ARE 361: Fundamentals for Lighting Design
Course Syllabus | Winter 2023 | 4 Credits

Instructor: Kevin W. Houser, PhD, PE (NE), FIES, LC, LEED AP
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E-mail: kevin.houser@oregonstate.edu

Meeting time: Tuesday, Thursday: 10:00 AM – 11:50 AM

Location: Owen Hall 237.

Office Hours: My office hours will be Wednesdays from 1:15 PM to 2:15 PM. It will be helpful if you will let me know if you plan to drop by during office hours so that I can be sure to be in my office. I am also available to meet at other times by appointment, and you can also drop by anytime. Generally, unless I am in a meeting or have a pressing deadline, I will be pleased to meet with you.

Communication and Interaction: You will have ongoing access to your peers and me throughout the course. Generally, the best way to talk about class content is during class time—we have all set aside that time in our schedule to focus exclusively on this course so let’s first optimize that time. Outside of class, you can stop by my office or contact me by e-mail. If I am in my office and available, I will be happy to meet with you. I will check e-mail Monday – Friday during normal business hours. I will do my best to respond to questions within 24 hours or, if sent on the weekend, the following Monday. I will maintain ongoing communication with you through class meetings, Canvas, and e-mail. Please use these same tools to contact me to share your ideas, comments, and questions.

Required materials:

2. Since we will be using Top Hat for attendance, please sure that you have a valid Top Hat license, with Top Hat installed and configured on your mobile device. Please see the attendance policy later in this syllabus.

Recommended references:
1. Digital access to the IES Lighting Library is available through Oregon State University’s Institutional Membership using these credentials (up to 10 simultaneous logins):
   Username: OSU@ies.org
   Password: 

Frequently Asked Questions:

What is the course catalog description? [LINK]

Demonstrate critical thinking about illuminating engineering and applied lighting in the built environment. Explore lighting terminology, photometric quantities and units, the visual response of the human eye and brain, luminous radiative transfer, lighting equipment, elementary lighting design procedures, and basic lighting calculations.

What are the pre-requisites?

CEM 471 Electrical Facilities with grade of “C” or better.

What is this course about?

This course is designed to develop an introductory understanding and critical thinking about illuminating engineering and applied architectural lighting. It familiarizes students with lighting terminology, quantities, and units, the human eye and brain, basic concepts in photometry and luminous radiative transfer, lighting equipment, elementary lighting design procedures, and basic lighting calculations.

The course is designed for students studying Architectural Engineering (ARE). For ARE students that will not specialize in lighting, this course provides the breadth of knowledge in applied illuminating engineering and architectural lighting design needed to effectively collaborate with lighting professionals. For ARE students that will specialize in lighting, this course provides the foundational breadth for the more advanced study that is needed to become a lighting professional.

What are the course learning outcomes?

By the conclusion of this course, students are expected to be able to:

1. Compute and manipulate photometric quantities such as luminous flux, luminous intensity, illuminance, exitance, and luminance.
2. Analyze lighting design solutions by identifying the components of light (sometimes called “layers of light”, or luminous characteristics) that were employed in design.
3. Explain the basic performance characteristics of light sources that are relevant when matching light sources to end-use application.
4. Identify major families of luminaire types and subtypes.

What are the ABET Student Learning Outcomes?

The learning activities in this course support the following ABET Student Learning Outcomes:

7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

[Maps to course learning outcomes 1, 2, 3, and 4.]

How is the course graded?

Assignments are intended to deepen your understanding of the material in preparation for examinations. Assignments will not be rigorously evaluated; they will generally be checked for completeness, sometimes with spot-checking for correctness. By contrast, all examination questions will be graded and discussed during class time. The anticipated breakdown of graded assignments is as shown below. This table is subject to revision:

Class Participation ..........................................................10%
Homework Assignments..................................................20%
Midterm Exams (Two at 20% each) ........................................40%
Final Examination ..........................................................30%

At the end of the course your letter grade will be determined by reference to the following table:

<table>
<thead>
<tr>
<th>Minimum %</th>
<th>Letter Grade</th>
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<tr>
<td>92</td>
<td>A</td>
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<td>89</td>
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<td>62</td>
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<td>0</td>
<td>F</td>
<td>59</td>
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</table>

Why is the course graded this way?

