INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad - 500 043

COMPUTER SCIENCE AND ENGINEERING

COURSE DESCRIPTION FORM

Course Title	**Linear Algebra And Ordinary Differential Equations**			
Course Code	**AHS002**			
Course Structure	**Lectures**	**Tutorials**	**Practicals**	**Credits**
	3	1	-	4
Course Coordinator	Ms. P Rajani, Assistant Professor			
Team of Instructors	Dr. M Anita, Mr. J Suresh Goud, Ms. P Srilatha, Ms. C Rachana Ms. K Rama Jyothi, Ms. N Praveena, Ms. A Neelima, Mr. S V S Hanumanth Rao			

I. COURSE OVERVIEW

The course focuses on more advanced Engineering Mathematics topics which provide with the relevant mathematical tools required in the analysis of problems in engineering and scientific professions. The course includes Types of matrices, Difference Calculus Methods and Differential Equations. The mathematical skills derived from this course form a necessary base to analytical and design concepts encountered in the program.

II. PREREQUISITE(S)

Level	Credits	Periods	Prerequisite
UG	4	6	Basic Algebra, Differential equations.

III. MARKS DISTRIBUTION

Subject	SEE Examination	CIA Examination	Total Marks
Linear Algebra and Ordinary Differential Equations	70 Marks	30 Marks	100 Marks

Semester End Examination 70 Marks All the Units (1, 2, 3, 4 and 5)	70 Marks (3 Hours)	5 questions to be answered. Each question carries 14 Marks

<table>
<tr><td rowspan="6">Average of two CIA Examinations</td><td colspan="4">Continuous Internal Assessment - 1</td></tr>
<tr><td rowspan="3">30 Marks
(2 Hours)</td><td rowspan="3">Units
I, II and
III (half)</td><td rowspan="2">Continuous Internal Examination (CIE)
(2 hours)</td><td>Part - A
5 questions to be answered out of
5 questions, each carries 1 mark.</td></tr>
<tr><td>Part - B
4 questions to be answered out of
5 questions, each carries 5 marks.</td></tr>
<tr><td>Quiz-I /Alternate Assessment Tool (AAT- I)</td><td>5 marks for assignment.</td></tr>
<tr><td colspan="4">Continuous Internal Assessment - 2</td></tr>
<tr><td rowspan="3">30 Marks (2 Hours)</td><td rowspan="3">Units
III (half)
IV and
V</td><td rowspan="2">Continuous Internal Examination (CIE)
(2 hours)</td><td>Part – A
5 questions to be answered out of
5 questions, each carries 1 mark.</td></tr>
<tr><td>Part - B
4 questions to be answered out of
5 questions, each carries 5 marks.</td></tr>
<tr><td>Quiz-II /Alternate Assessment Tool (AAT- II)</td><td>5 marks for assignment.</td></tr>
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IV. EVALUATION SCHEME

S. No	Component	Duration	Marks
1	CIE - I Examination	2 hour	25
2	Quiz - I / AAT - I	-	05
TOTAL			30
3	CIE - II Examination	2 hour	25
4	Quiz - II / AAT - II	-	05
TOTAL			30
CIA Examination marks to be considered as average of above two CIA’s			
5	EXTERNAL Examination	3 hours	70
GRAND TOTAL			100

V. COURSE OBJECTIVES

The goal of this course is to create awareness and acquire comprehensive knowledge in algebra and differential equations.

The course should enable the students to

I. Analyze and solve linear system of equations using matrices.
II. Apply differential equations on real time applications.
III. Determine the maxima and minima of functions of several variables.

VI. COURSE OUTCOMES

By the end of the module students should be able to

1. **Demonstrate** knowledge of matrix calculation as an elegant and powerful mathematical language in connection with rank of a matrix, linear system of equations.
2. **Interpret** the Eigen values and Eigen vectors of matrix in terms of the transformation it represents in to a matrix Eigen value problem , linear dependence and independence
3. **Determine** a modal matrix, and reducing a matrix to diagonal form.
4. **Evaluate** inverse and powers of matrices by using cayley-Hamilton theorem.
5. **Solving** differential equations of first order.
6. **Finding** orthogonal trajectories of Cartesian and polar equations.
7. **Solving** Second and higher order differential equations
8. **Apply** the differential equations for electrical circuits and simple harmonic motion.
9. **Apply** the Mean value theorems for the single variable functions.
10. **Apply** maxima and minima for functions of several variables' and Lagrange's method of multipliers.

VII. HOW PROGRAM OUTCOMES ARE ASSESSED

Program outcomes		Level	Proficiency assessed by
PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	H	Assignments
PO2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	H	Assignments
PO3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	S	Assignments
PO4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	S	Assignments
PO5	**Modern tool usage**: Create, select, and apply appropriate	S	------

	techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.		
PO6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	S	------
PO7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	S	------
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	S	------
PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	N	------
PO10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	N	------
PO11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	N	-----
PO12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	H	------

VIII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED

Program Specific Outcomes		Level	Proficiency Assessed by
PSO 1	**Professional Skills:** The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity.	S	Lectures and Assignments
PSO 2	**Problem-Solving Skills:** The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business success.	S	Assignments
PSO3	**Successful Career and Entrepreneurship:** The ability to employ modern computer languages, environments, and platforms in creating innovative career paths to be an entrepreneur, and a zest for higher studies.	S	Seminars

N - None **S - Supportive** **H – Highly Related**

IX SYLLABUS

UNIT-I

Theory of matrices: Real Matrices**:** Symmetric, skew-symmetric and orthogonal matrices; Complex matrices: Hermitian, Skew-Hermitian and unitary matrices; Elementary row and column transformations, elementary matrix, finding rank of a matrix by reducing to Echelon form and normal form; Finding the inverse of a matrix using elementary row/column transformations: Gauss-Jordan method; Solving of linear system of equations by LU decomposition method.

