Information Technology University
Department of Electrical Engineering

MT240: Complex Variables and Transforms			
Course Code	MT240	**Semester**	4th
Credit Hours	3	**Term**	Spring 2018
Instructor	Usama Bin Sikandar	**Pre-reqs**	Calculus and Analytic Geometry
Office	Room 9, 4th floor	**E-mail**	usama.sikandar@itu.edu.pk
Department	Electrical Engineering	**Discipline**	Mathematics
Teaching Assistants	Muhammad Abdullah	**Office Hours**	Monday 12 - 1:30 pm

Course Description

The course focuses on the basic geometry, algebra and calculus of complex variables and complex functions, for their applications in evaluating and analyzing Fourier and Laplace transforms.

Course Outcomes/Objectives

By the end of the course, the students must be able to

- Demonstrate a strong understanding of why complex numbers are important
- Visualize the arithmetics of complex numbers in Cartesian and polar forms
- Determine whether a complex function is analytic
- Calculate the map of a complex analytic function
- Calculate the derivative of an analytic function
- Analyze the convergence of complex Taylor and Laurent series
- Calculate complex integrals including treatment of residues
- Evaluate integrals related to Fourier and Laplace transforms for standard functions

Books

Text Books:	1. *Complex Variables and Applications* (8th ed) by J. W. Brown and R. V. Churchill 2. *Fourier and Laplace Transforms* by R. J. Beerends, H. G. ter Morsche, J. C. van den Berg and E. M. van de Vrie. Cambridge University Press (2003)
Reference Books:	3. *Advanced Engineering Methods* (10^{th} edition) by E. Kreyszig, H. Kreyszig and E. Norminton. 4. *Fundamentals of Complex Analysis with Applications to Engineering and Science*, by E. B. Saff and A. D. Snider.

Course Assessment Distribution:

Quizzes:	15 % (14 recitation worksheets, 5 quizzes)
Assignments:	20 % (7 homework assignments)
Midterm Exam:	25 %
Final Exam:	40 %

Weekly Lecture Breakdown			
Week 1:	Complex Plane	Week 10:	Fourier Series
Week 2:	Complex Arithmetics	Week 11:	Fourier Series Properties
Week 3:	Complex Functions	Week 12:	Fourier Transform
Week 4:	Cauchy-Riemann Equations	Week 13:	Fourier Transform Properties
Week 5:	Mobius Transformation	Week 14:	Convolution
Week 6:	Cauchy's Integral Theorem	Week 15:	Laplace Transform
Week 7:	Power Series and Laurent Series	Week 16:	Laplace Transform Properties
Week 8:	Residue Integration	Week 17:	Prep week
Week 9:	**Midterm exam**	Week 18:	**Final exam**

Chapter	Topics	Lectures
Churchill Ch 1 *Notes on Classroom	**Complex Variable** ● Fundamental theorem of algebra* ● Mathematical Convenience ● Applications ● Complex plane ● Cartesian and polar forms ● Conjugate root theorem* ● Complex arithmetics ● nth roots of a complex number ● Planar sets and regions in complex plane ● Open, closed, connected, bounded sets	4
Churchill Ch 2, 3, 9	**Complex Functions** ● Domain, co-domain and range in the complex plane ● Mapping from *x*-*y* plane to *u*-*v* plane ● Limits and continuity ● Complex exponential and trigonometric functions ● Polynomials and zeros ● Derivative and analyticity ● Cauchy-Riemann equations ● Harmonic functions ● Conformal mapping ● Mobius transformation	5
Churchill Ch 4	**Complex Integration** ● Paths and contours ● Path parameterization ● Contour integration ● Cauchy's integral theorem ● Cauchy's integral formulas	3
Churchill Ch 5, 6	**Residue Theory** ● Power and Taylor series ● Radius of convergence ● Convergence tests ● Laurent series ● Residues	4

