MARYLAND APPLIED GRADUATE ENGINEERING

Solar Thermal Energy Systems ENPM650
Sections 0101 and ME01

Instructor: Prof. B. Valentine
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Office Hours: Send me an email, we can meet via ZOOM anytime

Credits: 03

Term: Spring 2026
Course Dates: From Jan 29th – May 18st

Course Times: Thursdays 7:00 – 9:40 pm ONLINE

Canvas/ELMS: **ENPM650 Canvas Course Site**

Course Description

This course covers a review of related fundamentals, including limitations imposed by thermodynamics, solar spectral characteristics, measurement, and analytical models to predict solar irradiance with respect to time, location and orientation. The course will then examine the characteristics of various components in solar thermal systems with particular emphasis on flat plate and concentrating collectors, fixed and tracking collector systems, heat exchangers and thermal storage to understand how they work and how their performance is influenced by their design. The course will then lead to an examination of systems and system performance, including system design, predicted energy savings and related economics. The course will introduce low temperature applications such as solar hot water, space heating and water distillation, as well as concentrating solar energy for solar thermo-chemical processes to produce hydrogen and solar power generation systems. A project of importance to the development of Solar Thermal Power Systems will be assigned. There will also be two assignments using the energy systems modeling software, TRNSYS.

Prerequisites

Undergraduate level courses in thermodynamics, heat transfer, and fluid mechanics, at least one semester each.

Learning Outcomes

After successfully completing this course, you will be able to:

- Make a thermodynamic analysis of a thermal process.
- Perform basic calculations in thermal radiation and combined mode heat transfer.
- Perform computer simulations of renewable energy thermal and electric power sources.
- Develop understanding of limitations of renewable energy resources.
- Compare solar thermal power systems with other renewable and conventional power systems.

Required Textbook

- Solar Energy Engineering: Processes and Systems, 2nd edition by Soteris A. Kalogirou (2213) – Available free online, but not used much.

Course Structure

This course includes both on-campus and online sections. To attend synchronously online, log into ELMS-Canvas at the time of the Section 0101 class Thursdays 7 PM in JMP 2217and select "Video Conference" from the left side menu. This will open a Zoom link to the live classroom.

For asynchronous online students, all lectures will be recorded and made available on ELMS-Canvas under "Panopto Recordings/Video Lectures" within 24 hours of the class time. Be sure to review the recorded lecture in a timely manner.

On-campus students come to class prepared to engage with the lecture and materials. Online students, be sure to log into Canvas regularly and participate in discussions and activities. Regardless of the section you are enrolled in, participation is expected.

Please note that F1 students enrolled in the on-campus section are required to attend in person. If you have a conflict on a particular day, please reach out to me in advance to discuss.

Communication Guidelines

Communicating with the Instructor

My goal is to be readily available to you throughout the semester. Send me an email and I will get back with you as soon as I can. If you need more help, we can always meet with ZOOM.

I will send IMPORTANT messages, announcements, and updates through ELMS-Canvas. To ensure you receive this information in a timely fashion, make sure your email and announcement notifications (including changes in assignments and/or due dates) are enabled in ELMS-Canvas (How to change notification settings in CANVAS).

Log into our ELMs-Canvas course site at least once every 24-hour period to check your inbox and the Announcements page.

Names/Pronouns and Self-Identifications

The University of Maryland recognizes the importance of a diverse student body, and we are committed to fostering inclusive and equitable classroom environments. I invite you, if you wish, to tell us how you want to be referred to in this class, both in terms of your name and your pronouns (he/him, she/her, they/them, etc.). Keep in mind that the pronouns someone uses are not necessarily indicative of their gender identity. Visit trans.umd.edu to learn more.

Additionally, it is your choice whether to disclose how you identify in terms of your gender, race, class, sexuality, religion, and dis/ability, among all aspects of your identity (e.g., should it come up in classroom conversation about

our experiences and perspectives) and should be self-identified, not presumed or imposed. I will do my best to address and refer to all students accordingly, and I ask you to do the same for all your fellow Terps.