This course employs criterion-referenced grading, which means that your grade will be determined by the established standards for this course, not by comparing your performance to that of your classmates. The assumption is that the standard of performance is reachable by all: everyone could get an ‘A’, and likewise everyone could get an ‘F’.

How will my work be evaluated?

Assignments will require a paper-based deliverable, electronic deliverable, oral presentation, or some combination. You will be informed of the evaluation criteria on an assignment-by-assignment basis.

Your work will be evaluated is on the materials produced. It is impossible for me, and unfair to the class, to consider the workload from other classes or outside commitments. These factors will not be considered as part of your evaluation.

Professionalism in this course is as important as in the workplace and included such traits as preparation, productivity, and promptness. Cell phones, e-mail, texting, and all other potential distractions will not be tolerated during our regularly scheduled class meetings or during office hours.

Class periods will be interactive and will have a discussion component. Prepare yourself for class by completing the readings and assignments before class. Active participation is expected.

Participation and professionalism will contribute to your final grade.
### What are OSU’s deadlines for registration and refunds?

All students are subject to the registration and refund deadlines as stated in the Academic Calendar: [https://registrar.oregonstate.edu/osu-academic-calendar](https://registrar.oregonstate.edu/osu-academic-calendar)

### How often will we meet, and how much time should I expect to spend?

As a rule-of-thumb, OSU expects a ratio of about 1:2 [LINK] or 1:3 [LINK] between in-class time and out-of-class study time; each hour of class lecture is generally expected to require two to three hours of work outside of class. Since ARE 352 is a 4-credit course, you should expect to spend, on average, about 12 to 16 hours per week inclusive of in-class and out-of-class activities. Exceling in this course may take more time.

### How should I study for this course?

The Learning Corner of OSU’s Academic Success Center is excellent. The process described in the Study Cycle [LINK] is especially on-point. You are encouraged to review and follow the suggestions in that document. Briefly, the study cycle involves:

1. Preparing for success by knowing yourself (e.g., maintaining a schedule, studying when you are alert, avoiding distractions)
2. Previewing class material before each class meeting
3. Actively reading and actively attending class
4. Reviewing materials to fill in gaps, correct misunderstandings, and clarify understandings
5. Creating your own documentation of course materials via outlines, flowcharts, diagrams, flashcards, etc.
6. Self-testing by creating possible test questions, preferably with a partner and/or group
7. Rest before tests and employ appropriate test-taking strategies.

The Learning Corner has many other excellent resources, covering strategies for time management, procrastination, note-taking, studying, reading, prioritization, stress reduction, and wellness. If you feel you could improve in any of these categories, then it is worth spending time with the resources provided. See especially the DIY Tools [LINK].

### What is the policy about attendance and participation?

Attendance helps students learn the course material. Skipping class harms performance. Regular and punctual attendance is expected and is your responsibility.

Presenteeism is nearly as bad. It is in your best interest to invest your full attention in the material during class, time that we have set aside to spend together. Please come prepared, with a mindset to engage and concentrate.

Preparation includes arriving on time. A good engineer upholds professional conduct by being prompt. If this is not your habit, acquire it. It will help you in this class and in your career.

Recognizing the importance of attendance and active engagement to achieving course learning outcomes, class participation is 10% of the course grade. Class participation will generally be recorded through participation in Top Hat activities, often in the form of comprehension checks. Specifically, if you participate in the Top Hat (or other) activity for a given class period, you
will receive credit for that class period. If you do not participate in the Top Hat (or other) activity, you will not receive credit for that class period.

Exceptions:

1. Missing a class will be excused without penalty if you are ill, or if you are caring for someone that is ill. Please see sick policy, below.

2. If you have another valid reason for missing class, please contact me by e-mail as far in advance of the absence as possible. The workload from other classes or working an extra shift at a part-time job will not be considered valid reasons. Valid reasons for missing class could include the death of a loved one, a family medical emergency, or a religious holiday.

What is the policy about late work?

