INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

MECHANICAL ENGINEERING

COURSE DESCRIPTOR

Course Title	**COMPUTATIONAL MATHEMATICS LABORATORY**				
Course Code	AHS102				
Programme	B. Tech				
Semester	I	CSE | ECE | IT | EEE			
	II	AE | ME | CE			
Course Type	Foundation				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	2	1
Chief Coordinator	Mr. Ch Soma Shekar, Assistant Professor				
Course Faculty	Dr. M Anita, Professor Dr. S Jagadha, Professor Mr. J Suresh Goud, Assistant Professor Ms. L Indira, Assistant Professor Ms. P Srilatha, Assistant Professor Ms. C Rachana, Assistant Professor Ms. P Rajani, Assistant Professor Ms. B Praveena, Assistant Professor				

I. COURSE OVERVIEW:

The aim of this course is to know about the basic principles of Engineering Mathematics and its application in MATLAB by means of software. Nowadays the principles of MATLAB find wide range of applications in many situations such as signal processing and communications, image and video processing, control systems, test and measurement, computational finance, and computational biology. Using MATLAB, one can analyze data, develop algorithms, and create models and applications.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
-	-	-	Basic Principles Algebra and Calculus	-

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Computational Mathematics Laboratory	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✘	Chalk & Talk	✘	Quiz	✘	Assignments	✘	MOOCs
✔	LCD / PPT	✘	Seminars	✘	Mini Project	✔	Videos
✔	Open Ended Experiments						

V. EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks for internal assessment and 70 marks for semester end lab examination. Out of 30 marks of internal assessment, continuous lab assessment will be done for 20 marks for the day to day performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE):
The semester end lab examination for 70 marks shall be conducted by two examiners, one of them being Internal Examiner and the other being External Examiner, both nominated by the Principal from the panel of experts recommended by Chairman, BOS.

The emphasis on the experiments is broadly based on the following criteria:

20 %	To test the preparedness for the experiment.
20 %	To test the performance in the laboratory.
20 %	To test the calculations and graphs related to the concern experiment.
20 %	To test the results and the error analysis of the experiment.
20 %	To test the subject knowledge through viva – voce.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Table 1: Assessment pattern for CIA

Component	Laboratory		Total Marks
Type of Assessment	Day to day performance	Final internal lab assessment	
CIA Marks	20	10	30

Continuous Internal Examination (CIE):
One CIE exams shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

Preparation	Performance	Calculations and Graph	Results and Error Analysis	Viva	Total
2	2	2	2	2	10

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2	Presentation on real-world problems
PO 2	**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	2	Case Study
PO 4	**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.	2	Term Paper

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Professional Skills:** To produce engineering professional capable of synthesizing and analyzing mechanical systems including allied engineering streams.	1	Presentation on real-world problems
PSO 2	**Software Engineering Practices:** An ability to adopt and integrate current technologies in the design and manufacturing domain to enhance the employability.	-	-
PSO 3	**Successful Career and Entrepreneurship:** To build the nation, by imparting technological inputs and managerial skills to become Technocrats.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Demonstrate the basic principles of MATLAB.
II	Analyze the applications of Algebra and Calculus using MATLAB software.
III	Estimate the roots of Algebraic and Transcendental equations.
IV	Evaluate the characteristics of given curves by means of plotting a graph.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AHS102.01	CLO 1	Understanding the history and features of MATLAB	PO 1	3
AHS102.02	CLO 2	Solve the algebraic and transcendental equations using bisection method, method of false position and Newton-Raphson method.	PO 1, PO 2,PO 4	2

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AHS102.03	CLO 3	Plotting the roots of algebraic and transcendental equations in a given range	PO 4	2
AHS102.04	CLO 4	Verifying the basic properties of limits for the given functions	PO 2, PO 4	1
AHS102.05	CLO 5	Determining the derivatives of a given function	PO 1, PO 2	2
AHS102.06	CLO 6	Calculation of the area enclosed between axis, the curve and the ordinates.	PO 2, PO 4	3
AHS102.07	CLO 7	Demonstrate knowledge of matrix calculation as an elegant and powerful mathematical language in connection with rank of a matrix, linear system of equations.	PO 1, PO 2	1
AHS102.08	CLO 8	Interpret the Eigen values and Eigen vectors of matrix in terms of the transformation it represents in to a matrix Eigen value problems.	PO 2	3
AHS102.09	CLO 9	Solving Second and higher order differential equations.	PO 2, PO 4	3
AHS102.10	CLO10	Evaluate line, surface and volume integrals by expressing in other coordinate system.	PO 2, PO 4	3
AHS102.11	CLO 11	Apply numerical methods to interpolate.	PO 2	1
AME108.12	CLO 12	Apply method of least squares to fit a curve.	PO 2	2
AHS102.13	CLO 13	Solve the differential equation using numerical methods (Taylor's series, Euler's, Modified Euler's and Runge-Kutta methods).	PO 2	3
AHS102.14	CLO 14	Evaluate region is bounded between the given curves and plotting the diagram.	PO 2	2
AHS102.15	CLO 15	Analyze scalar and vector fields and compute the gradient, divergence and curl.	PO 2, PO 4	2

