



## ENGR 4501 - Nuclear Power Generation Fall 2017

### Prerequisite(s)

ENGR 3501 - Fundamentals of Nuclear Engineering

### Required or Elective

Required if minoring in Nuclear Engineering

### Meeting Location, Days and Times

Q-315 T R 9:30 – 10:45 AM

### Instructor

**Dr. Eduardo B. Farfan**, Professor of Nuclear Engineering

**E-mail:** efarfan1@kennesaw.edu

**Office Phone:** 678-915-4971

**Office Location:** Q-146

**Office Hours:**

T R 1:45 PM – 2:30 PM (by appointment only)

W 10:30 AM – 2:00 PM (by appointment only)

### Textbook

Nuclear Energy Conversion by M. M. El-Wakil; American Nuclear Society, 1992.

**Make sure to acquire the book by the end of the first week of classes.**

### Course Description

This course covers the principles of nuclear energy conversion to electric power. The content of the course includes: fundamentals of energy conversion, fission reactors, design and construction of light water reactors with emphasis on boiling water and pressurized water reactors, gas cooled reactors, fast breeder reactors, thermal and structural analysis of reactors and plant components, safety elements and accident prevention systems. The economic feasibility of nuclear power plants will also be discussed.

### Learning Objectives

Upon completion of the course, the students should be able to:

- 1- Explain the fundamentals of nuclear power generation.

- 2- Describe the concept and design of light water reactors.
- 3- Explain the fundamental designs of the Boiling Water Reactors (BWRs), their characteristics, operational aspects, control elements and stability.
- 4- Identify the major components of the BWR reactors including the coolant system, power generation elements and control systems.
- 5- Describe the design principles of Pressurized Water Reactors (PWRs), their primary and secondary loops, steam generators and reactor control systems.
- 6- Explain the functional aspects of PWRs, steady state operation, transients, reactivity and power control, emergency systems and associated procedures.
- 7- Discuss the benefits of Small Modular Reactors (SMRs) and their differences for other types of nuclear reactors.
- 8- Describe the economics of nuclear power generation and be able to perform feasibility analysis for nuclear power generation.

### Topics Covered

- 1- Fundamentals of energy conversion
- 2- Power plant steam cycle
- 3- Reactors heat removal
- 4- Fission reactors
- 5- Design and construction of light water reactors
- 6- Gas cooled reactors
- 7- Fast breeder reactors
- 8- Small modular reactors
- 9- Thermal and structural analysis of reactors and plant components
- 10- Safety elements and accident prevention systems
- 11- Economic feasibility of nuclear power plants

### Grading

Attendance	10%
Homework	15%
Project	30%
Midterm	20%
Final	25%
<b>Total</b>	<b>100%</b>

**Grade Conversion:** A: (90-100), B: (80-89), C: (70-79), D: (60-69), F: (0-59)

**Late work:** No late homework assignments will be accepted. Students must date and sign the assignment cover sheet provided by the instructor.

**Exams and Project:** All students are expected to be present at the time exams and project presentations are given. Students not present at the time when an exam or presentation is given will receive a “0” for that exam or presentation. No make-up exams will be given, unless the student makes arrangements with the instructor, prior to the exam due date, to receive an excused absence. The students will be informed when an exam will take place (e.g., at least a week before the exam).

## Course Outline

Unit	Lecture	Homework/Exams/Project *
1	Overview of Nuclear Power Systems	
2	Thermodynamic Aspects of Nuclear Power	HW 1
3	Boiling Reactor	HW 2
4	Boiling-Reactor Power Plants	HW 3 / Midterm
5	Pressurized-Water Reactors	HW 4
6	Pressurized-Water Reactor Power Plants	HW 5
7	Fast Breeder Reactor	HW 6
8	Fast Breeder Reactor Power Plants	HW 7
9	Small Modular Reactors	Project
10	Nuclear Power Economics	HW 8 / Final Exam

\*Students will be informed about an upcoming exam at least a week before the exam due date. Students will be given at least a week to complete the homework assignments.

## Use of Electronic Equipment in Class

- Calculators will be used periodically in class.
- Use of phones, tables, and pagers is **not** permitted in class.
- Use of computers will be allowed only with the instructor's permission.

## Tips for Effective Learning

- **Work closely with your instructor.** If you have any questions, please contact me immediately. The best way to contact me is via email or phone call, and you will be guaranteed to have a reply within 24 hours.
- **Begin your work early.** If you can start a task early, don't start late. Assuming you spend the same amount of time completing the task, starting later will be much more stressful than starting early. Never wait until the last minute to begin an assignment! You'll have no turnaround time if you need help or something happens.