Unless written on an assignment or otherwise announced, assignments are due at by the beginning of class. Late work will only be accepted for circumstances such as family or medical emergencies. Please also see sick policy, below. That said, I understand and appreciate that you are juggling various responsibilities. I am willing to consider revising homework or project deadlines when it can be done in ways that are fair and equitable. Discussion about deadlines should happen well ahead the date when an assignment is due. The best time to talk about an assignment deadline is at the time of assignment. The worst time is just before the assignment is due.

What is the policy about working in teams?

Open discussion and the public exchange of ideas are healthy parts of the learning process and university life. You are encouraged to discuss the course, exchange ideas, and work on assignments with your classmates. Keep in mind that there is an implied reciprocity associated with working together, solving problems together, and learning together. It is expected that in some instances your classmates will be a resource for you, while at other times you will be a resource for them. Also keep in mind that working together is a means, not an end. Ultimately, you need to know what you’re doing, and you alone are responsible for the work you turn in.

What constitutes academic misconduct?

Talking over your ideas and getting comments on your work from classmates, co-workers and instructors are not examples of plagiarism or cheating. Taking someone else’s work and calling it your own is plagiarism, including using other persons’ calculations, spreadsheets, computer programs, homework solutions, or ideas. Academic misconduct includes, but is not limited to, cheating, plagiarism, fabrication of information or citations, facilitation of acts of academic misconduct by others, unauthorized possession of examinations, submitting work of another person or work previously used without informing the instructor, and tampering with the academic work of other students. Such acts of dishonesty and misconduct violate the fundamental ethical principles of the University community and compromise the worth of work completed by others.

OSU Libraries offer a tutorial on academic misconduct [LINK]. Please refer to the OSU Student Code of Conduct at [https://beav.es/codeofconduct](https://beav.es/codeofconduct) and the Office of Student Conduct and Community Standards website for more information. If you are unsure if something will violate OSU’s academic
integrity policy, ask your professors, academic advisors, or academic integrity officers.

If you are found responsible for academic misconduct, the College Hearing Officer (or other hearing body) will determine sanctions that are appropriate to the violation and the surrounding context. College Hearing Officers are authorized to assign Academic Sanctions as described HERE.

What is the course policy about generative AI and AI-assisted technologies?

AI is not needed to perform any of the work in this course. Nevertheless, this course does not prohibit use of generative AI and AI assisted technologies for text and image generation, instead requiring responsible use. Some tenets of responsible use are:

- Apply the technology with human oversight and control. AI can generate authoritative-sounding output that can be incorrect, incomplete, or biased. AI results demand careful review, editing, and tracking-down of sources. At this stage of technology maturation, training data is often faulty; AI is prone to parrot erroneous content, having little ability to separate truth from fiction.

- If employed to assist with writing tasks, which is not generally recommended, these technologies should only be employed to improve readability and language. AI should not be employed to replace tasks such as interpreting data or drawing scientific conclusions.

- Disclose the use of AI and AI-assisted technologies in the writing and image-generation process.

- Do not list AI and AI-assisted technologies as an author or co-author. Authorship implies responsibilities and tasks that can only be attributed to and performed by humans.

You are ultimately responsible and accountable for your work. For anyone heavily reliant on AI to do their work, it follows that that person may be contributing little (or even zero) intellect, creativity, or value. If the tasks are so easy that they can be performed by AI, is a person leaning on AI even employable? Focus instead on your human value.

What if I or someone I am caring for is sick?

Students should not attend class or any public gatherings while ill with COVID-19, influenza, or any other contagion. Students with symptoms will be asked to leave the classroom or instructor’s office and return home for recovery. If you have COVID-19, influenza, or another virus or contagion, follow medical advice and university policies on self-isolation. It is important to avoid spreading the illness to others.

Most students should be able to complete a successful semester despite such an absence. I will provide students who are absent because of illness with a reasonable opportunity to make up missed work. Ordinarily, it is inappropriate to substitute for the missed assignment the weighting of a semester's work that does not include the missed assignment or exam. Completion of all assignments and exams assures the greatest chance for students to develop heightened understanding and content mastery that is
unavailable through the weighting process. The opportunity to complete all assignments and exams is intended to enable you to make responsible situational decisions, including the decision to avoid spreading a contagion to other students, staff, and faculty, without in any way endangering your academic opportunities and work.