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3												1		
CLO 2		2		2									1		
CLO 3		2													
CLO 4	1	1													
CLO 5	2	2													

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 6		3		3									1		
CLO 7	1	1													
CLO 8		3		3									1		
CLO 9	3	3		3									1		
CLO 10		3		3									1		
CLO 11	1	1													
CLO 12		2		2									1		
CLO 13	3	3		3									1		
CLO 14	2			2									1		
CLO 15		2		2									1		

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 1, PO 2, PO 4	SEE Exams	PO 1, PO 2, PO 4	Assignments	-	Seminars	-
Laboratory Practices	PO 2, PO 4	Student Viva	-	Mini Project	-	Certification	-

XII. ASSESSMENT METHODOLOGIES - INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS

LIST OF EXPERIMENTS	
Week-1	**BASIC FEATURES**
a. To Know the history and features of MATLAB b. To Know the local environment of MATLAB	
Week-2	**ALGEBRA**
a. Solving basic algebraic equations. b. Solving system of equations. c. Two dimensional plots.	
Week-3	**CALCULUS**
a. Calculating limits. b. Solving differential equations. c. Finding definite integral.	
Week-4	**MATRICES**

a. Addition, subtraction and multiplication of matrices. b. Transpose of a matrix. c. Inverse of a matrix.	
Week-5	**SYSTEM OF LINEAR EQUATIONS**
a. Rank of a matrix. b. Gauss Jordan method. c. LU decomposition method.	
Week-6	**LINEAR TRANSFORMATION**
a. Characteristic equation. b. Eigen values. c. Eigen vectors.	
Week-7	**DIFFERENTIATION AND INTEGRATION**
a. Higher order differential equations. b. Double integrals. c. Triple integrals.	
Week-8	**INTERPOLATION AND CURVE FITTING**
a. Lagrange polynomial. b. Straight line fit. c. Polynomial curve fit.	
Week-9	**ROOT FINDING TECHNIQUES**
a. Bisection method. b. Regula false method. c. Newton Raphson method.	
Week-10	**NUMERICAL DIFFERENTION AND INTEGRATION**
a. Trapezoidal, Simpson's method. b. Euler method. c. Runge Kutta method.	
Week-11	**3D PLOTTING**
a. Line plotting. b. Surface plotting. c. Volume plotting.	
Week-12	**VECTOR CALCULUS**
a. Gradient. b. Divergent. c. Curl.	
Text Book:	
1. Dean G. Duffy, Advanced Engineering Mathematics with MATLAB, CRC Press, Taylor and Francis Group,6th Edition, New Delhi, 2015.	
Reference Book:	
1. Cleve Moler, Numerical Computing with MATLAB, SIAM, Philadelphia, 2nd Edition, 2008.	

XIV. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Week No.	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	Understanding the basic features of MATLAB.	CLO 1	T1:1.1 R1:2.21
2	Determination of roots of a given polynomial.	CLO 2, CLO 3	T1:15.1 R1:2.25
3	Verification of basic properties of limits.	CLO 4	T1:2.1 R1:2.21

Week No.	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
4	Determination of rank, inverse, transpose and obtaining the solution to linear system of equations of a matrix.	CLO 7, CLO 8	T1:15.1-15.6 R1:2.32
5	Interpret the Eigen values and Eigen vectors of a matrix.	CLO 8	T1:15.5 R1:2.51
6	Determination of derivatives and integration to a given function.	CLO 5, CLO 10	T1:2.1 R1:2.8
7	Determination of best fit curve to the given data.	CLO 12	T1:3.0 R1:2.9
8	Calculation of area enclosed bounded by a region.	CLO 6, CLO 14	T1:14.5 R1:5.1
9	Solving the higher order differential equations.	CLO 9, CLO 13	T1:3.1 R1:5.21
10	Plotting a given surface bounded in a region.	CLO 6, CLO 14	T1:14.3-14.8 R1:5.1
11	Determination of gradient, divergence and curl of a vector.	CLO 15	T1:14.2 R1:2.2
12	Determination of roots to algebraic and transcendental equations by bisection method, method of false position and Newton-Raphson method	CLO 2	T1:2.2 R1:2.25

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S.No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	To improve standards and analyze the concepts.	NPTEL	PO 1, PO 4	PSO 1
2	Fourier series and Fourier Transforms	Laboratory Practices	PO 2, PO4	PSO 1
3	Laplace Transforms	Guest Lecture	PO 2, PO4	PSO 1

Prepared by:

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HOD, FE