## Emergency Plan

If the University is closed for more than a day or two by some kind of emergency (major weather event, flu epidemic, etc.), please check your KSU email for information on assignments.

## Withdrawal

Students who find that they cannot continue in college for the entire semester after being enrolled, because of illness or any other reason, need to complete an online form. To

completely or partially withdraw from classes at KSU, a student must withdraw online at [www.kennesaw.edu](http://www.kennesaw.edu), under Owl Express, Student Services.

The date the withdrawal is submitted online will be considered the official KSU withdrawal date which will be used in the calculation of any tuition refund or refund to Federal student aid and/or HOPE scholarship programs. It is advisable to print the final page of the withdrawal for your records. Withdrawals submitted online **prior** to midnight on the last day to withdraw without academic penalty will receive a “W” grade. Withdrawals **after** midnight will receive a “WF”. Failure to complete the online withdrawal process will produce no withdrawal from classes. Call the Registrar’s Office at 770-423-6200 during business hours if assistance is needed.

Students may, by means of the same online withdrawal and with the approval of the university Dean, withdraw from individual courses while retaining other courses on their schedules. This option may be exercised up until the W date on the Academic Calendar (on Registrar’s website). Failure to withdraw by the W date will mean that the student has elected to receive the final grade(s) earned in the course(s). The only exception to those withdrawal regulations will be for those instances that involve unusual and fully documented circumstances. In these rare cases, the policies of the university regarding hardship withdrawals will be strictly followed.

If any remaining coursework cannot be completed by the last class day, the instructor of this course will only consider assigning an incomplete grade to a student with an unusual and fully documented circumstance (must be verified by department chair or college dean), who is passing the course within two weeks of the last class day. If the final exam is among the assignments, the student’s grade will remain an “F” until it is taken, after which a grade change form will be submitted to the registrar if necessary, once the other agreed upon conditions are met.

### **KSU Diversity Vision Statement**

It is our vision to create a strong multicultural and diverse educational environment at KSU in order to increase student satisfaction and to promote an understanding and awareness of people from various backgrounds upon graduation. In this way, KSU students will be educated for, and can effectively compete in the global society.

### **Course Enrollment Status Statement**

Students are solely responsible for managing their enrollment status in a class; nonattendance does not constitute a withdrawal.

### **Student Support Resources – Strategies for Success**

- Library, Tech Support, Tutoring, Writing Center, Advising, Bookstore, Resource Guide, Online Courses, other support resources:  
<http://learnonline.kennesaw.edu/resources/index.php>

- Accessibility Statements or VPAT for Technologies: <https://softchalkcloud.com/lesson/serve/jV10GKPfztZwQn/html>
- Academic and Student Services: <http://www.kennesaw.edu/currentstudents.php>

## Other Technical Resources

- For D2L Technical Support: <http://uits.kennesaw.edu/>.
- D2L Privacy Statement: <http://www.brightspace.com/legal/privacy/>
- Blackboard Collaborate Support: [https://apps.kennesaw.edu/files/pr\\_app\\_uni\\_cdoc/doc/Blackboard%20Collaborate%20for%20Students.pdf](https://apps.kennesaw.edu/files/pr_app_uni_cdoc/doc/Blackboard%20Collaborate%20for%20Students.pdf)
- The Privacy Policies for External Tools: <http://www.blackboard.com/footer/privacy-center.aspx>
- Help Desk: [studenthelpdesk@kennesaw.edu](mailto:studenthelpdesk@kennesaw.edu), phone 470-578-6999
- Walk-in Help: Marietta campus - bottom floor H-building just outside the double doors on the East side.
- Personal Laptop/Smart Phone Help: <http://uits.kennesaw.edu/> or walk-in.
- Please remember to use the rules of Netiquette in any online communication environment. <http://www.education.com/reference/article/netiquette-rules-behavior-internet>

## Academic Honesty/Integrity/Ethics Statement

The high quality of education at Kennesaw State University is reflected in the credits and degrees its students earn. ***All assignments that take place in and out of the classroom must be your own work and original for this course.*** The protection of these high standards is crucial since the validity and equity of the University's grades and degrees depend upon it. Any student found to have violated any KSU academic honesty regulation after a hearing before a university hearing panel or before the Vice President for Student Success and Enrollment Services (or his/her designee) shall be suspended for at least one semester, unless the student persuades the deciding body that the circumstances of his or her behavior substantially mitigate the gravity of the violation. These regulations are designed to assist students in (1) developing appropriate attitudes about, and (2) understanding and following the university's standards relating to academic honesty. The regulations protect students by helping them avoid committing infractions that may compromise the completion of their KSU degrees or damage their reputations.

