

Applied Numerical Methods for EC Engineering		Semester	3
Course Code	BEC306D	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2:2:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Examination type (SEE)	Theory		
<p>Course objectives:</p> <ul style="list-style-type: none"> ● To provide the knowledge and importance of error analysis in engineering problems ● To represent and solve an application problem using a system of linear equations ● Analyze regression data to choose the most appropriate model for a situation. ● Familiarize with the ways of solving complicated mathematical problems numerically ● Prepare to solve mathematical models represented by initial or boundary value problems 			
<p>Teaching-Learning Process Pedagogy (General Instructions): These are sample Strategies, teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> 1. In addition to the traditional lecture method, different innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied Mathematical skills. 2. State the need for Mathematics with Engineering Studies and Provide real-life examples. 3. Support and guide the students for self-study. 4. You will assign homework, grading assignments and quizzes, and documenting students' progress. 5. Encourage the students to group learning to improve their creative and analytical skills. 6. Show short related video lectures in the following ways: <ul style="list-style-type: none"> ● As an introduction to new topics (pre-lecture activity). ● As a revision of topics (post-lecture activity). ● As additional examples (post-lecture activity). ● As an additional material of challenging topics (pre-and post-lecture activity). ● As a model solution of some exercises (post-lecture activity). 			
Module-1: Errors in computations and Root of the equations			
Approximations and Round Off -Errors in computation: Error definitions, Round-Off errors, Truncation errors and the Taylor series-The Taylor series, Error Propagation, Total numerical error, Absolute, Relative and percentage errors, Blunders, Formulation errors and data uncertainty. Roots of equations: Simple fixed point iteration methods. Secant Method, Muller's method, and Graeffe's Roots Squaring Method. Aitkin's Method. (8 hours) (RBT Levels: L1, L2 and L3)			
Module-2: Solution of System of Linear Equations			
Rank of the matrix, Echelon form, Linearly dependent and independent equations, Solutions for linear equations, Partition method, Croute's Triangularisation method. Relaxation method. Solution of non-linear simultaneous equations by Newton-Raphson method. Eigen Values and properties, Eigen Vectors, Bounds on Eigen Values, Jacobi's method, Given's method for symmetric matrices. (8 hours) (RBT Levels: L1, L2 L3)			

Module-3: Curve Fitting

Least-Squares Regression: Linear Regressions, Polynomial regressions, Multiple Linear regressions, General Linear Least squares, Nonlinear Regressions, QR Factorization. Curve Fitting with Sinusoidal Functions

Introduction to Splines, Linear Splines, Quadratic Splines, Cubic Splines. Bilinear Interpolation. **(8 hours)**

(RBT Levels: L1, L2 L3)

Module-4: Numerical integration, Difference equations and Boundary Value Problems

Romberg's method, Euler-Maclaurin formula, Gaussian integration for $n = 2$ and $n=3$. Numerical double integration by trapezoidal and Simpson's 1/3 rd rule. Solution of linear difference equations.

Boundary-Value Problems, Introduction. The Shooting Method, Finite-Difference Methods **(8 hours)**

(RBT Levels: L1, L2 and L3)

Module-5: Numerical solution of partial differential equations

Classifications of second-order partial differential equations, Finite difference approximations to partial derivatives. Solution of: Laplace equation, Poisson equations, one-dimensional heat equation and wave equations. **(8 hours)**

(RBT Levels: L1, L2 and L3)

Course outcome (Course Skill Set)

At the end of the course, the student will be able to:

1. Explain and measure errors in numerical computations
2. Test for consistency and solve a system of linear equations.
3. Construct a function which closely fits given n - n -points of an unknown function.
4. Understand and apply the basic concepts related to solving problems by numerical differentiation and numerical integration.
5. Use appropriate numerical methods to study phenomena modelled as partial differential equations.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE, the minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the **CIE** (Continuous Internal Evaluation) and **SEE** (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

The Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**).

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books (Name of the author/Title of the Book/Name of the publisher/Edition and Year)

Text Books:

1. **Steven C. Chapra & Raymond P. Canale:** "Numerical Methods for Engineers and Scientists", McGraw Hill, 8th Edition, 2020.
2. **Steven C. Chapra:** "Applied Numerical Methods with MATLAB for Engineers and Scientists", McGraw Hill, Fifth Edition, 2023.
3. **B. S. Grewal:** "Numerical Methods in Engineering & Science with programs in C, C++ and MATLAB", Khanna Publishers, 10thEd., 2015.

Reference Books:

1. **John H. Mathews & Kurtis D. Frank:** "Numerical Methods Using MATLAB", PHI Publications, 4th Edition, 2005.
2. **Won Young Yang, Wenwu Cao, Tae Sang Chung, John Morris:** "Applied Numerical Methods Using MATLAB", WILEY Interscience, Latest Edition, 2005.

Web links and Video Lectures (e-Resources):

- <http://nptel.ac.in/courses.php?disciplineID=111>
- [http://www.class-central.com/subject/math\(MOOCs\)](http://www.class-central.com/subject/math(MOOCs))
- <http://academicearth.org/>
- VTU e-Shikshana Program
- VTU EDUSAT Program.

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Seminar