25UMGT301	FOURIER TRANSFORMS AND COMPLEX ANALYSIS	Category	L	T	P	R	Credit	Year of Introduction
		BSC	3	0	0	0	3	2025

Preamble: This course introduces basic ideas of Fourier transforms which are widely used in the modelling and analysis of a wide range of physical phenomena and has got application across all branches of engineering. To understand the basic theory of functions of a complex variable, residue integration and conformal transformation.

Prerequisite: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO	Course Outcomes	Knowledge Level
CO1	Determine the Fourier transforms of functions and apply them to solve problems arising in engineering.	K3 Apply
CO2	Explain the analyticity of complex functions and apply it in Conformal mapping.	K3 Apply
CO3	Compute complex integrals using Cauchy's integral theorem and Cauchy's integral formula.	K3 Apply
CO4	Explain the series expansion of complex function about a singularity and apply residue theorem to compute real integrals.	K3 Apply

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**
CO2	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**
CO3	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**
CO4	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**
Avg	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	*	*	*	*	*			*	
CO2	*	*	*	*	*			*	
CO3	*	*	*	*	*			*	
CO4	*	*	*	*	*			*	

WKs Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	*			*	

Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	2.5 hrs

Continuous Internal Evaluation Pattern:

Attendance : 5 marks
Continuous Assessment Test : 20 marks
Continuous Assessment Assignment : 15 marks

SYLLABUS

Module 1 (10hrs)

Fourier integral, From Fourier series to Fourier integral, Fourier cosine and Sine integrals, Fourier Cosine and Sine Transform, Linearity, Transforms of Derivatives, Fourier Transform and its inverse, Linearity, Transforms of Derivative.
(Text1: Relevant topics from sections11.7, 11.8, 11.9)

Module 2 (10hrs)

Complex Function, Limit, Continuity, Derivative, Analytic functions, Cauchy-Riemann Equations (without proof), Laplace's Equations, Harmonic functions, Finding harmonic conjugate, Conformal mapping, Mappings of w=$z2$, $w=ez$, w=$\frac{1}{Z}$, $w=sinz$.

(Text1: Relevant topics from sections 13.3, 13.4, 17.1, 17.2, 17.4)

Module 3 (11hrs)

Complex Integration: Line integrals in the complex plane (Definition & Basic properties), First evaluation method, Second evaluation method, Cauchy's integral theorem (without proof) on simply connected domain, Independence of path, Cauchy integral theorem on multiply connected domain (without proof), Cauchy Integral formula (without proof).

(Text1: Relevant topics from sections14.1, 14.2, 14.3)

Module 4 (11hrs)

Taylor series and Maclaurin series, Laurent series (without proof), Singularities and Zeros – Isolated Singularity, Poles, Essential Singularities, Removable singularities, Zeros of Analytic functions – Poles and Zeros, Formulas for Residues, Residue theorem (without proof), Residue Integration- Integral of Rational Functions of cosθ and sinθ.

(Text1: Relevant topics from sections 15.4, 16.1, 16.2, 16.3, 16.4)

Textbook

1.Kreyszig, E. (2016). Advanced engineering mathematics (10th ed.). John Wiley & Sons.

Reference Books

1. Zill, D. G., & Shanahan, P. D. (2015). Complex analysis: A first course with applications (3rd ed.). Jones & Bartlett Learning.

2. Ramana, B. V. (2023). Higher engineering mathematics (39th ed.). McGraw-Hill Education.

3. Grewal, B. S. (2018). Higher engineering mathematics (44th ed.). Khanna Publishers.

SEMESTER EXAMINATION - MODEL QUESTION PAPER

(STC 2025 SCHEME)

Course Code	**25UMBT301**
Course Name	**FOURIER TRANSFORMS AND COMPLEX ANALYSIS**

Max. Marks: 60	Duration: 2.5 Hours

Part A *(Answer all questions. Each question carries 3 marks)*				
Qn No.	**Question**	**Marks**	**CO**	**BL**
1	Find the Fourier cosine integral of f(x)=$\begin{cases} 1, if \vee x \vee ¿ 1 \\ 0, otherwise \end{cases}$	3	1	L2
2	Find the Fourier transform of f(x)=$\begin{cases} x, if \lvert x \rvert < 1 \\ 0, otherwise \end{cases}$	3	1	L2
3	Show that the function f(z)= $\frac{\bar{z}}{z}$ does not have a limit as z=0	3	2	L3
4	Check whether the function u(x ,y) = $x\,y^2$ is the real art of an analytic function.	3	2	L3
5	Evaluate $\int_c \lvert z \rvert dz$ where c is the line segment joining -i and i	3	3	L3
6	Evaluate $\int_c \frac{z^2}{z^2-1} dz$ where c is the unit circle	3	3	L3
7	Find the Taylor series expansion of f(z)= sin z about z= $\frac{\pi}{4}$	3	4	L2
8	Find pole and residue of $\tan z$	3	4	L2
Part B (*Answer any one full question from each Module. Each carries 9 marks*)				
Module 1				
Qn No.	Question	Marks	CO	BL
7(a)	Find the Fourier cosine integral of the function f(x)= e^{-ax},x>0 and hence show that $\int_0^\infty \frac{cos\omega x}{1+\omega^2} d\omega = \frac{\pi}{2}$	5	1	L3
(b)	Find the Fourier sine transform of the function	4	1	L2

	f(x)= $\begin{cases} 1, 0<x<1 \\ -1, 1<x<2 \\ 0, x>2 \end{cases}$			
	OR			
8(a)	Find the Fourier transform of f(x)= $e^{-\alpha \vee x \vee ¿, \alpha>0 ¿}$	5	1	L3
(b)	Find the Fourier sine integral of f(x)= $\begin{cases} \sin x, 0 \le x \le \pi \\ 0, x>\pi \end{cases}$	4	1	L2
	MODULE-2			
9(a)	Show that f(z)= $\sin z$ is differentiable everywhere. and find its derivative	5	2	L2
(b)	Show that u= y^2-3x^2y is harmonic. and hence find the analytic function and harmonic conjugate	4	2	L3
	OR			
10(a)	Find the analytic function whose imaginary part is $\frac{x-y}{x^2+y^2}$	5	2	L2
(b)	Find the image of the infinite strip $\frac{1}{4}<y<\frac{1}{2}$	4	2	L3
	MODULE-3			
11(a)	Solve f(z)= x^2+ixy from A(1,1) to B(2,4) along the curve x=t and y=t	5	3	L3
(b)	Solve $\int_c \frac{z+4}{z^2+2z+5} dz$ where c is |z+1-i| = 2	4	3	L3
	OR			
12(a)	Solve $\int_c \frac{e^z}{z^2+4} dz$ where c is |z- i|= 2	5	3	L3
(b)	Solve $\int_c \Re(z)\, dz$ where c is a straight line from 0 to (1+2i)	4	3	L3
	MODULE-4			
13(a)	Expand f(z)= $\frac{z+1}{z-1}$ as a Taylor series about z= -1	5	4	L3

(b)	Find poles and residue of f(z)= $\frac{z e^{2iz}}{z^2+9}$	4	4	L2
	OR			
14(a)	Solve $\int_c \frac{\sin\pi z^2+\cos\pi z^2}{(z-1)(z-2)} dz$ where c is |z|=3	5	4	L3
(b)	Expand f(z)= $\frac{1}{z^2}$ as Taylor series about z= 2	4	4	L2