



King Fahd University of Petroleum & Minerals  
Department of Mathematics  
Introduction to Complex Variables  
MATH 445 – TERM 241

## Instructor Info

- Dr. Adel Khalfallah
- Office Hrs: UTR 8-9 AM
- Building 5, Room 201-5
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## Course Info

- Prereq: Math 201
- UTR
- 10 AM-10.50 AM
- Building 6, Room 101

### Course Description

Complex numbers, Analytic functions, Harmonic functions and Harmonic conjugates, Cauchy's theorem and Cauchy integral formulas, Power series, Laurent series, Isolated singularities, Residues, Applications of the residue theorem to real integrals, Conformal transformations

### Textbook

E.B. Saff, A.D. Snider, Fundamentals of Complex Analysis (3rd ed.)

### Course Learning Outcomes

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

- Explain the geometry of the complex plane
- State the main properties and examples of analytic functions.
- Evaluate line integrals using parameterization
- Compute the Taylor and Laurent expansions of standard functions.
- Determine the nature of singularities and calculate residues.
- Use Residue Theorem to evaluate integrals and series.
- State main properties of conformal mappings.

### Grading Scheme

40%	<b>2 Major Exams, 20% each</b>
15%	<b>Homework</b>
10%	<b>Project-Presentation</b>
35%	<b>Final Exam</b>

Final grade is according to the scale:

A+ = 90 - 100; A = 80 - 90; B+ = 75 - 80; B = 70 - 75, C+ = 65 - 70, C = 55-65, D+ = 50 - 55, D = 45 - 50; F < 45.

### Attendance

1. Students must adhere to the attendance policy of KFUPM.
2. A DN grade will be given to any student who accumulates 9 unexcused absences or 15 unexcused and excused absences.
3. A DN grade will be given to the eligible student after being warned twice.

### Academic Integrity

All KFUPM ethics policies apply in this course

### Graduate Attributes

<https://math.kfupm.edu.sa/bsinmathematics/graduate-attributes>

## Course Schedule

Week	Topic	HomeWork
<b>Week 1</b>	1.1 The algebra of complex numbers	1.1: 11, 15, 20, 22
Aug. 25- 29	1.2 Point Representation of Complex Numbers	1.2: 1, 5, 7(abdi)
	1.3 Vectors and Polar Forms	1.3: 7, 13, 25,
<b>Week 2</b>	1.4 The Complex Exponential	1.4 : 4(ab), 11, 12b, 20
Sept. 1-5	1.5 Powers and Roots	1.5 : 4b, 6c, 7c, 11
<b>Week 3</b>	1.6 Planar Sets	1.6 : 2-6, 11, 15, 16, 19
Sept. 08 - 12	1.7 The Riemann Sphere	1.7 : 1(bc), 2a, 5(ae)
<b>Week 4</b>	2.1 Functions of a Complex Variable	2.1 : 4, 5, 12, 15
Sept. 15-19	2.2 Limits and Continuity	2.2 : 1, 3, 4, 5, 11, 12, 25
<b>Sept. 22- Sept. 23: National Day Holidays</b>		
<b>Week 5</b>	2.3 Analyticity	2.3 : 4a, 10, 11, 16
Sept. 24-26	2.4 The Cauchy-Riemann Equations	2.4 : 2, 5, 6, 12
	2.5 Harmonic Functions	2.5 : 2, 3, 4
<b>Week 6</b>	3.2 Exp. & Trig. Functions.	3.2 : 9(acd), 11, 17, 19, 21
Sept. 29- Oct. 03	3.3 The Logarithmic Function	3.3 : 3, 4, 6, 7, 11, 15, 19
<b>(WEEK 6) Major Exam I; Material:1.1-2.5</b>		
<b>Week 7</b>	3.5 Power and Inverse Trig. Functions	3.5 : 1(ae), 3(ab), 5, 8, 12, 15(ab), 16, 17
Oct. 06-10	4.1 Contours	4.1 : 1, 3, 8, 13(abd)
	4.2 Contour Integrals	4.2 : 3, 7, 11, 14ac
<b>Week 8</b>	4.3 Independence of Path	4.3 : 2, 4, 5, 7, 12
Oct. 13-17	4.4 Cauchy's Integral Theorem	4.4 : 9, 10(cd), 13, 16,17,18,19
<b>Week 9</b>	4.5 Cauchy Formula & Consequences	4.5 : 2, 3(ace), 4, 8, 9, 10, 15, 16
Oct. 20-24	4.6 Bounds for Higher Derivatives s	4.6 : 2, 3, 4, 7, 8, 10, 14, 16
<b>Week 10</b>	5.1 Sequences and Series	5.1 : 1(cdf), 5, 9, 11(bcd), 12
Oct. 27-31	5.2 Taylor Series	5.2 : 1, 4, 5, 11, 13, 20
<b>Week 11</b>	5.3 Power Series	5.3 : 1, 3(adfg), 6, 9, 10, 12, 15, 19
Nov. 03-07	5.5 Laurent Series	5.5 : 1, 2, 5, 13

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(WEEK 11) Major Exam II; Material: 3.2 -5.3

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Nov. 10- Nov. 14: Midterm Break

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<b>Week 12</b>	5.6 Zeros and Singularities	5.6 : 1, 5, 6, 14
Nov. 17-21	5.7 The Point at Infinity	5.7: 1, 5, 6, 7
	6.1 The Residue Theorem	6.1 : 1, 2, 3, 7
<b>Week 13</b>	6.2 Trig. integrals	6.2 : 1, 5, 10
Nov. 24 -28	6.3 Improper Integrals over $\mathbb{R}$	6.3 : 1, 6
	6.4 Improper integrals involving trig. functions	6.4 : 3, 4, 9
<b>Week 14</b>	6.5 Indented contours	6.5 : 2, 5, 6, 12
Dec. 01-05	6.7 Rouché's Theorem	6.7 : 1, 2, 4, 8, 9, 12, 20
<b>Week 15</b>	7.3 Möbius Transformations	7.3 : 1, 3, 4, 5
Dec. 08-12		
<b>Week 16</b>	Review	
Dec. 15-16		

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Final Exam ; Material: Comprehensive

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