

## A. Course Handout (Student & Faculty)

Institute/School/College Name	Chitkara University Institute of Engineering & Technology		
Department/Centre Name	Department of Applied Sciences		
Programme Name	Bachelor of Engineering (B.E.), Computer Science & Engineering		
Course Name	Differential Equations and Transformation	Session	2022 - 2023
Course Code	22AS002	Semester/Batch	2 <sup>nd</sup> /2022
Lecture/Tutorial (Per Week)	6-0-0	Course Credit	4
Course Coordinator Name	Dr. Krishan Dutt Sharma		

### 1. Scope & Objective of the Course:

- To provide the ability to apply mathematics for the solution of complex engineering and real life problems.
- To Identify, formulate and analyze the engineering problems.
- To arrive at substantiated conclusions using principles of mathematics are covered.

### The main objectives of the courses are:

- To introduce and develop the Fourier series, half range sine and cosine series on arbitrary intervals for different problems.
- To find solution of second and higher order ordinary linear differential equations along with its applications in RLC circuits.
- To understand the requirement of Laplace transform, Inverse Laplace transform, properties and its application for the solution of differential equations.
- To be familiar with formation of partial differential equations and their solutions.
- To solve the Laplace, heat and wave equations for a variety of boundary conditions in domains of simple geometry and with simple boundary conditions; the techniques available will include separation of variables, Laplace and Fourier Transform methods.
- To determine continuity/differentiability/analyticity of a complex function; understand complex

### 2. Course Learning Outcome:

	Course Outcome	POs	CL	KC	Sessions
<b>CLO01</b>	Students will be able to analyze and correlate many real life problems mathematically and find the appropriate solutions for them using Fourier series and Transforms (Fourier and Laplace transform).	PO1,PO2,PO3,PO4,PO12	K2	Factual Conceptual	<b>3</b>
<b>CLO02</b>	Students will be able to solve various problems arising in physical phenomenon involving rate of change of variables and various processes in Science and Engineering governed by ordinary differential equations.	PO1,PO2,PO4,PO10,PO12	K3	Conceptual Procedural	<b>8</b>
<b>CLO03</b>	Students will be able to recognize and find families of solutions for most physical processes such as heat transfer, elasticity, quantum mechanics, water flow and other practical problems in Science and Engineering, which are governed by ordinary and partial differential equations.	PO1,PO3,PO4,PO5, PO10,PO12	K3	Conceptual Procedural	<b>10</b>



<b>CLO04</b>	Student will be able to analyze functions of complex variables, evaluate complex integrals and compute integrals over complex domains.	PO1,PO2,PO3,PO12	K3	Factual Conceptual	<b>3</b>
<b>Total Sessions</b>					<b>24</b>

CO ↓	PO →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		H	H	M									H
CO2		H	H		M						L		M
CO3		H		H	H	M					M		L
CO4		H	H		H								M

### 3. ERISE Grid Mapping

Feature Enablement	Level(1-5, 5 being highest)
Entrepreneurship	3
Research	4
Innovation	3
Skills	5
Employability	4

### 4. Recommended Books (Reference Books/Text Books):

- B01: Advanced Engineering Mathematics, R.K. Jain and S.R.K. Iyengar, Alpha Science International Ltd., 2014.
- B02: The Engineering Mathematics, 2nd Edition, Chitkara University Publication, Vol. II. 2013.
- B03: A text book of Engineering Mathematics, N. P. Bali and Manish Goyal, Laxmi Publications, 2010.
- B04: Advanced Engineering Mathematics, Erwin Kreyszig, 10<sup>th</sup> ed., Wiley India Pvt. Ltd. 2011.
- B05: Engineering Mathematics, Srimanta Pal & Subodh C. Bhunia, Edition 2015, Oxford University Press, 2015.
- B06: Calculus, by Howard Anton, Irl Bivens Stephens Davis.