Communicating with your Peers

With a diversity of perspectives and experience, we may find ourselves in disagreement and/or debate with one another. As such, it is important that we agree to conduct ourselves in a professional manner and that we work together to foster and preserve a virtual classroom environment in which we can respectfully discuss and deliberate controversial questions. I encourage you to confidently exercise your right to free speech—bearing in mind, of course, that you will be expected to craft and defend arguments that support your position. Keep in mind, that free speech has its limit and this course is NOT the space for hate speech, harassment, and derogatory language. I will make every reasonable attempt to create an atmosphere in which each student feels comfortable voicing their argument without fear of being personally attacked, mocked, demeaned, or devalued.

Any behavior (including harassment, sexual harassment, and racially and/or culturally derogatory language) that threatens this atmosphere will not be tolerated. Please alert me immediately if you feel threatened, dismissed, or silenced at any point during our semester together and/or if your engagement in discussion has been in some way hindered by the learning environment.

Netiquette Policy

Netiquette is the social code of online classes. Students share a responsibility for the course's learning environment. Creating a cohesive online learning community requires learners to support and assist each other. To craft an open and interactive online learning environment, communication must be conducted in a professional and courteous manner at all times, guided by common sense, collegiality and basic rules of etiquette.

Grading

Grade Breakdown

Assignment	Percentage %
Homework	**60%**
Course Project	**40%**
Total	**100%**

Course Assignments

There will be no exams for this course, only homework assignments and a course project.

Homework Assignments

- There will be 6 homework assignments, due 2 weeks after the day they are assigned. This includes a final homework assignment that covers all the course material, due at the end of final exam week. The purpose of the homework assignments is to reinforce what we learn in class. All the homework involves calculations, this is what engineers do.

Course Project

- A course project will be assigned to examine a Solar Thermal Energy system that is actively being investigated. Each student will have a different system to study, to evaluate the feasibility of commercial application of the system.

Grading of Assignments

The homework involves problem solving and applying what we learn in class. Usually, the answer to a problem will be given, and it is your job to show the steps that lead to the answer. You ASSUME the answers to the problems that you are given are CORRECT, and if you DON'T arrive at the given answers you are invited to contact me, and we will work through it together. There is no reason for not getting everything correct.

Grade Computation

Grade Disputes: I am happy to discuss any of your grades with you, and if I have made a mistake, I will immediately correct it. Any formal grade disputes must be submitted in writing and within one week of receiving the grade.

Final letter grades are assigned based on the percentage of total assessment points earned. To be fair to everyone I must establish clear standards and apply them consistently, so please understand that being close to a cutoff is not the same as making the cut (89.99 ≠ 90.00). It would be unethical to make exceptions for some and not others.

Course Schedule

Week #		
1	➢ **Course overview and objectives** • **Overview of learning objectives** • **Overview of topics to be covered** ➢ **Course Project assignment and discussion** • **Introduction to TRNSYS modeling software** • **Overview of course assignments**	
2	➢ **System thermal analysis: Thermodynamics** • **First and second laws** • **Ideal work and lost work** ➢ **System Thermal Analysis** • **Thermodynamic applications**	**HW #1 Assigned**
3	➢ **System Thermal Analysis** • **Second law analysis** ➢ **System Thermal Analysis** • **Second law applications**	

