

MTH531: Foundation and Application of Analysis II

Credit Hours: 3

Contact Hours: This is a 3-credit course, offered in accelerated format. This means that 16 weeks of material is covered in 8 weeks. The exact number of hours per week that you can expect to spend on each course will vary based upon the weekly coursework, as well as your study style and preferences. You should plan to spend 14-20 hours per week in each course reading material, interacting on the discussion boards, writing papers, completing projects, and doing research.

Faculty Information



Faculty contact information and office hours can be found on the faculty profile page.

Course Description and Outcomes



Course Description:

This graduate-level course provides an overview of analysis principles and implications. The topics covered by this extended course range from higher order differential and integral calculus, to Fourier transforms, partial differential equations and analysis of complex variables. This course will also offer best practices for Dual Credit course instruction and discussions of standard pedagogy. Previous undergraduate coursework (at least 12 credits of undergraduate Calculus) is assumed. (3 credits total.)

Course Overview:

This course provides an overview of analysis principles and implications. The topics covered by this extended course range from higher order differential and integral calculus, to Fourier transforms, partial differential equations, and analysis of complex variables. This course will also offer best practices for Dual Credit course instruction and discussions of standard pedagogy.

Course Learning Outcomes:

1. Compute higher order derivatives and critical values, interpreting the answers and applications.
2. Evaluate higher dimensional integrals using various methods, interpreting the answers and applications.
3. Analyze and apply Fourier transforms to various functions.
4. Solve partial differential equations for theoretical and applications problems.
5. Interpret complex numbers and functions and apply them to derivatives.
6. Compute complex integrals, power series, and Taylor series and apply to analytic or functions with singularities.
7. Use Laurent series and residue integration to compute complex and real integrals
8. Reflect on implications for application of mathematical concepts in the classroom.

Participation & Attendance



Prompt and consistent attendance in your online courses is essential for your success at CSU-Global Campus. Failure to verify your attendance within the first 7 days of this course may result in your withdrawal. If for some reason you would like to drop a course, please contact your advisor.

Online classes have deadlines, assignments, and participation requirements just like on-campus classes. Budget your time carefully and keep an open line of communication with your instructor. If you are having technical problems, problems with your assignments, or other problems that are impeding your progress, let your instructor know as soon as possible.

Course Materials



Required:

Kreyszig, E. (2011). *Advanced Engineering Mathematics* (10th ed.). Hoboken, N.J.: John Wiley & Sons, Inc. ISBN 9780470458365

Suggested:

NOTE: All non-textbook required readings and materials necessary to complete assignments, discussions, and/or supplemental or required exercises are provided within the course itself. Please read through each course module carefully.

Course Schedule



Due Dates

The Academic Week at CSU-Global begins on Monday and ends the following Sunday.

- Discussion Boards: The original post must be completed by Thursday at 11:59 p.m. MT and Peer Responses posted by Sunday 11:59 p.m. MT. Late posts may not be awarded points.
- Critical Thinking: Assignments are due Sunday at 11:59 p.m. MT.
- Live Classroom: Although participation is not required, Live Classroom sessions are held during Weeks 3 and 6. There are two total sessions.

| Week # | Readings | Assignments |
|--------|--|--|
| 1 | <ul style="list-style-type: none"> Chapters 9.1-9.9 in <i>Advanced Engineering Mathematics</i> | <ul style="list-style-type: none"> Discussion (25 points) Critical Thinking (80 points) |
| 2 | <ul style="list-style-type: none"> Chapters 10.1-10.9 in <i>Advanced Engineering Mathematics</i> | <ul style="list-style-type: none"> Discussion (25 points) Critical Thinking (80 points) |
| 3 | <ul style="list-style-type: none"> Chapters 11.1-11.10 in <i>Advanced Engineering Mathematics</i> | <ul style="list-style-type: none"> Discussion (25 points) Portfolio Milestone (115 points) |
| 4 | <ul style="list-style-type: none"> Chapters 12.1-12.12 in <i>Advanced Engineering Mathematics</i> | <ul style="list-style-type: none"> Discussion (25 points) |
| 5 | <ul style="list-style-type: none"> Chapters 13.1-13.7 in <i>Advanced Engineering Mathematics</i> | <ul style="list-style-type: none"> Discussion (25 points) Critical Thinking (80 points) |
| 6 | <ul style="list-style-type: none"> Chapters 14.1-14.4 in <i>Advanced Engineering Mathematics</i> | <ul style="list-style-type: none"> Discussion (25 points) Critical Thinking (80 points) Portfolio Milestone (85 points) |
| 7 | <ul style="list-style-type: none"> Chapters 15.1-15.5 in <i>Advanced Engineering Mathematics</i> | <ul style="list-style-type: none"> Discussion (25 points) Critical Thinking (80 points) |
| 8 | <ul style="list-style-type: none"> Chapters 16.1-16.4 in <i>Advanced Engineering Mathematics</i> | <ul style="list-style-type: none"> Discussion (25 points) Portfolio Project (200 points) |

