



# INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

## INFORMATION TECHNOLOGY

### 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<br>Dr. S Jagadha, Professor<br>Mr. J Suresh Goud, Assistant Professor<br>Ms. L Indira, Assistant Professor<br>Ms. P Srilatha, Assistant Professor<br>Ms. C Rachana, Assistant Professor<br>Ms. P Rajani, Assistant Professor<br>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 16<sup>th</sup> 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                   | <b>Engineering knowledge:</b> 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                   | <b>Problem analysis:</b> 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                   | <b>Conduct investigations of complex problems:</b> 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: 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 analysis and design of computer - based systems of varying complexity. | -        | -                                   |
| PSO 2                            | Software Engineering Practices: The ability to apply standard practices and strategies in software service management using open-ended programming environments with agility to deliver a quality service for business success.                                                            | -        | -                                   |
| PSO 3                            | 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.                                                                             | 1        | Presentation on real-world problems |

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                   |

| CLO Code  | CLO's  | At the end of the course, the student will have the ability to:                                                                                               | PO's Mapped      | Strength of Mapping |
|-----------|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|---------------------|
| 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                   |
| 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   |     |     |     |     |     |     |     |      |      |      |                                  |      |      |

| 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 4                           | 1                      | 1   |     |     |     |     |     |     |     |      |      |      |                                  |      |      |
| CLO 5                           | 2                      | 2   |     |     |     |     |     |     |     |      |      |      |                                  |      |      |
| 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    |

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#### 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                                                                                   |                       |
|-------------------------------------------------------------------------------------------------------|-----------------------|
| <b>Week-1</b>                                                                                         | <b>BASIC FEATURES</b> |
| a. To Know the history and features of MATLAB<br>b. To Know the local environment of MATLAB           |                       |
| <b>Week-2</b>                                                                                         | <b>ALGEBRA</b>        |
| a. Solving basic algebraic equations.<br>b. Solving system of equations.<br>c. Two dimensional plots. |                       |
| <b>Week-3</b>                                                                                         | <b>CALCULUS</b>       |

|                                                                                                                                                |                                                                                                                                                                                |
|------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                | <ul style="list-style-type: none"> <li>a. Calculating limits.</li> <li>b. Solving differential equations.</li> <li>c. Finding definite integral.</li> </ul>                    |
| <b>Week-4</b>                                                                                                                                  | <b>MATRICES</b>                                                                                                                                                                |
|                                                                                                                                                | <ul style="list-style-type: none"> <li>a. Addition, subtraction and multiplication of matrices.</li> <li>b. Transpose of a matrix.</li> <li>c. Inverse of a matrix.</li> </ul> |
| <b>Week-5</b>                                                                                                                                  | <b>SYSTEM OF LINEAR EQUATIONS</b>                                                                                                                                              |
|                                                                                                                                                | <ul style="list-style-type: none"> <li>a. Rank of a matrix.</li> <li>b. Gauss Jordan method.</li> <li>c. LU decomposition method.</li> </ul>                                   |
| <b>Week-6</b>                                                                                                                                  | <b>LINEAR TRANSFORMATION</b>                                                                                                                                                   |
|                                                                                                                                                | <ul style="list-style-type: none"> <li>a. Characteristic equation.</li> <li>b. Eigen values.</li> <li>c. Eigen vectors.</li> </ul>                                             |
| <b>Week-7</b>                                                                                                                                  | <b>DIFFERENTIATION AND INTEGRATION</b>                                                                                                                                         |
|                                                                                                                                                | <ul style="list-style-type: none"> <li>a. Higher order differential equations.</li> <li>b. Double integrals.</li> <li>c. Triple integrals.</li> </ul>                          |
| <b>Week-8</b>                                                                                                                                  | <b>INTERPOLATION AND CURVE FITTING</b>                                                                                                                                         |
|                                                                                                                                                | <ul style="list-style-type: none"> <li>a. Lagrange polynomial.</li> <li>b. Straight line fit.</li> <li>c. Polynomial curve fit.</li> </ul>                                     |
| <b>Week-9</b>                                                                                                                                  | <b>ROOT FINDING TECHNIQUES</b>                                                                                                                                                 |
|                                                                                                                                                | <ul style="list-style-type: none"> <li>a. Bisection method.</li> <li>b. Regula false method.</li> <li>c. Newton Raphson method.</li> </ul>                                     |
| <b>Week-10</b>                                                                                                                                 | <b>NUMERICAL DIFFERENTIATION AND INTEGRATION</b>                                                                                                                               |
|                                                                                                                                                | <ul style="list-style-type: none"> <li>a. Trapezoidal, Simpson's method.</li> <li>b. Euler method.</li> <li>c. Runge Kutta method.</li> </ul>                                  |
| <b>Week-11</b>                                                                                                                                 | <b>3D PLOTTING</b>                                                                                                                                                             |
|                                                                                                                                                | <ul style="list-style-type: none"> <li>a. Line plotting.</li> <li>b. Surface plotting.</li> <li>c. Volume plotting.</li> </ul>                                                 |
| <b>Week-12</b>                                                                                                                                 | <b>VECTOR CALCULUS</b>                                                                                                                                                         |
|                                                                                                                                                | <ul style="list-style-type: none"> <li>a. Gradient.</li> <li>b. Divergent.</li> <li>c. Curl.</li> </ul>                                                                        |
| <b>Text Book:</b>                                                                                                                              |                                                                                                                                                                                |
| 1. Dean G. Duffy, Advanced Engineering Mathematics with MATLAB, CRC Press, Taylor and Francis Group, 6 <sup>th</sup> Edition, New Delhi, 2015. |                                                                                                                                                                                |
| <b>Reference Book:</b>                                                                                                                         |                                                                                                                                                                                |
| 1. Cleve Moler, Numerical Computing with MATLAB, SIAM, Philadelphia, 2 <sup>nd</sup> 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<br>R1:2.21       |
| 2        | Determination of roots of a given polynomial.                                                                                            | CLO 2, CLO 3                    | T1:15.1<br>R1:2.25      |
| 3        | Verification of basic properties of limits.                                                                                              | CLO 4                           | T1:2.1<br>R1:2.21       |
| 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<br>R1:2.32 |
| 5        | Interpret the Eigen values and Eigen vectors of a matrix.                                                                                | CLO 8                           | T1:15.5<br>R1:2.51      |
| 6        | Determination of derivatives and integration to a given function.                                                                        | CLO 5, CLO 10                   | T1:2.1<br>R1:2.8        |
| 7        | Determination of best fit curve to the given data.                                                                                       | CLO 12                          | T1:3.0<br>R1:2.9        |
| 8        | Calculation of area enclosed bounded by a region.                                                                                        | CLO 6, CLO 14                   | T1:14.5<br>R1:5.1       |
| 9        | Solving the higher order differential equations.                                                                                         | CLO 9, CLO 13                   | T1:3.1<br>R1:5.21       |
| 10       | Plotting a given surface bounded in a region.                                                                                            | CLO 6, CLO 14                   | T1:14.3-14.8<br>R1:5.1  |
| 11       | Determination of gradient, divergence and curl of a vector.                                                                              | CLO 15                          | T1:14.2<br>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<br>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**