UNIT – II

Linear transformations: Cayley-Hamilton theorem: Statement, verification, finding inverse and powers of a matrix; Linear dependence and independence of vectors; Linear transformation; Eigen values and eigen vectors of a matrix; Properties of eigen values and eigen vectors of real and complex matrices; Diagonalization of matrix.

UNIT – III

Differential equations of first order and their applications: Formation of a differential equation; Differential equations of first order and first degree: Exact, non exact, linear equations; Bernoulli equation;

Applications of first order differential equations: Orthogonal trajectories; Newton's law of cooling; Law of natural growth and decay.

UNIT – IV

Higher ordinary linear differential equations and their applications: Linear differential equations of second and higher order with constant coefficients, non homogeneous term of the type $f(x) = e^{ax}, \sin ax, \cos ax$ and $f(x) = x^n, e^{ax}v(x), x^n v(x)$; Method of variation of parameters; Applications to electrical circuits and simple harmonic motion.

UNIT – V

Functions of single and several variables: Mean value theorems: Rolle's theorem, Lagrange's theorem, Cauchy's theorem and generalized mean value theorems-without proofs.

Functions of several variables: Functional dependence, Jacobian, maxima and minima of functions of two variables without constraints and with constraints; Method of Lagrange multipliers.

Textbooks:

1. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons Publishers, 9th Edition, 2014.
2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 42nd Edition, 2012.

Reference Books:

1. RK Jain & SRK Iyengar, "Advanced Engineering Mathematics", Narosa Publishers, 5th Edition, 2016.
2. Ravish R Singh, Mukul Bhatt, "Engineering Mathematics-1", Tata Mc Graw Hill Education, 1st Edition, 2009.
3. Srimanthapal & Suboth C.Bhunia, "Engineering Mathematics", Oxford Publishers, 3rd Edition, 2015.

X. COURSE PLAN:

The course plan is meant as a guideline. There may probably be changes.

Course Content Delivery --- Lecture Wise Break-up of Topics

I Spell

Unit	Lecture Number	Topic Planned to be covered	Learning Objective	References
I	1	**Theory of Matrices** Introduction of matrices	**Define** types of matrices	T-1, R-1
	2-3	Real and complex matrices	**Solve** real and complex matrices	T-1, R-1
	4-6	Find rank by echelon and normal form	**Apply** echelon and normal form to find rank of matrix	T-1, R-1
	7	Gauss-Jordan method	**Apply** Gauss Jordan method to find inverse	T-1, R-1
	8	LU decomposition method	**Solve** equations by LU decomposition method	T-1, R-1
II	9-12	Cayley Hamilton theorem	**Apply** clayey Hamilton theorem to find inverse	T-1, R-1
	13-16	Eigen values and Eigen vectors	**Define** and apply the properties of eigen values and eigen vectors	T-1, R-1
	17-18	Diagonalisation	**Use** diagonalisation to diagonalisie a square matrix and find higher powers of a matrix	T-1, R-1
III	19--22	**Differential equations** Introduction of first order differential equations	**Solve** first order differential equations	T-1, R-1

II Spell

Unit	Lecture Number	Topic Planned to be covered	Learning Objective	References
III	23-24	Orthogonal trajectories	**Calculate** orthogonal trajectories for given differential equations	T-2, R-2
	25-26	**Applications**	**Apply** first order differential equations to Newton's law of cooling and law of natural growth and decay	T-2, R-2
IV	27-30	Second and Higher order differential equations with constant coefficients	**Calculate** the C.F and P.I to solve higher order differential equations	T-2, R-2
	31-34	Method of variation of parameters	**Use** the particular to solve	T-2, R-2
	35-36	**Applications** of second order differential equations	**Apply** second order differential equations for electrical circuits and Simple harmonic motion	T-2, R-2
V	37	**Differential Calculus Methods** Verification of Rolle's Theorem to the given functions	**Apply** the Rolle's theorem	T-2, R-2
	38-39	Verification of Lagrange's Mean value theorem to the given functions	**Apply** Lagrange's Mean Value Theorem	T-2, R-2
	40	Verification of Cauchy's mean value theorem to the given functions	**Apply** Cauchy's Mean Value Theorem	T-2, R-2

	41	Functional dependence for two and three functions	**Apply** Jacobian transformation	T-2, R-2
	42-43	Maxima and minima of functions of two variables without constraints	**Determine** maximum and minimum of a function of several variables	T-2, R-2
	44-45	Lagranges method of undetermined multipliers	**Use** the lagrange multiplier method to find extreme of functions with constraints	T-2, R-2

XI. MAPPING COURSE OBJECTIVES LEADING TO THE ACHIEVEMENT OF THE PROGRAM OUTCOMES

Course Objectives	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
I	H	H											S	S	
II	S	H											S	S	
III	H												S		

N = None **S = Supportive** **H = Highly related**

XII. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF TSHE PROGRAM OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	H	H	S										S	S	
2	H	S											S		
3	S	S		S										S	
4	H												S		
5	S		H										S		
6	H													S	
7		H											S		
8	H													S	
9		S											S		
10		S	S										S		

S = Supportive **H = Highly related**

Prepared by: Ms. P Rajani, Assistant Professor

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