Assignment Details



This course includes the following assignments/projects:

Module 1

Critical Thinking (80 points)

Choose one of the following two assignments to complete this week. Do not complete both assignments. Identify your assignment choice in the title of your submission.

Note that while there are two options for the Critical Thinking assignment, there is only one rubric. Review the rubric to confirm you are meeting the assignment requirements.

Option #1: Lesson on the Dot Product

Answer these questions. Show all of your work for full credit.

- In your own words, prepare a comprehensive lesson plan explaining the dot product, its formulas, and applications. Provide examples and figures, too. The audience will be college-level students.
- Provide a sample in-class dot product quiz for your students along with brief solutions.
- What would be major student obstacles to understanding the material? How would you address that?
- Given the function $f(x,y) = (1/2)x^2 + (1/2)y^2$
 - Find a direction in which the function increases most rapidly at (1,1).

- (b) Find a direction in which the function encounters zero change at (1,1).

Show all of your work for full credit.

Review the **Module 1 Critical Thinking Rubric** for full details on how you will be graded on this assignment.

Option #2: Lesson on the Cross Product

Answer these questions. Show all of your work for full credit.

1. In your own words, prepare a comprehensive lesson plan explaining the cross product, its formulas, and its applications. Provide examples and figures, too. The audience will be college-level students.
2. Provide a sample in-class cross product quiz for your students along with brief solutions.
3. What would be major student obstacles to understanding the material? How would you address that?
4. Given the surface $x^2+y^2+z-9=0$
 - (a) Find a tangent plane to the surface at (1,2,4)
 - (b) Find the parametric equations to the normal line of the surface at the point (1,2,4).

Review the **Module 1 Critical Thinking Rubric** for full details on how you will be graded on this assignment.

Module 2

Critical Thinking (80 points)

Choose one of the following two assignments to complete this week. Do not complete both assignments. Identify your assignment choice in the title of your submission.

Note that while there are two options for the Critical Thinking assignment, there is only one rubric. Review the rubric to confirm you are meeting the assignment requirements.

Option #1: Mathematics Theorems #1

Answer these questions. Show all of your work for full credit.

1. Find the value of the double integral $\iint xy \, dA$ integrated over the region R . R is the region bounded by the line $y=(1/2)x$, $y=\sqrt{x}$, $x=2$ and $x=4$. Be sure to show all your work.
2. Use Green's theorem to find $\oint x^2y \, dx + x \, dy$ over a counterclockwise triangular path passing through the vertices (0,0), (1,0) and (1,2).
3. Find the area of the surface $x^2+y^2-z=0$ that is cut from above by the plane $z=4$.
4. In your own words, explain Stoke's theorem.

Review the **Module 2 Critical Thinking Rubric** for full details on how you will be graded on this assignment.

Option #2: Mathematics Theorems #2

Answer these questions. Show all of your work for full credit.

1. Find the value of the double integral $\iint (2x - y^2)dA$ integrated over the region R. R is the region bounded by the line $y = -x+1$, $y = x+1$, and $y = 3$. Be sure to show all your work.
2. A particle begins at (5,0) and travels along the upper semicircle $x^2+y^2=25$. Use Green's theorem to find the work done by a force $F(x, y) = xyi + (.5x^2 + yx)j$.
3. Find the surface area of that part of the cylinder $x^2+z^2=4$ that is above the rectangle $R = \{ (x, y) : 0 < y < 4, 0 < x < 1 \}$.
4. In your own words, explain the Divergence theorem.