4	**➢ System Thermal Analysis** **• Intro to Radiation Heat transfer** **➢ System Thermal Analysis** **• Radiation heat transfer calculations**	**HW #1 Due** **HW #2 Assigned**
5	**➢ System Thermal Analysis** **• Solar Radiation Heat Transfer** **• Combined Mode Heat Transfer** **-\=** **• Solar energy intro** **➢ Solar thermal energy calculations** **• Flat plate solar collector analysis**	
6	**➢ Hot water heat using flat plate solar collectors** **• System design from charts** **➢ Assignment using TRNSYS simulator** **• Hot water supply calculation**	**HW #2 Due** **HW #3 Assigned (Using TRNSYS)**
7	**➢ Solar cooling** **• Refrigeration cycles** **• Refrigeration analysis** **➢ Solar cooling** **• Absorption refrigeration** **• Adsorption refrigeration**	
8	**Spring Break**	
9	**➢ Office/factory space heating and cooling systems** **• Building designs for solar space heating** **• Heating and cooling load calculation for offices and commercial buildings** **➢ Solar building technologies** **• Energy efficient widows** **• Building design for energy efficiency**	**HW #3 Due** **HW #4 Assigned**
10	**➢ Solar lighting** **• Daylighting systems** **• Daylighting calculations** **• Lighting design**	
11	**➢ Other solar thermal applications** **• Solar desalination** **• Solar ponds** **• Hydrogen generation using solar thermal energy**	**Friday April 26: Course Project Due**

	➢ **Intro to Solar Thermal Power Systems** • **Solar concentration** • **Concentrator design** • **Optical analysis** • **Thermal Storage**	
12	➢ **Intro to Solar Thermal Power Systems** • **Solar concentration** • **Concentrator design** • **Optical analysis** • **Thermal Storage** ➢ **The design of solar thermal concentrating collectors: Parabolic trough collectors** • **Design of the trough for heat collection** • **Calculation of the heat transfer rates** • **Analysis of losses in the system**	**HW #4 Due** **HW #5 Assigned**
13	➢ **The design of solar thermal concentrating collectors: linear Fresnel collectors (cont.)** • **Analysis of fault mechanisms of linear Fresnel collectors** • **Parasitic power considerations** ➢ **The design of solar thermal concentrating collectors: Parabolic dish collectors** • **Parabolic dish collector design** • **Analysis of loss in collection and concentration of sunlight** • **Analysis of errors introduced** • **Tracking systems for parabolic dish collectors**	
14	➢ **The design of solar thermal concentrating collectors: Parabolic dish collectors (cont.)** • **Calculation of efficiencies in heat collector for Stirling engines** • **Analysis of fault mechanisms of the dish and the engine** • **Engine mounting considerations** ➢ **The design of solar thermal concentrating collectors: Central receiver systems** • **Central receiver design** • **Complete analysis of loss in collection and concentration of sunlight** • **Analysis of errors introduced** • **Heliostat alignment**	

15	**Course Summary** **Employment Opportunities with your Educational Preparation**	**HW #5 Due** **Final Problems Assigned**
16	**Final exam week. Final problems due May 21, 2024**	

Note: This is a tentative schedule, and subject to change as necessary – monitor ELMS-Canvas for current deadlines. In the unlikely event of a prolonged university closing, or an extended absence from the university, adjustments to the course schedule, deadlines, and assignments will be made based on the duration of the closing and the specific dates missed.

Course Policies and Procedures

The University of Maryland's conduct policy indicates that course syllabi should refer to a webpage of course-related policies and procedures. For a complete list of graduate course related policies, visit the Graduate School website. Below are course-specific policies and procedures which explain how these Graduate School policies will be implemented in this class.

Satisfactory Performance

The Graduate School expects students to take full responsibility for their academic work and academic progress. The student, to progress satisfactorily, must meet all the academic requirements of this course. Additionally, each student is expected to complete all readings and any preparatory work before each class session, come to class prepared to make substantive contributions to the learning experience, and to proactively communicate with the instructor when challenges or issues arise.

Questions about Assignments

Please ask all questions you may have about an assignment by 8 AM/PM the day before the assignment is due. Any questions asked after that time may not be answered in time for you to make changes to your work.

Late Work Policy

Assignments should be completed by the due date and time listed with the assignment, on the syllabus, and/or in the course calendar. If you are unable to complete an assignment by the stated due date, it is your responsibility to contact your instructor to discuss an extension, at least 24 hours BEFORE the assignment is due. Extensions are not guaranteed, but may be granted at the instructor's discretion.

Assignments submitted late will receive a 10% deduction in total grade per each calendar day late up to a maximum of three days late (i.e., there is a maximum of a 30% grade reduction for assignments submitted late). Work submitted more than three days late will not receive feedback and will automatically earn a grade of zero.