### 5. Other readings & relevant websites:

S.No.	Link of Journals, Magazines, websites and Research Papers:	LectureNo.
Link 1	<a href="https://www.math.psu.edu/tseng/class/Math251/Notes-PDE%20pt2.pdf">https://www.math.psu.edu/tseng/class/Math251/Notes-PDE%20pt2.pdf</a>	1
Link 2	<a href="http://www.thefouriertransform.com/ppt">http://www.thefouriertransform.com/ppt</a>	5
Link 3	<a href="https://www.math.psu.edu/tseng/class/Math251/Notes-LT1.pdf">https://www.math.psu.edu/tseng/class/Math251/Notes-LT1.pdf</a>	16
Link 4	<a href="http://www.robots.ox.ac.uk/~jmb/lectures/pdelecture1.pdf">http://www.robots.ox.ac.uk/~jmb/lectures/pdelecture1.pdf</a>	20
Link 5	<a href="https://home.iitm.ac.in/jaikrishnan/teaching/MA5360/files/2--functions-complex-">https://home.iitm.ac.in/jaikrishnan/teaching/MA5360/files/2--functions-complex-</a>	24

## 6. Course Plan:

### a. Lecture Plan

Session No.	Topics	Recommended Book
1	<b>Fourier Series:</b> Introduction,	B01
2	Fourier Series on Arbitrary Intervals	B01
3	Half-range cosine and sine series	B01
4	<b>Ordinary Differential Equations:</b> Exact differential equations, Reducible to Exact differential equations.	B02
<b>FA1 (17<sup>th</sup> April, 2022)</b>		
5	Equation solvable for p, y and x, Clairaut's equation	B02
6	Applications to orthogonal trajectories.	B02
7	<b>Second and higher order ordinary linear differential equations with constant coefficients:</b> Complimentary function	B03
8	Particular integrals (standard types), Differential Operator Method	B03
9	Variation of parameters, Method of Undetermined Coefficients.	B05
10	Cauchy-Euler differential equation, Simultaneous linear differential equations (two variables) with constant coefficients.	B04
11	Application to RLC circuit	B05
<b>ST-I (29<sup>th</sup> April, 2023)</b>		
12	<b>Laplace Transform,</b> Linearity and Shifting Property	B02
13	Inverse transforms properties,	B02
14	Transforms of derivatives and integrals,	B02
15	Unit step function, Dirac's delta function	B02
16	Applications to differential equations.	B02
17	<b>Partial Differential equations:</b> Equation of first order, Lagrange's Linear equation.	B03
18	Standard types of first order non-linear partial differential equations	B03
19	Solutions of second order linear partial differential equations in two variables with constant coefficients by finding complementary function and particular integral	B03
20	Classification of PDE of second order – parabolic, elliptic and hyperbolic equations, Solution by separation of variables	B03



21	Solution of one-dimensional wave equation, Solution of two-dimensional Laplace equation using Fourier series	<b>B03</b>
<b>*ST-II (20<sup>th</sup> May, 2022)</b>		
22	<b>Functions of Complex Variables:</b> Analytic Function, Cauchy-Riemann equations.	<b>B05</b>
23	Harmonic functions	<b>B06</b>
24	Conformal mapping.	<b>B01</b>
<b>END TERM – FULL SYLLABUS</b>		