Review the **Module 2 Critical Thinking Rubric** for full details on how you will be graded on this assignment.

Module 3

Critical Thinking

None

Portfolio Milestone: Topic Selection + Annotated Bibliography (115 points)

For the Module 3 Portfolio Milestone, you will need to select a topic for your Portfolio Project and submit an annotated bibliography that includes at least 10 - 12 sources. The sources must be peer-reviewed, credible, authored sources; anonymous websites or sites like Wikipedia are not acceptable as sources. Please refer to the following CSU Global Writing Center guide for writing annotated bibliographies.

https://csuglobal.libguides.com/writingcenter/writing_templates/annotated_bibliographies

Requirements:

- Your annotated bibliography should be 2-3 pages in length, not counting the required title page and references page.
- Ensure that you provide a summary, a paraphrase, and a direct quotation for each of your sources.
- Your bibliography must be formatted according to the CSU-Global Guide to Writing and APA Requirements.

Module 4

Critical Thinking

None

Module 5

Critical Thinking (80 points)

Choose one of the following two assignments to complete this week. Do not complete both assignments. Identify your assignment choice in the title of your submission.

Note that while there are two options for the Critical Thinking assignment, there is only one rubric. Review the rubric to confirm you are meeting the assignment requirements.

Option #1: Finding Roots #1

Answer these questions. Show all your work for full credit.

1. Find all 4 roots of the equation $z^4+1=0$.
2. Suppose that the domain of the function $f(z) = x^2+2i$ is the closed unit disk $D=\{z: |z|\leq 1\}$ on the plane. Describe the range of $f(z)$.
3. Show that the function $\text{Arg}(z)$ is not continuous on each point of the non-positive real axis.
4. Show that the function $f(z)=\text{Im}(z)$ is nowhere differentiable.

Review the **Module 5 Critical Thinking Rubric** for full details on how you will be graded on this assignment.

Option #2: Finding Roots #2

Answer these questions. Show all your work for full credit.

1. Find all 5 roots of the equation $z^5+1=0$.
2. Suppose that the domain of the function $f(z)=z^3$ is the closed semi-disk $D = \{z: |z|\leq 2, \text{Im}z \geq 0\}$ on the plane. Describe the range of $f(z)$.
3. Show that the function $\text{Arg}(z)$ is not continuous on each point of the non-positive real axis.
4. Show that the function $f(z) = \bar{z}$ is nowhere differentiable.

Review the **Module 5 Critical Thinking Rubric** for full details on how you will be graded on this assignment.

Module 6

Critical Thinking (80 points)

Choose one of the following two assignments to complete this week. Do not complete both assignments. Identify your assignment choice in the title of your submission.

Note that while there are two options for the Critical Thinking assignment, there is only one rubric. Review the rubric to confirm you are meeting the assignment requirements.

Option #1: Complex Integration #1

Answer these questions. Show all your work for full credit.

1. Suppose n is any integer. Compute $\int (z - z_0)^n dz$ over the counterclockwise circle with radius r centered at z_0 .
2. Compute $\int \sin z dz$ over the counterclockwise circle (traversed once) with radius 7 centered at $z_0 = 2+3i$.
3. If C is the circle (traversed once counterclockwise) of radius 2 with center at $z = 0$, calculate $\int_C \frac{7e^z}{z^2-9} dz$.
4. Explain why the annulus $\{z: 1 < |z| < 2\}$ is not simply connected.
5. Let C be the circle of radius 2 centered at $z=0$. Compute the following integral over C : $\int \frac{ze^z}{2z-3} dz$

Review the **Module 6 Critical Thinking Rubric** for full details on how you will be graded on this assignment.

Option #2: Complex Integration #2

Answer these questions. Show all your work for full credit.