***Student Conduct Pledge/Statement:*** *As a member of the Kennesaw State University community of scholars, I understand that my actions are not only a reflection on myself, but also a reflection on the University and the larger body of scholars of which it is a part. Acting unethically, no matter how minor the offense, will be detrimental to my academic progress and self-image. It will also adversely affect all students, faculty, staff, the reputation of this University, and the value of the degrees it awards. Whether on campus or online, I understand that it is not only my personal responsibility, but also a duty to the entire KSU community that I act in a manner consistent with the highest level*

*of academic integrity. Therefore, I promise that as a member of the Kennesaw State University community, I will not participate in any form of academic misconduct.*

**Types of Academic Misconduct:**

1) **Cheating:** Receiving, attempting to receive, knowingly giving or attempting to give unauthorized assistance in the preparation of any work required to be submitted for credit (including examinations, laboratory reports, essays, themes, term papers, etc.) is considered cheating, as is engaging in any behavior that a professor prohibits as academic misconduct in the syllabus or class discussion. Unless specifically authorized, using and/or having access to electronic devices during an examination, quiz, test or other assessment is automatically considered cheating, regardless of the student's reason for using/accessing the device;

2) **Plagiarism:** Including direct quotations from other sources into work required to be submitted

for credit without indicating them as such by quotation marks, block quotes or other appropriate formatting. Incorporating the work of someone (e.g. ideas, theories, data, figures, graphs, programs, electronic based information, illustrations, etc.) into a paper or project without due acknowledgement;

3) **Self-Plagiarism:** Submitting any work for credit which was not authored specifically and originally for the assignment in question without the prior permission of the professor receiving that assignment. Most commonly, this means submitting the same, or substantially the same, paper or other assignment for credit in more than one class;

4) **Misrepresentation and/or Falsification:** Knowingly providing false information in completing University forms or applications (including admissions forms, scholarship applications, time sheets, false or counterfeit transcripts, etc.) or in any work submitted for credit. This includes providing fabricated/altered documents to substantiate an excused absence (such as to meet attendance requirements or have the chance to make-up a missed exam). Signing in for another student or having another individual sign in on a student's behalf on an attendance sheet also constitutes a violation of this code section.

5) **Unauthorized Access to University Materials:** Taking, attempting to take, stealing or in any unauthorized manner otherwise procuring, gaining access to, altering or destroying any material pertaining to the conduct of a class (including tests, examinations, grade change forms, grade rolls, roll books, laboratory equipment, University grade records in written or computerized form, etc.).

6) **Malicious/Intentional Misuse of Computer Facilities/Services:** Maliciously or intentionally misusing university-controlled computer facilities and services. This includes violations of state and federal laws (e.g. copyright violations, unauthorized access to systems, alteration/damage/destruction, or attempted alteration/damage/destruction, use for profit, etc.) or a department's rules for computer usage (e.g. account violations, damage, or destruction of the system and/or its

performance, unauthorized copying of electronic information, use of threatening or obscene language, etc.).

7) Malicious **Removal, Retention or Destruction of University Resource Materials:** Misplacing, taking, destroying any item or part of an item belonging to or in the protection of the University (or the attempt thereof) with the intention of bringing about an undue disadvantage in the academic pursuits of other Kennesaw State University students.

These examples of academic dishonesty shall not be construed to be comprehensive, and infractions will be dealt with on an individual basis according to university policies and procedures. It is the obligation of each student to assist in the enforcement of academic standards.

*See: The KSU Student Code of Conduct at KSU Codes of Conduct-2015.pdf*

**Enforcement:** This policy is strictly enforced. Please note, *I reserve the right to select any paper and/or assignment that are turned in for a grade for plagiarism review. Plagiarism review consists of running your paper/assignment through various search engines and databases at my disposal in order to check for “borrowed” or “bought” information. Students will be required to use TurnItIn.Com to have their papers reviewed for plagiarism.* If you are found in violation of academic dishonesty, then you will be subject to the enforcement policies and procedures, as outlined by the University and the Department.

## Disruption of the Classroom

Faculty members are responsible for maintaining discipline in the classroom setting to the extent that all students in that class have an opportunity to participate in the learning process. Free exchange of ideas through appropriate dialogue is a necessary and important part of the learning process. Outside the classroom, other areas of the campus provide support services, which are also important to the total learning process. Sometimes the faculty or staff member may be confronted with a situation where the conduct of a particular student or students is so inappropriate that it impedes the natural and necessary learning process. All incidents of disciplinary violations of the KSU Student Code of Conduct outside of residence hall property shall be reported to the Department of Student Conduct and Academic Integrity (SCAI).

