Course Plan

Institute/School/College Name	Chitkara University Institute of Engineering & Technology		
Department/Centre Name	Department of Applied Sciences		
Programme Name	B.E.-CSE		
Course Name	Differential Equations and Transformations	Session	2023 - 2024
Course Code	22AS002	Semester/Batch	2nd /2023
Lecture/Tutorial (Per Week)	4-0-0	Course Credit	4
Course Coordinator Name	Dr. Inderpreet Kaur		

1. 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 analyse 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.

2. Course Learning Outcome:

	Course Outcome	POs	CL	KC	Contact Hours
CLO01	Students will analyze and correlate many real life problems mathematically and thus find the appropriate solutions for them using Fourier series and Transforms (Fourier and Laplace transform)	PO1,PO2,PO11	K2	Factual Conceptual	**18**
CLO02	Student will be able to solve various practical problems in Science and Engineering using ordinary differential equations	PO1,PO2,PO4	K3	Fundamental Conceptual	**18**
CLO03	Students will possess an ability to recognize and find families of solutions for most real physical processes such as heat transfer, elasticity, quantum mechanics,	PO1, PO2	K3	Conceptual Procedural	**12**

	water flow and other practical problems in Science and Engineering, which are governed by ordinary and partial differential equations				
CLO04	Student will be able to analyze functions of complex variables, techniques of complex integrals and compute integrals over complex surfaces.	PO1,PO2,PO4	K3	Conceptual Procedural	6
Total Contact Hours					**54**

Revised Bloom's Taxonomy Terminology
  *Cognitive Level =CL
  *Knowledge Categories = KC

Course Learning Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CLO1	H	H									H	
CLO2	H	H		M								
CLO3	H	H										
CLO4	H	H		H								

3. **ERISE Grid Mapping**

Feature Enablement	Level(1-5, 5 being highest)
Entrepreneurship	2
Research	4
Innovation	3
Skills	5
Employability	4

4. **Recommended Books (Reference Books/Text Books):**
   - **T1:** Advanced Engineering Mathematics, R.K. Jain and S.R.K. Iyengar, Alpha Science International Ltd., 2014.
   - **T2:** The Engineering Mathematics, 2nd Edition, Chitkara University Publication, Vol. II. 2013.
   - **T3:** A text book of Engineering Mathematics, N. P. Bali and Manish Goyal, Laxmi Publications, 2010.
   - **R1:** Advanced Engineering Mathematics, Erwin Kreyszig, 10th ed., Wiley India Pvt. Ltd.2011.

- **R2:** Engineering Mathematics, Srimanta Pal &Subodh C. Bhunia, Edition 2015, Oxford University Press, 2015.
- **R3:** Calculus, by Howard Anton, Irl Bivens Stephens Davis

Other readings & relevant websites:

S.No.	Link of Journals, Magazines, websites and Research Papers	Session No.
Link 1	https://www.slideshare.net/Pokar/fourier-series-32752445	1
Link 2	https://www.youtube.com/watch?v=spUNpyF58BY	5
Link 3	https://www.slideshare.net/lankeshssss/ordinary-differential-equation-137100520	8
Link 4	https://www.slideshare.net/Himel_Himo/presentation-on-laplace-transforms	20
Link 5	https://www.slideshare.net/isratzerin6/partial-differential-equation-amp-its-	26
Link 6	https://www.youtube.com/watch?v=UVoD3ylDWW4	34

5. **Course Plan:**

Session No.	Topics	Recommended Book
1-3	**Fourier Series:** Introduction, Fourier Series on arbitrary Intervals,	T1
4	Half-range cosine and sine series	T1
FA(19ᵗʰ Jan 2024)		
5	**Fourier transform:** Fourier transform of derivative, Shifting and Scaling, Convolution, Fourier Cosine and Sine Transform, Linearity, Shifting and Scaling, Fourier Cosine and Sine transforms of Derivatives, Parseval's Identity	T1, T2
6	**Ordinary Differential Equations:** Differential equations of first order and first degree, Linear and Bernoulli equations.	T2
7-8	Exact differential equations	T2
9	Equation solvable for p, y and x	T2
10	Clairaut's equation , Applications to orthogonal trajectories.	T2
11-12	**Second and higher order ordinary linear differential equations with constant coefficients:** Complimentary function, Particular integrals (standard types), Differential Operator Method	R1
ST-I (17ᵗʰ Feb 2024)		
13	Variation of parameters, Method of Undetermined Coefficients.	T2
14-15	Cauchy-Euler differential equation, Simultaneous linear differential equations (two variables) with constant coefficients.	R1, T2
16-17	Application to RLC circuit	R2
18-19	**Laplace Transform**, Linearity and Shifting Property	T2
20	Inverse transforms properties,	T2

21	Transforms of derivatives and integrals,	T2
22	Unit step function, Dirac's delta function	T2
23-24	Applications to differential equations.	T2
ST-2 (30th March 2024)		
25	**Partial Differential equations**: Formation of partial differential equations, Equation of first order	T3
26-27	Lagrange's Linear equation, Charpit's method	T2, T3
28	Standard types of first order non-linear partial differential equations	T3
29-30	Solutions of second order linear partial differential equations in two variables with constant coefficients by finding complementary function and particular integral	T3
31	Classification of PDE of second order – parabolic, elliptic and hyperbolic equations, Solution by separation of variables	T3
32	Solution of one-dimensional wave equation, Solution of two-dimensional Laplace equation using Fourier series	T3
ST-3 (4th May 2024)		
33	**Functions of Complex Variables:** Limit, Continuity, Derivative of complex Functions	R1
34	Analytic Function, Cauchy-Riemann equations	R2
35	Harmonic functions, conformal mapping, Complex Integration,	T2, R3
36	Cauchy's theorem, Cauchy Integral Formula, Taylors and Laurent's Expansion	T2, R2
ETE (Last Week of May)		