1. Compute the integral $\int \bar{z}^2 dz$ along the counterclockwise triangle with vertices (0,0), (0,2), and (2,2).
2. Compute $\int \cos z dz$ over the counterclockwise circle (traversed once) with radius 5 centered at $z_0 = 4 - 8i$.
3. If C is the circle (traversed once counterclockwise) of radius 1 with center at $z = 1$, calculate $\int_C \frac{1-z}{1+z} dz$.
4. Explain why the exterior of the circle $x^2 + y^2 = 4$ is not simply connected.
5. Let C be the circle of radius 2 centered at $z = 0$. Compute the following integral over C : $\int \frac{\sin(3z)}{z - \frac{\pi}{2}} dz$

Review the **Module 6 Critical Thinking Rubric** for full details on how you will be graded on this assignment.

Portfolio Milestone: Annotate Online (85 points)

For the Module 6 Portfolio Milestone, you will submit an Annotated Outline in which you include the complete citations of the sources that you plan to use in your final Portfolio Project. These citations then form your annotations.

Model your Annotated Outline after the references in APA formatting at this link:

https://owl.purdue.edu/owl/general_writing/common_writing_assignments/annotated_bibliographies/annotated_bibliography_samples.html

Requirements:

- Your Annotated Outline should be 5 pages in length, not counting the required title page and references page.
- Your outline must be formatted according to the [CSU-Global Guide to Writing and APA Requirements](#).

Module 7

Critical Thinking (80 points)

Option 1

Now that you have studied seven weeks of complex analysis, do some research on the history of the field. Who are the key people involved in its development? Describe what you consider to be five historical turning points in the field of Complex Analysis. Next, give an appraisal of the research done in complex analysis within the last 50 years. Formulate a list of five research questions that still need to be answered in this field.

Requirements:

1. Your written paper should be 4-6 pages in length, not counting the title and reference pages, which you must include.
2. You need to cite 4 – 6 sources. The CSU-Global Library is a great place to find resources.

3. You should have an introduction, which will tell the reader what your paper is about. You should have a conclusion paragraph, which will summarize your paper.
4. Your paper must be formatted according to CSU-Global Guide to Writing and APA Requirements.
5. If you need assistance with your writing style, start with the links under the Research Help and Writing Help tabs on the CSU-Global Library's homepage.

Option 2

Write an essay that rebuts each of these statements:

- Complex Analysis has no real world applications.
- Integrals work the same way in complex analysis as in real analysis.
- Complex Analysis was developed single handily by Augustin-Louis Cauchy.

Requirements:

1. Your written paper should be 4-6 pages in length, not counting the title and reference pages, which you must include.
2. You need to cite 4 – 6 sources. The CSU-Global Library is a great place to find resources.
3. You should have an introduction, which will tell the reader what your paper is about. You should have a conclusion paragraph, which will summarize your paper.
4. Your paper must be formatted according to CSU-Global Guide to Writing and APA Requirements.
5. If you need assistance with your writing style, start with the links under the Research Help and Writing Help tabs on the CSU-Global Library's homepage.

Module 8

Portfolio Project (200 points)

Option 1

Research a topic from this course and summarize recent advances in that area. Discuss at least one application of this research. What are some of the open questions that researchers are working on?

Requirements:

- Your final paper must be 10-12 pages in length, not including the required cover page and references page.
- Use a minimum of 10-12 sources. They must be peer-reviewed, credible, authored sources; anonymous websites or sites like Wikipedia are not acceptable as sources. The [CSU-Global Library](#) is a great place to find peer-reviewed resources.
- Follow the [CSU-Global Guide to Writing and APA Requirements](#). Your paper should include an introduction, a body with at least two fully developed paragraphs, and a conclusion.
- Your final paper will be graded not only on content, but also on the quality of your writing, syntax, and grammar. Be sure to pay special attention to the quality of your written work. It is highly recommended that you closely proofread your assignment prior to submission. In addition, you are again expected to provide support for your arguments based on both the required and recommended readings for the course and on your research, and you should incorporate any relevant points culled from the discussion boards. Review the Portfolio Project Rubric below. If you need assistance with your writing style, start with [Tools for Effective Writing at the CSU-Global Library](#), accessible from the Library's homepage.