- If the situation is not imminently dangerous, the faculty or staff member may control the immediate situation by requiring the student(s) to meet specific criteria (not speaking during the remainder of the class period, leaving the classroom or office area immediately, etc.), or the faculty member may choose to dismiss the class for the remainder of the period to avoid a confrontation.
- In situations where a student's conduct is both disruptive and poses imminent danger to the health and safety of himself/herself or others, immediately contact

the KSU Police at [\(470\) 578-6666](tel:4705786666). The responding officer at the time of notification shall remove the student from the area immediately.

- Immediately report the incident to the SCAI Dept. and/or the Office of the Dean for Students and for possible handling under the "Interim Suspension" policy, described in Section III below.
- The SCAI officer will investigate the incident and will advise as to the appropriate course of action in each situation.
- See <http://scai.kennesaw.edu/students/general-info/conduct-violation.php> for more information.

## Student Records/FERPA

Kennesaw State University adheres to the Family Educational Rights & Privacy Act of 1974 – FERPA. See the following link for more information:

[http://www.usg.edu/information\\_technology\\_handbook/section9/tech/9.5\\_privacy\\_and\\_security](http://www.usg.edu/information_technology_handbook/section9/tech/9.5_privacy_and_security)

## Student Rights and Responsibilities

Students of Kennesaw State University are entitled to an environment that is conducive to learning and individual growth. To this end, students enrolling at Kennesaw State University assume a responsibility to abide by the policies and regulations expressed in this section. By doing so, students may fulfill their responsibilities and enjoy the exercise of their own rights while also respecting the rights of others. All rights and responsibilities may be found in the University Catalog at [catalog.kennesaw.edu](http://catalog.kennesaw.edu).

## Sexual Misconduct Policy

Kennesaw State University adheres to KSU's policy prohibiting sexual misconduct both in and out of the classroom. Questions about this policy should be directed to the KSU Equal Employment Opportunity (EEO) and Title IX officer by telephone at (470) 578-2614. You may also visit the University's EEO website <http://www.kennesaw.edu/eoo/index.html> for more information.

## Americans with Disabilities Act (ADA) – Support Services

In compliance with applicable disability law, qualified students with a disability may be entitled to *reasonable accommodation*. Any student with a documented disability (hidden or visible) needing academic adjustments, including classroom or test accommodations is requested to notify the instructor within the first two weeks of the course. Verification from KSU disabled Student Support Services is required. All discussions and documentation will remain confidential.

Disabled Student Support Services:

James V. Carmichael Student Center Addition – 2<sup>nd</sup> Floor, Suite 267, 470.578.6443



[http://www.kennesaw.edu/stu\\_dev/dsss/prospect.shtml](http://www.kennesaw.edu/stu_dev/dsss/prospect.shtml)

Please visit the Student Disabilities Services website at [www.kennesaw.edu/stu\\_dev/sds](http://www.kennesaw.edu/stu_dev/sds) for more information.

## Copyright Law

Kennesaw State University adheres to USG's policy to respect the right of copyright. Holders and comply with copyright laws as set forth in the United States Copyright act. For more information, see the following link to USG's policy: <http://www.usg.edu/copyright/>

## Web Accessibility

Kennesaw State University follows the guidelines of the Universal Design for Learning standard of web accessibility. Faculty use Word, PDF, and HTML formats when communicating electronic information to students whenever possible and appropriate in light of the goals of the course. Faculty are trained to use Web Accessibility Evaluation tools, e.g., WAVE ([www.wave.webaim.org](http://www.wave.webaim.org)), and make adjustments as possible and appropriate in light of the goals of the course. For free resources available to students on web accessibility, please visit the Web Accessibility Resources page at the Distance Learning Center: <http://www.kennesaw.edu/dlc/facultyresources/index.php#>

## Electronic Recording and Social Media

Electronic recording performed without the consent of the people being recorded chills the free exchange of ideas. Academic freedom, free inquiry, and freedom of expression should not be limited by the fear that one's brainstorming, polemic discourse, speculative inquiry, or any other kind of expressed curiosity made within the space of a university classroom will be made public without one's consent. This fear is unacceptable regardless of whether one is in an online, hybrid, or face-to-face classroom setting. Accordingly, no person shall make public any electronically recorded class discussion without the written permission of the instructor. This policy is not intended to discourage electronic recording in the classroom or the use of social media when such actions are performed with the written consent of the instructor, and others as appropriate. Note: Faculty accommodate all reasonable requests to electronically record a class discussion; these requests must be documented by the DisAbled Student Support Services available at: [http://www.kennesaw.edu/stu\\_dev/dsss/prospect.shtml](http://www.kennesaw.edu/stu_dev/dsss/prospect.shtml)