	• Cauchy's residue theorem • Residue integration	
Mid Term Exam		
Beerends Ch 3, 4	**Fourier Series** • Complex Fourier series • Frequency domain spectrum • Fundamental theorem of Fourier series • Properties of Fourier Series • Parseval's identity	4
Beerends Ch 6, 7	**Fourier Transform** • Fourier series to Fourier transform • Frequency domain spectrum • Fundamental theorem of Fourier transform • Inverse Fourier transform • Properties of Fourier Transform • Parseval's theorem • Convolution	6
Beerends Ch 12, 13	**Laplace Transform** • s-domain • Region of convergence • Initial and final value theorems • Properties of Laplace transform	4
Final Exam		

Course Learning Objectives (CLOs):

CLO	Description	BT	PLOs
1	Determine whether a complex function is analytic	C1, 4	1
2	Calculate the mapping through a complex analytic function	C2, 3	1, 4
3	Analyze the convergence of complex Taylor and Laurent series	C4, 5	1, 2, 4
4	Evaluate the integrals related to Fourier and Laplace transforms for standard functions	C2, 3	1, 3, 5

Mapping of CLOs to Assessment Modules:

Assessments	CLO1	CLO2	CLO3	CLO4
Quizzes	✓	✓	✓	✓
Assignments	✓	✓	✓	✓
MidTerm	✓	✓	✓	
Final Exam	✓	✓	✓	✓

Mapping of CLOs to Program Learning Outcomes (PLOs):				
PLOs/CLOS	**CLO1**	**CLO2**	**CLO3**	**CLO4**
PLO 1 (Engineering Knowledge)	✓	✓	✓	✓
PLO 2 (Problem Analysis)			✓	
PLO 3 (Development of Solutions)				✓
PLO 4 (Investigation)		✓	✓	
PLO 5 (Modern tool usage)				✓
PLO 6 (The Engineer and Society)				
PLO 7 (Environment and Sustainability)				
PLO 8 (Ethics)				
PLO 9 (Individual and Team Work)				
PLO 10 (Communication)				
PLO 11 (Project Management)				
PLO 12 (Lifelong Learning)				

Grading Policy:	
Quiz Policy:	There will be 4 or 5 quizzes in this course. Quizzes will be unannounced but will take place in a recitation right after the submission of a homework assignment and will be totally based on the problems in that assignment. So to score well in quizzes, students must spend sufficient time solving the problems individually. Grading for quizzes will generally be on a scale of 0 to 10. All quizzes will count toward the total.
Assignment Policy:	In order to develop comprehensive understanding of the subject and push the students out of their comfort zone in the subject, **challenging problems** will be assigned as homework. The students must do the **homework individually**. Copying of homework or any kind of plagiarism is highly discouraged and violations will be dealt with severely by referring any occurrences to the disciplinary committee and a **straight-away zero**. Homework submitted **late by one day will be penalized by 20%**, but after that **nothing will be accepted**. **All homework assignments will count towards the total** (no 'best-of' policy). The problems in the assignment are meant to be challenging to raise the students' caliber in the subject, give them confidence and enable them to prepare not just the exams but the real world scenarios.
Plagiarism:	The course has a **zero tolerance policy towards plagiarism.** While collaboration in this course is highly encouraged, you must ensure that you do not claim other people's work/ ideas as your own. Plagiarism occurs when the words, ideas, assertions, theories, figures, images, programming codes of others are presented as your own work. You must cite and acknowledge all sources of information in your assignments. Failing to comply with the plagiarism policy will lead to strict penalties including a **failing grade** in the course and referral to the **Disciplinary Committee** for a strict action, which may possibly lead to **failing grades in all the courses** of the semester.
Grading	Absolute grading

Grades	A+	A	A-	B+	B	B-	C+	C	C-	D+	D	F
Cutoffs	>85	>75	>70	>65	>60	>55	>50	>45	>40	>35	>30	<30