

# ACADEMIC – GRADUATE STUDIES AND RESEARCH DIVISION

**BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI-HYDERABAD CAMPUS**

# SECOND SEMESTER 2021-22

Course Handout (Part II)

15-01-2022

In addition to Part-I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

*Course No.* : CE G513

*Course Title* : Advanced Computational Techniques

*Instructor-in-Charge* : Dr. Raghu Piska

**Description:** Interpolation, Polynomial Interpolation, Lagrange, Newton’s Interpolation, Numerical integration, Wilson Method, Newmark’s Method, Gauss and Hermitian Quadrature, Quadrature rules for multiple integrals, Large system of linear simultaneous equations, Direct and iterative algorithms based on Gauss elimination, Gauss Seidel method and symmetric banded equations, storage schemes – skyline, band solver, frontal solver, Cholesky decomposition, Non-linear system of equations, Eigen value problems, Forward iteration, Inverse iteration, Jacobi, Given’s method, Transformation of generalized Eigen value problem to standard form, Vector iteration method, Initial and boundary value problems, Solution of first and second order differential equations using Euler, modified Euler, and Runge-Kutta methods, Finite difference operators.

# Scope and Objective of the Course:

Analytical and exact solutions are possible only for the simple and very standard problems in Engineering. Most of the real-world problems require numerical methods to determine the solution. Numerical methods involve tedious iterative operations which cannot be solved manually. To implement the problem using a computer, one has to supply the detailed algorithm via the computer programs in any of the available tools. The objective of the course is to introduce the students to existing numerical methods to solve linear and nonlinear equations, Eigen value problems, partial and differential equations etc. Parallelly students will be introduced to writing pseudo codes to implement these numerical methods in MATLAB.

**Course Outcomes**: At the end of this course, the students will be able to:

CO1. Solve different Engineering problems using the existing numerical methods

CO2. Implement these numerical methods by writing programs in MATLAB

Student Learning Outcomes (SLOs) assessed in this course – **(a), (b),**

**Student Learning Outcomes (SLOs):**

SLOs are outcomes (a) through (b) plus any additional outcomes that may be articulated by the program.

1. An ability to think logically and write the pseudo codes and develop codes in MATLAB
2. an ability to apply knowledge of numerical methods for solving real world problems

Textbook:

1. Curtis F Gerald and Patrick O Wheatley *“Applied Numerical Analysis, (2006)” Pearson*

# Reference books:

1. Richard L Burden, J. Douglas Faires, (2011). “*Numerical Analysis*”, CENGAGE learning.
2. Rajasekaran(1999). “*Numerical Methods in Science and Engineering”,* S.Chand

# Course Plan:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Lecture No.** | **Learning objectives** | **Topics to be covered** | **Chapter in the Text**  **Book** | **SLO** |
| 1-2 | Introduction | Introduction to errors, numerical methods | Ch-0 | a,b |
| 3-6 | Interpolation techniques | Polynomial, Lagrange, Newton’s interpolation | Ch-3 | a,b |
| 7-12 | Solution to linear equations | Gauss elimination, Gauss siedel, symmetric banded equations, Cholesky decomposition | Ch-2 | a,b |
| 13-16 | Solution to nonlinear equations | Newton Raphson method | Ch-1 | a,b |
| 17-20 | Solution to Eigen value problems | Forward and inverse iteration, Jacobi and Given’s method, transformation, Vector iteration method | Ch-6 | a, b |
| 21-25 | Solution to boundary value problems | Finite difference method etc… | Ch-5 | a,b |
| 26-30 | Numerical integration | Wilson θ method, Gauss and Hermitian quadrature, Newmarks’s method | Ch-5 | a,b |
| 31-38 | Solution to first and second order differential equations | Euler, modified Euler, Runge Kutta method | Ch-6 | a,b |
| 39-42 | Miscellaneous problems |  |  | a,b |

**Evaluation Scheme:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Component** | **Duration** | **Weightage (%)** | **Date & Time** | **Nature of Component** |
| Mid Semester Test | 90 min (theoretical) | 25 | As per Timetable | Closed book |
| Comprehensive Exam | 120 min  (Theoretical + Programming) | 35 | As per Timetable | OPEN BOOK |
| Assignments (Theoretical +  MATLAB Programming) |  | 20  (Theoretical - 5% and programming -15%) | - | OPEN BOOK |
| Mini Project |  | 15 |  | OPEN BOOK |
| Teaching presentation |  | 5 |  |  |

**Chamber Consultation Hour:** 4:30PM (office no: 040 – 66303773, mobile no: 9494728796)

**Notices:** Concerning this course will be displayed on CMS

**Make-up Policy:** Make-up would be granted only for genuine cases with prior permission.

**Academic Honesty and Integrity Policy**: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

# INSTRUCTOR-IN-CHARGE

**CE G513**