Students with a contagion do not need to provide a physician's certification of illness. Ill students should inform me via e-mail or through Canvas (but not through personal contact) as soon as possible that they will be absent because of an illness. I will work with you to arrange to make up missed assignments or exams.

The above considerations also apply if you are caring for someone that is ill. The Office of the Dean of Students can also assist you if you are navigating a range of extenuating life circumstances including but not limited to prolonged illness, hospitalization, and financial concerns. They can be reached via Zoom chat or audio Monday through Friday from 9 AM to 5 PM at beav.es/4qQ or by email at support.odos@oregonstate.edu.

What is OSU's COVID-19 Safety and Success Policy

Thank you for working together to maintain a safe, successful, and inclusive learning environment. OSU's COVID-19 Safety & Success website should be referenced for the most up-to-date resources and policies. At time of this writing, OSU requires the use of a face covering when in indoor spaces to contribute to the health and safety of the OSU community during the ongoing COVID-19 pandemic. Instructors and students might remove face coverings when lecturing or presenting when six feet away from others, and will return to using a face covering once a task is completed. Please review the OSU policy and expectations around the use of face coverings outside the classroom, vaccination requirements, and isolation and quarantine requirements. The full set of guidelines are available at https://covid.oregonstate.edu/.

What are my rights as an OSU student?

OSU has twelve established student rights, known as the Student Bill of Rights. They include due process in all university disciplinary processes, an equal opportunity to learn, and grading in accordance with the course syllabus: https://asosu.oregonstate.edu/advocacy/rights

Where can I go for help?

There are many people and resources at Oregon State that are eager to help you on your academic path, and that will support you as achieve success in college courses. If you're unsure where to start, check out these free academic support resources:

- Academic Coaching
- Supplemental Instruction
- The Writing Center
- The Learning Corner
- University Exploratory Study Program (UESP)

If none of these resources is the right fit, be in touch. Talk to me, to your academic advisor, or to a Strategist in the Academic Success Center. We want to help you succeed.
<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
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<tr>
<td>What is OSU’s statement regarding students with disabilities?</td>
<td>Accommodations for students with disabilities are determined and approved by Disability Access Services (DAS). If you, as a student, believe you are eligible for accommodations but have not obtained approval please contact DAS immediately at 541-737-4098 or at <a href="http://ds.oregonstate.edu">http://ds.oregonstate.edu</a>. DAS notifies students and faculty members of approved academic accommodations and coordinates implementation of those accommodations. While not required, students and faculty members are encouraged to discuss details of the implementation of individual accommodations.</td>
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| What about interpersonal violence support services?                   | - OSU Sexual Assault Support Services (SASS): 541-737-2131. Provides confidential support, information, crisis intervention, and/or counseling for OSU students who have experienced unwanted sexual contact or relationship violence.  
  - Survivor Advocacy and Resource Center (SARC): 541-737-2030. Provides consultation and assistance to questions about your reporting options to either the school or law enforcement, or could provide accompaniment to either reporting agency.  
  - Center Against Rape and Domestic Violence (CARDV): 541-754-0110. Provides 24-7 confidential crisis response, hospital and legal advocacy, hotline support, and support groups.  
  - Sexual Assault Nurse Examiner, Student Health Center: 541-737-9355. Provides emergency medical evaluations for sexual assault. |
| What is Reach Out for Success?                                         | University students encounter setbacks from time to time. If you encounter difficulties and need assistance, it’s important to reach out. Consider discussing the situation with an instructor or academic advisor. Learn about resources that assist with wellness and academic success at [https://counseling.oregonstate.edu/reach-out-success](https://counseling.oregonstate.edu/reach-out-success). If you are in immediate crisis, please contact the Crisis Text Line by texting OREGON to 741-741 or call the National Suicide Prevention Lifeline at 1(800)273-8255. |
| What about Diversity?                                                  | The College of Engineering strives to create an affirming climate for all students including underrepresented and marginalized individuals and groups. Diversity encompasses differences in age, color, ethnicity, national origin, gender, physical or mental ability, religion, socioeconomic background, veteran status, sexual orientation, and marginalized groups. We believe diversity is the synergy, connection, acceptance, and mutual learning fostered by the interaction of different human characteristics. |
| What about religious holidays?                                         | Oregon State University strives to respect all religious practices. If you have religious holidays that are in conflict with any of the requirements of this class, please see me immediately so that we can make alternative arrangements. |
| Is every detail of this syllabus binding?                              | No. This syllabus is subject to change with notice from the instructor. There may be additional syllabus content accessible through Canvas. If anything on this syllabus is found to conflict with any policies of Oregon State University, the policies of Oregon State University will prevail. |
| How do I evaluate this during the fall, winter, and spring terms?      | During the fall, winter, and spring terms the online [Student Evaluation of Teaching](https://counseling.oregonstate.edu/reach-out-success) system opens to students the Wednesday of week 8 and closes the |
How does copyright apply to instructor provided materials, including assignments, exams, and this syllabus?

