be read by the department chair and members of the council, who may also have questions or comments of their own. If you have any questions, please feel free to let me know.

Please also let me know if we can be of any help in the design and facilitation of this course.

Sincerely,

Amy Boone M.Ed.,
Teaching and Learning Specialist, Adams Center

ABILENE CHRISTIAN UNIVERSITY

LIBRARY

M E M O R A N D U M

DATE: December 12, 2025

TO: Dr. Mark DeHart

FROM: Mark McCallon, Associate Dean for Library Services

RE: Course Application for NSE 603 - Reactor Thermal Hydraulics

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After reviewing the course application and syllabus, the library can support the proposed course. Please contact Mark McCallon (mccallonm@acu.edu), Librarian Liaison to the Department of Engineering and Physics, if you will require additional library resources in the future to support the course. Thank you for letting us review the course application and syllabus.