

**COURSE NAME:** GDD303 Lighting and Rendering

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Credit Value: 3  
Total Course Hours: 42  
Prerequisite Course(s): None  
Corequisite Course(s): None

## COURSE DESCRIPTION

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In this class, students will learn the fundamentals of lighting and rendering in game engines, both in theory and practice. Theory modules include topics such as raytracing, global illumination, caustics, as well as understanding how physically based lighting and surface shaders work together to light scenes. Practical application will be used to light and render scenes in order to fully understand how these concepts work together. Additionally, students will learn how these concepts can be applied artistically to dramatically shift the mood of their scenes, a useful tool in any game designer's toolkit.

## LAND ACKNOWLEDGEMENT

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Canadore College resides on the traditional territory of the Anishinaabeg and within lands protected by the Robinson Huron Treaty of 1850. This land is occupied by the people of Nipissing First Nation, Treaty #10 in the Robinson Huron Treaty of 1850 since time immemorial.

## PLAR INFORMATION

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This course is not eligible for Prior Learning Assessment and Recognition.

## COURSE LEARNING OUTCOMES

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Upon completion of this course, the student will have reliably demonstrated the ability to:

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| <p><b>1.0 Practice the basics of implementing lighting systems in a game engine.</b></p> <ul style="list-style-type: none"><li>1.1 Discuss the basics of real time lighting, its strengths, as well as its drawbacks.</li><li>1.2 Discuss the basics of baked lighting, its strengths, as well as its drawbacks.</li><li>1.3 Demonstrate ability to create, place, and bake reflection probes in a scene.</li><li>1.4 Demonstrate ability to create, place, and bake light probes in a scene.</li><li>1.5 Discuss differences between various light types, such as spot, point, etc.</li><li>1.6 Demonstrate ability to implement light cookies.</li></ul> <p><b>2.0 Evaluate the basics of ray tracing and global illumination.</b></p> <ul style="list-style-type: none"><li>2.1 Discuss the basics of mathematical theories behind ray tracing.</li><li>2.2 Discuss the basics of the mathematical theory behind global illumination.</li><li>2.3 Demonstrate ability to adjust indirect lighting settings such as intensity and albedo</li></ul> | <p>boost.</p> <ul style="list-style-type: none"><li>2.4 Demonstrate ability to adjust lighting settings such as light bounces, ray tracing samples, filtering, etc.</li><li>2.5 Describe how to create lightmaps for baked lighting solutions.</li><li>2.6 Demonstrate ability to bake lightmaps with baked ambient occlusion.</li></ul> <p><b>3.0 Assess advanced ray tracing techniques.</b></p> <ul style="list-style-type: none"><li>3.1 Describe the theory and implementation of ray tracing for real time global illumination.</li><li>3.2 Describe the theory and implementation of ray tracing for real time reflections.</li><li>3.3 Describe the principles light scattering, and how it will affect the lighting of a scene.</li><li>3.4 Describe of how to implement real time caustics and refractions.</li></ul> <p><b>4.0 Apply advanced engine lighting and rendering techniques.</b></p> <ul style="list-style-type: none"><li>4.1 Discuss the basics of the forward rendering pipeline, the deferred rendering pipeline, how they differ, when to use one over the other.</li></ul> |
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- 4.2 Discuss the difference between gamma and linear color space, what the purpose of each is, when to use one over the other.
- 4.3 Describe the basics of high dynamic range lighting, as well as how to implement into a project.
- 4.4 Demonstrate ability to implement volumetric lighting and fog, adjust settings to balance realism with performance.
- 4.5 Describe how to modify light and shadow settings such as cascades, resolution, etc in order to optimize realtime lighting performance.
- 5.0 Evaluate properties of shaders and materials.
- 5.1 Discuss the theory behind physically based rendering (PBR) shaders.
- 5.2 Discuss how material reflection property affects final appearance of model, as well as its contribution to the scene lighting in a PBR system.
- 5.3 Discuss how material emission property affects final appearance of model, as well as its contribution to the scene lighting in a PBR system.
- 5.4 Discuss how material translucency property affects final appearance of model, as well as its contribution to the scene lighting in a PBR system.
- 5.5 Discuss how material diffusion property affects final appearance of model, as well as its contribution to the scene lighting in a PBR system.
- 5.6 Discuss how material subsurface scattering property affects final appearance of model, as well as its contribution to the scene lighting in a PBR system.

## GENERAL EDUCATION

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This is not a General Education course.

