



KALINGA INSTITUTE OF INDUSTRIAL TECHNOLOGY (KIIT)

(Deemed to be University)

DEPARTMENT OF MATHEMATICS

SCHOOL OF APPLIED SCIENCES

AUTUMN SEMESTER 2023-24

COURSE HANDOUT

Date: 20.07.2023

1. Course Title: DIFFERENTIAL EQUATIONS AND LINEAR ALGEBRA
2. Course Code: MA 11001
3. L-T-P Structure: 3-1-0
4. Course Coordinator: Dr. Madhusmita Sahoo
5. Associate Course Coordinator: Dr. Joydeb Pal

6. COURSE OBJECTIVE

The objective of this course is to familiarize prospective engineers with techniques in ordinary differential equations and linear algebra. It aims to equip the students to tackle advanced levels of mathematics and applications that they would find useful in their disciplines.

7. COURSE OUTCOMES

After completing the course, the students will be able to

- CO 1:** Understand the concept of modeling and formulation of Differential equations of physical problems,
- CO 2:** Apply different methods to solve ODE problems involving growth decay, cooling effects, electrical circuits, etc.,
- CO 3:** Develop an ability to solve 2nd order linear ODEs,
- CO 4:** Apply the knowledge of special functions in engineering problems.
- CO 5:** Use the essential tool of matrices and linear algebra thoroughly,
- CO 6:** Apply the knowledge of eigenvalue and eigenvector in the field of engineering and also get the concept of complex matrices.

8. COURSE DETAILS

Ordinary Differential Equations of First Order

Introduction and formation of differential equations, Overview: separable method, homogeneous equations, equations reducible to homogeneous form. Exact differential equations, equations reducible to the exact form, linear differential equations, equations reducible to linear form (Bernoulli's equation). Applications of differential equations: Growth-Decay Problems, Newton's Law of Cooling, Mixing problems, Orthogonal trajectories.

Linear Differential Equations of Second Order

Second-order linear homogeneous equations with constant coefficients; differential operators; solutions of homogeneous equations; Euler-Cauchy equation; linear dependence and independence; Wronskian; Solutions of non-homogeneous equations: general solution, complementary function, particular integral; solution by variation of parameters; undetermined coefficients. Applications of 2nd order differential equations in Electric circuit.



Special Functions

Improper Integrals for one variable, some test for convergence of improper integrals, Gamma function, Properties, Beta function, and Relation between Gamma and Beta functions. The radius of convergence of power series, Legendre equation. Legendre polynomial. Recurrence relations and Orthogonality property of Legendre polynomials. Bessel's equation, Bessel's function, and Recurrence relation.

System of Linear Equations and Vector Space

The linear system of equations; the rank of a matrix; consistency of linear systems; Solution of a system of linear equations: Gauss elimination, the inverse of a matrix by Gauss Jordan method, Vector Space, Sub-space, Basis and dimension, linear dependence and independence, Linear transformation.

Matrix-Eigenvalue Problems

Eigenvalues, Eigenvectors, Eigen basis, Quadratic form; Hermitian, Skew-Hermitian forms; Similar matrices; Diagonalization of matrices.

Text book

T1. Kreyszig, E. "Advanced Engineering Mathematics (10th Edition)", (2011), John Wiley & Sons, ISBN: 978-81-265-5423-2.

Reference books

R1. Grewal, B. S. "Higher Engineering Mathematics (44th Edition)", (2015), Khanna Publishers, ISBN: 81-7409-195-5.

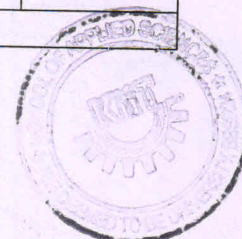
R2. Dass, H. K. & Verma, R. "Introduction to Engineering Mathematics-Voumel-I (8th Edition)", (2014), S. Chand & Company Pvt. Ltd., ISBN: 81-219-3524-5.

R3. Ramana, B. V. "Higher Engineering Mathematics (11th Edition)", (2010), Tata McGraw-Hill, ISBN: 13-978-07-063419-0; ISBN: 10-0-07-063419-X.

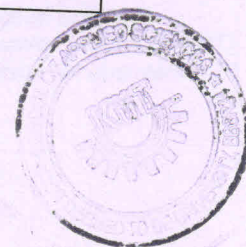
R4. Roy, J. S. and Padhy, S. "A course on ordinary & partial differential Equations (4th Edition)", (2014), Kalyani Publishers, ISBN: 978-93-272-3896-9.

9. LESSON PLAN AND ACTIVITIES

Broad Topics	Lecture No.	Detail Topics to be covered	Article No./ Book	Co Mapping
First Order ODEs	1	Introduction and formation of differential equations	1.1(T1)	CO1
	2	Variable separable method, homogeneous ODEs	1.3(T1)	CO1
	3	Equations reducible to homogeneous form	1.3(T1)	CO1
	4	Tutorial (Problem-Solving)		
	5	Exact differential equations, equations reducible to the exact form	1.4(T1)	CO1
	6	Linear differential equations of 1 st order	1.5(T1)	CO1
	7	Equations reducible to linear form (Bernoulli's equation)	1.5(T1)	CO1
	8	Tutorial (Problem-Solving)		
	9	Growth-Decay Problems	1.3(T1)	CO2
	10	Newton's Law of Cooling, Mixing problems	1.3(T1)	CO2
	11	Orthogonal trajectories	1.6(T1)	CO2
	12	Tutorial (Problem-Solving)		
	13	Doubt clearing Class		
		Assignment-I		
		Quiz-I (To be conducted Centrally)		



