COURSE PLAN

School	: Engineering
Department	: Mechanical Engineering
Course Code	: ME537 (Elective)
Course Name	: Applied Computational Methods
Course Structure (L-T-P-CH-Cr)	: 3-1-0-4-4

Instructor: Dr. Dilip Datta

1. Abstract

This is an introductory course on computational methods for solving complicated mathematical models numerically. The course broadly covers roots finding, regression analysis, numerical differentiation and integration, and solutions of ordinary and partial differential equations.

2. Objective

The objective of the course is to give the students the ideas how mathematical models, not solvable by exact methods, can be solved numerically.

3. Prerequisite of the Course

To opt this course, a student should have some computer programming knowledge/skill.

4. Course Outline + Suggested Reading

Module	Topic
1	Approximations and error analysis.
2	Roots of single-variable equations and polynomials.
3	Solution of system of equations.
4	Curve fitting.
5	Numerical differentiation.
6	Numerical integration.
7	Solution of ordinary differential equations.
8	Solution of partial differential equations.

Suggested Reading:

a) S.C. Chapra and R.P. Canade. *Numerical Methods for Engineers.* Tata McGraw-Hill, 2006.

b) J.H. Mathews. *Numerical Methods for Mathematics, Science and Engineering.* Prentice-Hall of India, 2000.

5. Time and Evaluation Plans

(a) Time Plan

SN	Contents	L+T
1	Introduction, approximations and error analysis	2+1
2	Roots of single-variable nonlinear equations – bracketing methods, bisection method, false position method, fixed point iteration, Newton-Raphson method and secant method	3+1
3	Roots of singe-variable polynomials – polynomial deflation, Bairstows method and Muller method	3+1
4	Solution of linear system of equations – Gauss elimination method, Gauss-Jordan method, matrix inversion, LU decomposition, Jacobi iteration and Gauss-Seidel iteration	6+2
5	Solution of nonlinear system of equations – fixed point iteration, Newtons method, Jacobian matrix and Seidel iteration	3+1
6	Curve fitting – least-square line fitting, exponential curve fitting, Lagrange polynomial and Newtons polynomial, interpolation by piece-wise linear, quadratic and cubic splines	6+2
7	Eigenvalues and eigenvectors of homogeneous and symmetric matrices	3+1
8	Numerical differentiation – finite difference methods	3+1
9	Numerical integration – trapezoidal rule, Simpsons rules, Romberg integration and Gauss quadrature	3+1
10	Solution of ordinary differential equations – Euler and Runge-Kutta methods for initial value problem, shooting and finite difference methods for boundary value problems, eigenvalue problems	6+2
11	Solution of partial differential equations – elliptical and parabolic equations	3+1
	Total contact hours	**41+14**

(b) Evaluation Plan

SN	Component	Marks	Time	Period
1	Test I	25	30 minutes	
2	Test II	25	30 minutes	
3	Major I	40	1 hour	
4	Test III	25	Assignment type	
5	Test IV	25	30 minutes	
6	Major II	60	2 hours	
	Total	**200**		

6. Pedagogy

(a) Teaching-learning methods will be adopted in a way to support the discussion on each module by 1 or 2 hand-on/tutorial class(es) for better understanding.

(b) Learning of students will be evaluated through computer assignments, class test/quiz, and examinations.

(c) Teaching of the instructor will be evaluated by students through a questionnaire.

7. Expected Outcome

From this course, students would learn how to solve a mathematical model numerically using the computing power of a computer, which is very tough or even impossible to solve by an exact method.