## ESSENTIAL EMPLOYABILITY SKILLS OUTCOMES

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This course contributes to the following Ministry of Colleges and Universities approved essential employability skills (EES) outcomes:

1. Communicate clearly, concisely, and correctly in the written, spoken, and visual form that fulfils the purpose and meets the needs of the audience.
2. Respond to written, spoken, or visual messages in a manner that ensures effective communication
7. Analyse, evaluate, and apply relevant information from a variety of sources.
10. Manage the use of time and other resources to complete projects.

## EXTERNAL COURSE ACCREDITATIONS AND CONDITIONS

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There are no external accreditations or conditions identified for this course.

## COURSE EVALUATION

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Tests and Quizzes - 30%

Assignments - 40%

Labs / Studies - 30%

## PROGRAM SPECIFIC GRADING

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As per College Grading System

### GRADING SYSTEM

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A+:	90-100%	B+:	77-79%	C+:	65-69%	D:	50-54%	S - Satisfactory
A:	85-89%	B:	73-76%	C:	60-64%	F:	0-49%	I - Incomplete
A-:	80-84%	B-:	70-72%	D+:	55-59%			F- Repeat Course, included in GPA
								FS- Failure Supplemental
								FR- Repeat course, excluded from GPA

\*For a complete chart of grades and descriptions, please see the Grading Policy.

## LEARNING RESOURCES

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No textbooks have been identified for this course.

### Other Resources:

Art of Lighting Game Environments in Unity  
Introduction to Lighting and Rendering

Resources listed on the course outline support the achievement of learning outcomes, and may be used throughout the course to varying degrees depending on the instructor's teaching methodology and the nature of the resource.

Technology requirements - <https://www.canadorecollege.ca/BYOD>

The Harris Learning Library's staff can help you find resources to support your learning - [www.eclibrary.ca](http://www.eclibrary.ca)

## LEARNING ACTIVITIES

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In Class instruction/discussion  
Instructor demonstration  
Individual hands-on practice  
In-class assignments

## DELIVERY MODE

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This course may be delivered, in whole or in part, in a number of modalities, including in class, online, hybrid, in a synchronous or asynchronous manner or a combination thereof, as per accreditation and/or regulatory

standards where appropriate.

## RECORDING GUIDELINES

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This class may be recorded by faculty of the College. Faculty will inform students when recording of the class commences and ceases. 'Recorded' means that the audio-visual and chat portions of the class will be recorded and then be stored on the College or vendor provider server. They will be made available to students, but only for the express and sole use of those registered in this course. If you have any questions or concerns about this recording, please contact your instructor or the College's privacy officer at [privacy.officer@canadorecollege.ca](mailto:privacy.officer@canadorecollege.ca). Full recording guidelines can be found at: <https://cdn.agilitycms.com/canadore-college/academic-centre-of-excellence/Canadore%20Recording%20Guidelines.pdf>

## ACADEMIC POLICIES

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Canadore College is committed to the highest standards of academic integrity, and expects students to adhere to these standards as part of the learning process in all environments. The College's Academic Integrity policy seeks to ensure that all students understand their rights and responsibilities in upholding academic integrity and that students receive an accurate and fair assessment of their work. Please review the Academic Integrity policy (A-18) and other academic policies found on our website: <https://www.canadorecollege.ca/about/policies>.

## COLLEGE POLICIES

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- Protecting human rights in support of a respectful college community

For college policies please see: <http://www.canadorecollege.ca/about-us/college-policies>.

## STUDENT SUCCESS SERVICES - Your Success Matters!

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Student Success Services provides student-focused services to facilitate students' success in their studies. Staff provide support by reducing and/or removing educational-related barriers through individualized accommodations and supports to students with disabilities.

Please visit our webpage to learn more: <https://www.canadorecollege.ca/support/student-success-services> or look for our events on social media.

To connect with Student Success Services email [studentsuccessnow@canadorecollege.ca](mailto:studentsuccessnow@canadorecollege.ca) or call 705.474.7600 ext 5205.

## FIRST PEOPLES' CENTRE:

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A culturally safe environment offering CONFIDENTIAL student focused services, drop in or make an appointment to access:

- One on one counselling
- Elder in residence program
- Peer tutoring
- Peer mentorship
- Lunch & learn workshops on study skills, self-care, life skills
- Learning Resource Centre

Drop by our offices at C254 College Drive, E101 Commerce Court or call 705 474 7600 Ext. 5961 College Drive / 5647 Commerce Court.

<https://www.canadorecollege.ca/experience/indigenous-student-experience>

### **WAIVER OF RESPONSIBILITY**

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Every attempt is made to ensure the accuracy of this information as of the date of publication. The college reserves the right to modify, change, add, or delete content.

### **HISTORICAL COURSE OUTLINES**

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Students use course outlines to support their learning. Students are responsible for retaining course outlines for future use in applications for transfer of credit to other educational institutions.