Materials in this course, unless otherwise indicated, are protected by United States copyright law [Title 17, U.S. Code]. Materials are presented in an educational context for personal use and study and should not be shared, distributed, or sold in print, or digitally, outside the course without permission.

As a student your ability to post or link to copyrighted material is also governed by United States copyright law. The law allows students to post or link to copyrighted materials within the course environment when the materials are pertinent to course work. Instructors or other staff of the institution reserve the right to delete or disable your post or link if in their judgment it would involve violation of copyright law.

course and the instructor?

Sunday before Finals Week. Students will receive notification, instructions and the link through their ONID e-mail. They may also log into the system via Online Services. Course evaluation results are extremely important and used to help improve courses and the learning experience of future students. Responses are anonymous (unless a student chooses to “sign” their comments agreeing to relinquish anonymity) and unavailable to instructors until after grades have been posted. The results of scaled questions and signed comments go to both the instructor and their unit head/supervisor. Anonymous (unsigned) comments go to the instructor only.
**Anticipated Schedule**
This is a working outline for guidance only. Specific topics and scheduling are subject to revision.

<table>
<thead>
<tr>
<th>Period</th>
<th>Topic</th>
<th>Readings</th>
<th>Assignments</th>
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<tbody>
<tr>
<td>1.1</td>
<td>• Syllabus review, expectations, and course overview.</td>
<td>• Syllabus and Assignments (Available on Canvas)</td>
<td>• Assigned HW #1: The Raisin Observation</td>
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<td>• <em>Explain HW #1: The Raisin Observation</em></td>
<td>• Livingston, Chapters 1, 2, 3, and 4</td>
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<td>• Applied lighting as science and art. Organizational framework for image and non-image forming responses in humans (e.g., the lighting variables that a designer controls, and how that influences human outcomes)</td>
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<td>1.2</td>
<td>• Eye/Brain physiology</td>
<td>• Livingston, Chapters 5 and 6</td>
<td>• Due HW #1: The Raisin Observation</td>
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<td></td>
<td>o Visual Responses: Fundamental seeing factors (luminance, contrast, size, time, age), luminance adaptation, chromatic adaptation, visual acuity, accommodation, ageing.</td>
<td>• PLD66, How to Communicate Light (Available on Canvas)</td>
<td>• Assigned HW #2: Lighting Image Examples, Annotations, and Critiques</td>
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<td>o Non-Visual Responses: Acute, Circadian</td>
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<td>• Assigned HW #3: The Language of Light and Lighting</td>
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<td></td>
<td>o Moderating factors</td>
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<td></td>
<td>• The language of lighting</td>
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<td>o Emotive vocabulary for the luminous environment</td>
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<td>o Shade, shadow, highlight</td>
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<td>o Points, lines, area</td>
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<td></td>
<td>o Kelly's ambient, focal glow, and brilliance</td>
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<td>• Lighting project examples</td>
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<td>• <em>Explain HW #2: Lighting Image Examples</em></td>
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<td>• <em>Explain HW #3: Language of Light and Lighting</em></td>
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<td>2.1</td>
<td>• Quantitative terminology, photometric units, and the technical language of light</td>
<td>• MEEB 13th edition, Chapter 6 excerpt (Available on Canvas)</td>
<td>• Assigned HW #4: Practicing the Fundamentals</td>
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<td></td>
<td>o Fundamental Five</td>
<td>• Livingston, Chapter 7</td>
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<td></td>
<td>o Material properties</td>
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<td>▪ Reflection, transmission, absorption</td>
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<td>▪ Specular, diffuse, spread</td>
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<td></td>
<td>▪ Color</td>
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<td></td>
<td>• Radiometry vs. Photometry</td>
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### 2.2
- Mathematical examples of interrelationships between luminous flux, luminous intensity, illuminance, exitance, and luminance
- Livingston, Chapter 15
- Due HW #2: Lighting Image Examples, Annotations, and Critiques
- Due BONUS: IES Student Membership