**7. Delivery/Instructional Resources:**

Lecture No.	Topics	PPT (link of ppts on the central server)	Industry Expert Session	Web References	Audio-Video
1-3	<b>Fourier Series and Transforms:</b> Introduction, Fourier Series on Arbitrary Intervals, Half-range cosine and sine series.	<a href="https://drive.google.com/drive/folders/1Xm0uHsBuXIZAnPhEJ8PO9_PTk-jLxzh7?usp=sharing">https://drive.google.com/drive/folders/1Xm0uHsBuXIZAnPhEJ8PO9_PTk-jLxzh7?usp=sharing</a>	NA	<a href="https://nptel.ac.in/courses/122/104/122104018/">https://nptel.ac.in/courses/122/104/122104018/</a>	<a href="https://www.youtube.com/watch?v=r18Gi8ISkfM">https://www.youtube.com/watch?v=r18Gi8ISkfM</a>
4-11	<b>Ordinary Differential Equations:</b> Exact differential equations, Equation solvable for p, y and x, Clairaut's equation, Applications to orthogonal trajectories, Second and higher order ordinary linear differential equations with constant coefficients: Complimentary function, Particular integrals (standard types), Differential Operator Method, Variation of parameters, Method of Undetermined Coefficients, Cauchy-Euler differential equation, Simultaneous linear differential equations (two variables) with constant coefficients, Application to RLC circuit.	<a href="https://drive.google.com/drive/folders/1Xm0uHsBuXIZAnPhEJ8PO9_PTk-jLxzh7?usp=sharing">https://drive.google.com/drive/folders/1Xm0uHsBuXIZAnPhEJ8PO9_PTk-jLxzh7?usp=sharing</a>	NA	<a href="https://www.digimat.in/nptel/courses/video/11108081/L01.html">https://www.digimat.in/nptel/courses/video/11108081/L01.html</a>	<a href="https://www.youtube.com/watch?v=OET0qwat15o&amp;list=PLdM-WZokR4tbGKbeK8fDIdENONEcvAQIC">https://www.youtube.com/watch?v=OET0qwat15o&amp;list=PLdM-WZokR4tbGKbeK8fDIdENONEcvAQIC</a>

12-16	<b>Laplace Transform:</b> Laplace Transform, Linearity and Shifting Property, Inverse transforms properties, Transforms of derivatives and integrals, Unit step function, Dirac's delta function, Applications to differential equations.	<a href="https://drive.google.com/drive/folders/1Xm0uHsBuXIZAnPhEJ8PO9_PTk-jLxzh7?usp=sharing">https://drive.google.com/drive/folders/1Xm0uHsBuXIZAnPhEJ8PO9_PTk-jLxzh7?usp=sharing</a>	NA	<a href="https://www.youtube.com/watch?v=OAEjSiFGdhQ">https://www.youtube.com/watch?v=OAEjSiFGdhQ</a>	<a href="https://www.khanacademy.org/math/differential-equations/laplace-transform">https://www.khanacademy.org/math/differential-equations/laplace-transform</a>
17-21	<b>Partial Differential equations:</b> Equation of first order, Lagrange's Linear equation, Standard types of first order non-linear partial differential equations, Solutions of second order linear partial differential equations in two variables with constant coefficients by finding complementary function and particular integral, Classification of PDE of second order – parabolic, elliptic and hyperbolic equations, Solution by separation of variables, Solution of one-dimensional wave equation, Solution of two-dimensional Laplace equation using Fourier series.	<a href="https://drive.google.com/drive/folders/1Xm0uHsBuXIZAnPhEJ8PO9_PTk-jLxzh7?usp=sharing">https://drive.google.com/drive/folders/1Xm0uHsBuXIZAnPhEJ8PO9_PTk-jLxzh7?usp=sharing</a>	NA	<a href="https://nptel.ac.in/courses/111/107/111107108/">https://nptel.ac.in/courses/111/107/111107108/</a>	<a href="https://www.youtube.com/watch?v=vZEN4NXhmag">https://www.youtube.com/watch?v=vZEN4NXhmag</a>
22- 24	<b>Functions of Complex Variables:</b> Analytic Function, Cauchy-Riemann equations, Harmonic functions, conformal mapping,	<a href="https://drive.google.com/drive/folders/1Xm0uHsBuXIZAnPhEJ8PO9_PTk-jLxzh7?usp=sharing">https://drive.google.com/drive/folders/1Xm0uHsBuXIZAnPhEJ8PO9_PTk-jLxzh7?usp=sharing</a>	NA	<a href="https://nptel.ac.in/courses/111/103070">https://nptel.ac.in/courses/111/103070</a>	<a href="https://www.slideserve.com/ashton/complex-variables">https://www.slideserve.com/ashton/complex-variables</a>