Religious Observance

It is the student's responsibility to inform the instructor of any intended absences for religious observances in advance. Notice should be provided as soon as possible but no later than the end of the schedule adjustment period.

Academic Integrity

For this course, some of your assignments will be collected via Turnitin on ELMS/Canvas. I have chosen to use this tool because it can help you improve your scholarly writing and help me verify the integrity of student work. For information about Turnitin, how it works, and the feedback reports you may have access to, visit Turnitin Originality Checker for Students

The University's Code of Academic Integrity is designed to ensure that the principles of academic honesty and integrity are upheld. In accordance with this code, the University of Maryland does not tolerate academic dishonesty. Please ensure that you fully understand this code and its implications because all acts of academic dishonesty will be dealt with in accordance with the provisions of this code. All students are expected to adhere to this Code. It is your responsibility to read it and know what it says, so you can start your professional life on the right path. **As future professionals, your commitment to high ethical standards and honesty begins with your time at the University of Maryland.**

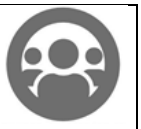
It is important to note that course assistance websites, such as CourseHero, or AI generated content are not permitted sources, unless the instructor explicitly gives permission. Material taken or copied from these sites can be deemed unauthorized material and a violation of academic integrity. These sites offer information that might be inaccurate or biased and most importantly, relying on restricted sources will hamper your learning process, particularly the critical thinking steps necessary for college-level assignments.

Additionally, students may naturally choose to use online forums for course-wide discussions (e.g., Group lists or chats) to discuss concepts in the course. However**, collaboration on graded assignments is strictly prohibited unless otherwise stated**. Examples of prohibited collaboration include: asking classmates for answers on quizzes or exams, asking for access codes to clicker polls, etc. Please visit the **Office of Graduate Studies' full list of campus-wide policies** and reach out if you have questions.

Finally, on each exam or assignment you must write out and sign the following pledge: ***"I pledge on my honor that I have not given or received any unauthorized assistance on this exam/assignment."***

If you ever feel pressured to comply with someone else's academic integrity violation, please reach out to me straight away. Also, ***if you are ever unclear*** about acceptable levels of collaboration, ***please ask***!

To help you avoid unintentional violations, ***the following table*** lists levels of collaboration that are acceptable for each graded exercise. Each assignment will contain more specific information regarding acceptable levels of collaboration.

Assignment Type	 **OPEN NOTES**	 **READ BOOK**	 **LEARN ONLINE**	 **GATHER CONTENT WITH AI**	 **ASK FRIENDS**	 **WORK IN GROUPS**

Homework	✓	✓	✓	DISCUSS IN CLASS	NO	NO
Semester Project	✓	✓	✓	DISCUSS IN CLASS	NO	NO

Course Evaluation
Please submit a course evaluation through Student Feedback on Course Experiences in order to help faculty and administrators improve teaching and learning at Maryland. All information submitted to Course Experiences is confidential. Campus will notify you when Student Feedback on Course Experiences is open for you to complete your evaluations at the end of the semester. Please go directly to the **Student Feedback on Course Experiences** to complete your evaluations. By completing all of your evaluations each semester, you will have the privilege of accessing through Testudo the evaluation reports for the thousands of courses for which 70% or more students submitted their evaluations.