### 3.1
- Introduction to radiative transfer concepts
  - Inverse square law, cosine law of incidence, and point calculations
  - Beam and field angles for directional light sources
  - Computing average horizontal illuminance in an empty room
  - What does lighting software do?
- Livingston, Chapter 15

### 3.2
- GUEST LECTURE #1 [SmithGroup]
  - Lighting Designer Perspectives and Project Examples
- Due HW #4: Practicing the Fundamentals

### 4.1
- EXAM #1

### 4.2
- Return Exam #1
- How and why what you are learning in this course relates to other lighting courses, the ARE curriculum, and professional practice
- Lighting professionals’ survey responses to attributes, skills, abilities, and technical knowledge (Available on Canvas)

### 5.1
- Lighting design process. Task analysis. Design criteria development and prioritization.
- In-class example: Programming and schematic design for a corridor
- Explain HW #5: Lighting Design Process
- Livingston, Chapters 2 and 3
- Innes, Chapter 8 Design Process (Available on Canvas)
- Karlen and Benya, Chapter 9 A Basic Approach to Lighting Design (Available on Canvas)
- Assigned HW #5: Lighting Design Process
<table>
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• Lighting solutions that exemplify the concepts of John Flynn.  
• Parametric image examples (ERCO Light Perspectives)  
• Explain HW #6: Lighting Design Analysis—Psychological Impressions  
• Flynn Electrical Consultant Series (Available on Canvas).  
• Livingston, Chapter 6 and 12 |
| 6.1   | • Lighting design analysis day: Today we will form small teams to dissect and discuss numerous lighting design projects. We will then share results of that exercise with the whole class.  
• Assigned HW #6: Lighting Design Analysis—Psychological Impressions |
| 6.2   | • Conceptual design day: Today we will form small teams to conceptually design several lighting designs. We will then share the results of that exercise with the whole class.  
• Due HW #5: Lighting Design Process |
| 7.1 Feb 21 | • GUEST LECTURE #2: [Lighting Design Alliance] Lighting Designer Perspectives and Project Examples  
• Due HW #6: Lighting Design Analysis—Psychological Impressions |
| 7.2   | • EXAM #2 |
| 8.1   | • Return Exam #2  
• Ethics in engineering and in the lighting professions  
• Codes of ethics for NSPE, IES, IALD, and CIE (Available on Canvas) |
| 8.2   | • Light Sources  
  o Choosing a light source  
  o Basic color concepts for light sources (chromaticity, CCT, color rendering)  
• Livingston, Chapter 8  
• IES Lighting Handbook, Chapter 13  
• Assigned HW #7: Light Sources |
<table>
<thead>
<tr>
<th></th>
<th>Brief overview of legacy light sources, types and performance characteristics</th>
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<td></td>
<td>Solid-state lighting</td>
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<td><strong>Explain HW #7: Light Sources</strong></td>
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| 9.1 | Solid State Lighting (continued) |   |

| 9.2 | Luminaires and Photometric Reports, Part I | Livingston, Chapter 11 |
|     |   | Sorcar, Chapter 5 (Available on Canvas) |
|     |   | **Due HW #7: Light Sources** |
|     |   | **Assigned HW #8: Luminaires and Photometric Reports** |
|     |   | **Due HW #8: Luminaires and Photometric Reports** |
|     |   | **Due HW #3: The Language of Light and Lighting** |

| 10.1 | Luminaires and Photometric Reports, Part II |   |
|      |   | Components of a photometric report in detail (luminous intensity distribution, zonal lumens, spacing criterion, luminaire luminance, coefficients of utilization) |
|      |   |   |

| 10.2 | Catch-up | Due HW #8: Luminaires and Photometric Reports |
|      | Review for Final Examination |   |

| 11 | Final Examination during Final Exams Week |   |