6. Delivery/Instructional Resources

Session No.	Topics	PPT (link of ppts on the central server)	Industry Expert Session(If yes: link of ppts on the central server)	Web References	Audio-Video

1-5	**Fourier Series and Transforms**: Introduction, Fourier Series on Arbitrary Intervals, Half-range cosine and sine series, Fourier transform with properties: Fourier Transform Linearity property, Fourier transform of derivative, Shifting and Scaling, Convolution, Fourier Cosine and Sine transforms and properties: Fourier Cosine and Sine Transform, Linearity, Shifting and Scaling, Fourier Cosine and Sine transforms of Derivatives, Parseval's Identity.	https://www.slideshare.net/IffatAnjum/fourier-transforms-40750759	NA	https://nptel.ac.in/courses/122104018	https://www.youtube.com/watch?v=r18Gi8lSkfM
6-17	**Ordinary Differential Equations:** Differential equations of first order and first degree, Linear and Bernoulli equations, 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.	https://www.slideshare.net/ahmed7aider/ordinary-differential-equations	NA	https://nptel.ac.in/courses/122104018	https://www.youtube.com/watch?v=OET0qwat15o&list=PLdM-WZokR4tbGKbeK8fDIdEN0NEcvAQlC
18-24	**Laplace Transform:** 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.	https://www.slideshare.net/001Abhishek1/laplace-transform-59113100	NA	https://archive.nptel.ac.in/courses/111/106/111106139/	https://www.khanacademy.org/math/differential-equations/laplace-transform
25-32	**Partial Differential equations:** Formation of partial differential equations, Equation of first order, Lagrange's Linear equation, Charpit's method, Standard types of first order non-	https://www.slideshare.net/aman1894/partial-differential-	NA	https://nptel.ac.in/5ourse s/111/107/111107108/	https://www.youtube.com/watch?v=kEN_Ze8QNdM

	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.	equations-42054204			
33-36	**Functions of Complex Variables:** Limit, Continuity, Derivative of complex Functions, Analytic Function, Cauchy-Riemann equations, Harmonic functions, conformal mapping, Complex Integration, Cauchy's theorem, Cauchy Integral Formula, Taylors and Laurent's Expansion.	https://www.slideshare.net/ShreyPatel16/complex-function-96985172	NA	https://archive.nptel.ac.in/courses/111/106/111106141/	https://www.slideserve.com/ashton/complex-variables

7. Action plan for different types of learners

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

8. Evaluation Scheme & Components:

Evaluation Component	Type of Component	No. of Assessments	Weightage of Component	Mode of Assessment
Component 1	FA	01	10%	Offline
Component 2	Sessional Tests (STs)	03	40%	Online/Offline
Component 3	End Term Examinations	01	50%	Online/Offline
Total			**100%**	

All the three ST's are compulsory.

Details of Evaluation Components:

Evaluation Component	Description	Syllabus Covered (%)	Timeline of Examination	Weightage (%)

Component 01	FA	10%	Before ST1	10%
Component 02	ST 01	Upto 30%	As defined in Academic Calendar	40%
	ST 02	Upto 60%	As defined in Academic Calendar	
	ST 03	Upto 80%	As defined in Academic Calendar	
Component 03	End Term Examination*	100%	At the end of the semester	50%
Total				100%

*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
Sessional Test 1	1-12 Sessions	40
Sessional Test 2	1-24 Sessions	40
Sessional Test 3	1-32 Sessions	40
End Term Examination		50

9. **Syllabus of the Course:**

SUBJECT: Differential Equations and Transformations		Subject Code: 22AS002
Content	No. of Sessions	Weightage (%)
Unit 1 Fourier Series and Transforms: Introduction, Fourier Series on Arbitrary Intervals, Half-range cosine and sine series, Fourier transform with properties: Fourier Transform Linearity property, Fourier transform of derivative, Shifting and Scaling, Convolution, Fourier Cosine and Sine transforms and properties: Fourier Cosine and Sine Transform, Linearity, Shifting and Scaling, Fourier Cosine and Sine transforms of Derivatives, Parseval's Identity.	5	13.89
Unit 2 Ordinary Differential Equations: Differential equations of first order and first degree, Linear and Bernoulli equations, 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.	12	33.33

Unit 3 Laplace Transform: 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.	**7**	**19.4**
Unit 4 Partial Differential equations: Formation of partial differential equations, 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.	**8**	**22.2**
Unit 5 Functions of Complex Variables: Limit, Continuity, Derivative of complex Functions, Analytic Function, Cauchy-Riemann equations, Harmonic functions, conformal mapping, Complex Integration, Cauchy's theorem, Cauchy Integral Formula, Taylors and Laurent's Expansion.	**4**	**11.11**

This Document is approved by:

Designation	Name	Signature
Course Coordinator	Dr. Inderpreet Kaur	
Program Incharge	Dr. Reetu Malhotra	
Dean	Dr. Mohit Kumar Kakkar	
DD/MM/YYYY	03/01/2024	