#### 8. Action plan for different types of learners:

Slow Learners	Average Learners	Fast Learners
Extra Class on Saturday, Doubt sessions.	Doubt-sessions	Doubt Sessions

#### 9. Evaluation Scheme & Components:

Evaluation Component	Type of Component	No. of Assessments	Weightage of Component	Mode of Assessment
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Component 1	Formative Assessments(FAs)	01	10%	offline
Component 2	Sessional Tests (ST's)	02*	30%	offline
Component 3	End Term Examinations	01	60%	offline
<b>Total</b>		<b>100%</b>		

\* Out of 2 ST's the ERP system automatically picks the best 01 ST mark for evaluation.

**Details of Evaluation Components:**

Evaluation Component	Description	Syllabus Covered (%)	Timeline of Examination	Weightage (%)
Component 01	ST 01	Upto 40%	As defined in Academic Calendar	40%
	ST 02	41% - 80%	As defined in Academic Calendar	
Component 02	End Term Examination*	100%	At the end of the semester	60%
<b>Total</b>				<b>100%</b>

\*As per Academic Guidelines minimum 75% attendance is required to become eligible for appearing in the End Semester Examination.

**Evaluation Components of Sessional Test and End Term Examination**

Type of Assessment	Time of Conduction	Total Marks	Question Paper Format				
			1 Mark MCQ	2 Mark Subjective	3 Mark Subjective	5 Mark Subjective	10 Mark Subjective
Sessional Test 1	1-11 Sessions	40	5	0	5	2	1
Sessional Test 2	12-21 Sessions	40	5	0	5	2	1
End Term Examination		60	0	10	0	8	0

**10. Syllabus of the Course:**

Name of the Course: Differential Equations and Transformations	Course Code: AM122		
Contents	No. of Lectures	Weightage (%)	
Unit1 Fourier Series and Transforms:Introduction, Fourier Series on Arbitrary Intervals, Half-range cosine and sine series.	3	12.5	

<b>Unit 2 Ordinary Differential Equations:</b> Exact differential equations, Equation solvable for p, y and x, Clairaut's equation, Applications to orthogonal trajectories, Second and higher order ordinary linear differential equations with constant coefficients: Complimentary function, Particular integrals (standard types), Differential Operator Method, Variation of parameters, Method of Undetermined Coefficients, Cauchy-Euler differential equation, Simultaneous linear differential equations (two variables) with constant coefficients, Application to RLC circuit. <b>Laplace Transform:</b> Laplace Transform, Linearity and Shifting Property, Inverse transforms properties, Transforms of derivatives and integrals, Unit step function, Dirac's delta function, Applications to differential equations.	8	33.3
<b>Unit 3 Partial Differential equations:</b> Equation of first order, Lagrange's Linear equation, Charpit's method, Standard types of first order non-linear partial differential equations, Solutions of second order linear partial differential equations in two variables with constant coefficients by finding complementary function and particular integral, Classification of PDE of second order – parabolic, elliptic and hyperbolic equations, Solution by separation of variables, Solution of one-dimensional wave equation, Solution of two-dimensional Laplace equation using Fourier series.	10	41.6
<b>Unit 4 Functions of Complex Variables:</b> Analytic Function, Cauchy-Riemann equations, Harmonic functions, conformal mapping,	3	12.5

#### 11. Academic Honesty policy:

Chitkara University ensures the implementation of the highest level of academic integrity in all the documents being prepared/adopted by its Faculty members and students. Any breach of the same will be tantamount to severe academic penalties.

This Document is approved by:

Designation	Name	Signature
Course Coordinator	Dr. Krishan Dutt Sharma	
Program Head	Dr. Reetu Malhotra	
Dean	Dr. Mohit Kumar Kakkar	
Date (DD/MM/YYYY)	28 <sup>th</sup> March 2023	