Copyright Notice

Tips for Succeeding in this Course

1. **Participate.** I invite you to engage deeply, ask questions, and talk about the course content with your classmates. You can learn a great deal from discussing ideas and perspectives with your peers and professor. Participation can also help you articulate your thoughts and develop critical thinking skills.
2. **Manage your time.** Students are often very busy, and I understand that you have obligations outside of this class. However, students do best when they plan adequate time that is devoted to course work. Block your schedule and set aside plenty of time to complete assignments including extra time to handle any technology related problems.
3. **Login regularly.** I recommend that you log in to ELMS-Canvas several times a week to view announcements, discussion posts and replies to your posts. You may need to log in multiple times a day when group submissions are due.
4. **Do not fall behind.** This class moves at a quick pace and each week builds on the previous content. If you feel you are starting to fall behind, check in with the instructor as soon as possible so we can troubleshoot together. It will be hard to keep up with the course content if you fall behind in the pre-work or post-work.
5. **Use ELMS-Canvas notification settings.** Pro tip! Canvas ELMS-Canvas can ensure you receive timely notifications in your email or via text. Be sure to enable announcements to be sent instantly or daily.
6. **Ask for help if needed.** If you need help with ELMS-Canvas or other technology, IT Support. If you are struggling with a course concept, reach out to me and your classmates for support.

Student Resources and Services

Taking personal responsibility for your learning means acknowledging when your performance does not match your goals and doing something about it. I hope you will come talk to me so that I can help you find the right approach to success in this course, and I encourage you to visit the Counseling Center's Academic Resources to learn more

about the wide range of resources available to you. Below are some additional resources and services commonly used by graduate students. For a more comprehensive list, please visit the Graduate School's Campus Resources Page.

Accessibility and Disability Services
The University of Maryland is committed to creating and maintaining a welcoming and inclusive educational, working, and living environment for people of all abilities. The University of Maryland is also committed to the principle that no qualified individual with a disability shall, on the basis of disability, be excluded from participation in or be denied the benefits of the services, programs, or activities of the University, or be subjected to discrimination. The Accessibility & Disability Service (ADS) provides reasonable accommodations to qualified individuals to provide equal access to services, programs and activities. ADS cannot assist retroactively, so it is generally best to request accommodations several weeks before the semester begins or as soon as a disability becomes known. Any student who needs accommodations should contact me as soon as possible so that I have sufficient time to make arrangements.

For assistance in obtaining an accommodation, contact Accessibility and Disability Service at 301-314-7682, or email them at adsfrontdesk@umd.edu. Information about sharing your accommodations with instructors, note taking assistance and more is available from the Counseling Center.

Writing Center
Everyone can use some help sharpening their communication skills (and improving their grade) by visiting The Graduate School's Writing Center and schedule an appointment with them. Additionally, international graduate students may want to take advantage of the Graduate School's free English Editing for International Graduate Students (EEIGS) program.

Health Services
The University offers a variety of physical and mental health services to students. If you are feeling ill or need non-emergency medical attention, please visit the University Health Center.

If you feel it would be helpful to have someone to talk to, visit UMD's Counseling Center or one of the many other mental health resources on campus.

Notice of Mandatory Reporting
Notice of mandatory reporting of sexual assault, sexual harassment, interpersonal violence, and stalking: As a faculty member, I am designated as a "Responsible University Employee," and I must report all disclosures of sexual assault, sexual harassment, interpersonal violence, and stalking to UMD's Title IX Coordinator per University Policy on Sexual Harassment and Other Sexual Misconduct.

If you wish to speak with someone confidentially, please contact one of UMD's confidential resources, such as CARE to Stop Violence (located on the Ground Floor of the Health Center) at 301-741-3442 or the Counseling Center (located at the Shoemaker Building) at 301-314-7651.

You may also seek assistance or supportive measures from UMD's Title IX Coordinator, Angela Nastase, by calling 301-405-1142, or emailing titleIXcoordinator@umd.edu.

To view further information on the above, please visit the Office of Civil Rights and Sexual Misconduct's website at ocrsm.umd.edu.

Basic Needs Security

If you have difficulty affording groceries or accessing sufficient food to eat every day, or lack a safe and stable place to live, please visit UMD's Division of Student Affairs website for information about resources the campus offers you and let me know if I can help in any way.

Veteran Resources

UMD provides some additional supports to our student veterans. You can access those resources at the office of Veteran Student life and the Counseling Center. Veterans and active duty military personnel with special circumstances (e.g., upcoming deployments, drill requirements, disabilities) are welcome and encouraged to communicate these, in advance if possible, to the instructor.