Second Order Linear ODEs	14	Second-order linear homogeneous ODEs	2.1(T1)	
	15	Differential operators; solutions of homogeneous linear ODEs with constant coefficients	2.2 & 2.3 (T1)	CO3
	16	Tutorial (Problem-Solving)		
	17	Euler-Cauchy ODEs	2.5(T1)	CO3
	18	Linear dependence and independence; Wronskian	2.6(T1)	CO3
	19	Solutions of non-homogeneous linear ODEs: general solution, complementary function, particular integral	2.7(T1)	CO3
	20	Tutorial (Problem-Solving)		
	21	Method of undetermined coefficients	2.7(T1)	CO3
	22	Method of undetermined coefficients	2.7(T1)	CO3
	23	Method of variation of parameters	2.10(T1)	CO3
	24	Tutorial (Problem-Solving)		
	25	Method of variation of parameters	2.10(T1)	CO3
	26	Applications of 2nd order linear differential equations in Electric circuit	2.9(T1)	CO3
		Assignment-II		
		Quiz-II (To be conducted Centrally)		
Special Functions	27	Improper Integrals for one variable	6.6(R3)	CO4
	28	Tutorial (Problem-Solving)		
	29	Test for convergence of improper integrals	6.6(R3)	CO4
	30	Test for convergence of improper integrals	6.6(R3)	CO4
	31	Gamma function, Beta function, Relation between Gamma and Beta functions, Properties	11.1 & 11.2 (R3)	CO4
	32	Tutorial (Problem-Solving)		
	33	Introduction to Power Series; Radius of convergence of power series	5.1(T1)	CO4
	34-35	Legendre equation. Legendre polynomials	5.2(T1)	CO4
	36	Tutorial (Problem-Solving)		
	37	Recurrence relations of Legendre polynomials and Orthogonality property	5.2(T1)	CO4
	38	Bessel's equation, Bessel's function (1 st Kind)	5.4(T1)	CO4
	39	Recurrence relation of Bessel's functions	5.4(T1)	CO4
	40	Tutorial (Problem-Solving)		
System of Linear Equations and Vector Space	41-42	System of linear equations; Solution by Gauss elimination Method	7.3(T1)	CO5
	43	Vector Space, Sub-space	7.4(T1)	CO5
	44	Tutorial (Problem-Solving)		
	45-46	Linear dependence and independence; Basis and dimension	7.4(T1)	CO5
	47	The rank of a matrix; consistency of linear systems	7.4(T1)	CO5
	48	Tutorial (Problem-Solving)		
	49-50	The inverse of a matrix by Gauss Jordan method	7.8(T1)	CO5
	51	Linear transformation	7.9(T1)	CO5
	52	Tutorial (Problem-Solving)		
		Critical Thinking (Assignment III)		
Matrix Eigenvalue Problems	53	Eigenvalues, Eigenvectors, Eigen basis	8.1(T1)	CO6
	54	Real Matrices; Quadratic form	8.3(T1)	CO6
	55	Complex Matrices, Hermitian, Skew-Hermitian forms	8.5(T1)	CO6
	56	Tutorial (Problem-Solving)		



57	Similar matrices	8.4(T1)	CO6
58-59	Diagonalization of matrices	8.4(T1)	CO6
60	Tutorial (Problem-Solving)		
	Quiz-III (To be conducted Centrally)		
61-62	Previous Year's question & answer discussion		

N.B: The problems in the tutorial classes may be solved by touching the specific parts taught in the previous classes.

10. ASSESSMENT COMPONENTS

Sl. No.	Assessment Component	Duration	Weightage / Marks	Nature of the Component
1	Mid Semester Examination	90 min	20	Closed Book
2	End Semester Examination	3 Hours	50	Closed Book
3	Problem Solving (Assignment)	1 week	10	Open Book
4	Quiz Test	20 min	15	Closed Book
5	Critical Thinking	15 days	05	Open Book

11. ACTIVITIES CALENDAR

Sl. No.	Type of Activity/ Nature of the Component	Marks	Schedule for Activities	Duration For Submission	Publication of result	Mapping with COs
1	Assignment-I (Open Book)	5	3 rd week of August	1 week	1 st week of September	CO1 & CO2
2	Quiz -I (Closed Book)	5	3 rd week of August	30min	3 rd week of August	CO1 & CO2
3	Assignment-II (Open Book)	5	2 nd week of September	1 week	4 th week of September	CO1 & CO3
4	Quiz -II (Closed Book)	5	2 nd week of September	30min	2 nd week of September	CO3
5	Critical Thinking (Open Book)	5	2 nd week of November	15 days	4 th week of November	CO2, CO3, CO4, CO5 & CO6
6	Quiz -III (Closed Book)	5	4 th week of November	30min	4 th week of November	CO4, CO5 & CO6

12. CHAMBER CONSULTATION HOUR

(Concern faculty will intimate the students about the chamber consultation time)

MS
20/07/2023
Dr. Madhusmita Sahoo
Course Coordinator

MRD
20/07/2023
Dr. Mrutyunjay Das
Coordinator, Department of Mathematics



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27.07.23
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