Prior to your final submission in Module 8, you will submit your topic choice and annotated bibliography in Module 3, and an annotated outline in Module 6.

Option 2

Relate a concept from this course to a topic taught at the high-school or undergraduate level. Discuss the significance of these connections based on current research.

Requirements:

- Your final paper must be 10-12 pages in length, not including the required cover page and references page.
- Use a minimum of 10-12 sources. They must be peer-reviewed, credible, authored sources; anonymous websites or sites like Wikipedia are not acceptable as sources. The [CSU-Global Library](#) is a great place to find peer-reviewed resources.
- Follow the [CSU-Global Guide to Writing and APA Requirements](#). Your paper should include an introduction, a body with at least two fully developed paragraphs, and a conclusion.
- Your final paper will be graded not only on content, but also on the quality of your writing, syntax, and grammar. Be sure to pay special attention to the quality of your written work. It is highly recommended that you closely proofread your assignment prior to submission. In addition, you are again expected to provide support for your arguments based on both the required and recommended readings for the course and on your research, and you should incorporate any relevant points culled from the discussion boards. Review the Portfolio Project Rubric below. If you need assistance with your writing style, start with [Tools for Effective Writing at the CSU-Global Library](#), accessible from the Library's homepage.

Prior to your final submission in Module 8, you will submit your topic choice and annotated bibliography in Module 3, and an annotated outline in Module 6.

Course Policies



Course Grading

20% Discussion Participation
0% Opening Exercises
40% Critical Thinking Assignments
20% Portfolio Milestones
20% Final Portfolio Project

Grading Scale and Policies

| | |
|----|---------------|
| A | 95.0 – 100 |
| A- | 90.0 – 94.9 |
| B+ | 86.7 – 89.9 |
| B | 83.3 – 86.6 |
| B- | 80.0 – 83.2 |
| C+ | 75.0 – 79.9 |
| C | 70.0 – 74.9 |
| D | 60.0 – 69.9 |
| F | 59.9 or below |

In-Classroom Policies

For information on late work and incomplete grade policies, please refer to our [In-Classroom Student Policies and Guidelines](#) or the Academic Catalog for comprehensive documentation of CSU-Global institutional policies.

Academic Integrity

Students must assume responsibility for maintaining honesty in all work submitted for credit and in any other work designated by the instructor of the course. Academic dishonesty includes cheating, fabrication, facilitating academic dishonesty, plagiarism, reusing /re-purposing your own work (see *CSU-Global Guide to Writing and APA Requirements* for percentage of repurposed work that can be used in an assignment), unauthorized possession of academic materials, and unauthorized collaboration. The CSU-Global Library provides information on how students can avoid plagiarism by understanding what it is and how to use the Library and Internet resources.

Citing Sources with APA Style

All students are expected to follow the *CSU-Global Guide to Writing and APA Requirements* when citing in APA (based on the APA Style Manual, 6th edition) for all assignments. For details on CSU-Global APA style, please review the APA resources within the CSU-Global Library under the “APA Guide & Resources” link. A link to this document should also be provided within most assignment descriptions on your course’s Assignments page.

Disability Services Statement

CSU–Global is committed to providing reasonable accommodations for all persons with disabilities. Any student with a documented disability requesting academic accommodations should contact the Disability Resource Coordinator at 720-279-0650 and/or email ada@CSUGlobal.edu for additional information to coordinate reasonable accommodations for students with documented disabilities.

Netiquette

Respect the diversity of opinions among the instructor and classmates and engage with them in a courteous, respectful, and professional manner. All posts and classroom communication must be conducted in accordance with the student code of conduct. Think before you push the Send button. Did you say just what you meant? How will the person on the other end read the words?

Maintain an environment free of harassment, stalking, threats, abuse, insults or humiliation toward the instructor and classmates. This includes, but is not limited to, demeaning written or oral comments of an ethnic, religious, age, disability, sexist (or sexual orientation), or racist nature; and the unwanted sexual advances or intimidations by email, or on discussion boards and other postings within or connected to the online classroom.

If you have concerns about something that has been said, please let your instructor know.