COURSE TITLE	**COMPUTATIONAL METHODS IN MECHANICAL ENGINEERING**
COURSE CODE	**01CA1111**
COURSE CREDITS	**3**

Objective:

1. To understand the basic concept of computational techniques
2. To apply the computational technique in mechanical system
3. To understand advance computational techniques
4. This course aims to provide an overview of production management, focusing on the computer aided tools applicable in managing automated production. It comprehends about the production systems, facility location and layout, production planning and control, Materials resource planning, scheduling, shop floor control, Simulation of Machine shop and modern approaches.
5. The course intends to provide application of mathematical foundations to graduate students. The course should enhance their ability to develop mathematical models and solve problems using analytical and numerical methods.

Course Outcomes: After completion of this course, student will be able to:

1. Apply modeling techniques to solve constrained decision-making problems.
2. Develop mathematical models for engineering problems.
3. Solve practical engineering problems using appropriate computational techniques.
4. Analyze the sensitivity of solutions with respect to different variables.
5. Evaluate the effectiveness of computational simulation tools in solving industrial engineering problems.

Pre-requisite of course: Engineering Mathematics

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	0	50	30	20	0	0

Contents : Unit	Topics	Contact Hours
1	**Differential Equations and Numerical Solution of Ordinary Differential Equations** Basic Concepts, 1st Order ODE, 2nd Order ODE, , Applications of differential equation in Mechanical Engineering, , Introduction, Solution by Taylor's Picard's Method, Euler's Method, Runge-Kutta Methods, Predictor-Corrector Methods, the Cubic Spline Method, , Simultaneous and Higher Order Equations, Boundary Value Problems: Finite-Difference Method, The Shooting Method, The Cubic Spline Method	11
2	**Basic Concepts of PDEs and Numerical Solution of Partial Differential Equations** First-Order Partial Differential Equations (PDEs), Nonlinear first-order PDEs, , Introduction of numerical method for PDE, Finite-Difference Approximations,, Laplace's Equation: Jacobi's Method, Gauss-Seidel Method, SOR Method, , ADI Method, Parabolic Equations, Iterative Methods, Hyperbolic Equations	10
3	**Laplace Transforms and Fourier Analysis** Laplace Transform, Linearity, First Shifting Theorem (Shifting), Transforms of Derivatives and Integrals, ODE; Unit Step Function (Heaviside Function), Second Shifting Theorem (t-Shifting); Short Impulses, Dirac's Delta Function,, Partial Fractions; Convolution, Integral Equations, Differentiation and Integration of Transforms, ODEs with Variable Coefficients; Systems of ODEs., Introduction to fourier Series, Convergence of fourier series for continuous and piecewise continuous functions, , Differentiation and integration of fourier series, Fourier cosine and sine series	8
4	**Linear Algebra** Matrices and Vectors: Vectors in 2-Space and 3-Space; Addition and Scalar Multiplication, , Matrix Multiplication; Linear Systems of Equations and Gauss elimination, Ill-Conditioning,, Linear Independence, Rank of a Matrix, Solutions of Linear Systems: Existence and Uniqueness, Determinants and Cramer's Rule; Inverse of a Matrix, Gauss–Jordan Elimination; Solution by Iteration. Linear Transformations; Matrix Eigen values, Determining Eigen values-Eigenvectors and their applications	5
5	**Probability and Statistics** Data Representation, Average, Spread; Experiments, Outcomes, Events; Probability, Permutations and Combinations, Random Variables. Probability Distributions; Mean and Variance of a Distribution; Binomial, Poisson, and Hyper geometric Distributions; Normal Distribution, Introduction, Random Sampling; Point Estimation of Parameter, Confidence Intervals; Testing Hypotheses, , Decisions; Goodness off it, X2 - Test, Nonparametric Tests, Regression, , Linear Regression, Polynomial Regression, General Linear Regression, Nonlinear Regression, Correlation	5

Contents : Unit	Topics	Contact Hours
6	**Least- square Curve Fitting and Function Approximation** Introduction, Least-square Curve Fitting, Spline Interpolation, , Cubic Splines, Chebyshev Minimax Approximation, Chebyshev Polynomials.	3
Total Hours		**42**

Textbook :

1 Advanced Engineering Mathematics, Erwin Kreyszig, John wiley &Sons, 2016

2 Numerical Methods for Engineers, S C Chapra, and R C Canale, Tata McGraw-Hill, 2018

References:

1 Advanced Engineering Mathematics, Advanced Engineering Mathematics, M D Greenberg, Pearson Education, 2019

2 Introduction Methods of Numerical Analysis, Introduction Methods of Numerical Analysis, S.S Sastry, PHI, 2016

3 Advanced Engineering Mathematics, Advanced Engineering Mathematics, Srk Iyengar Rk Jain, NAROSA PUBLISHING HOUSE PVT LTD , 2013

4 Advanced Engineering Mathematics, Advanced Engineering Mathematics, H.K.Das, S Chand, 2007

5 ADVANCED ENGINEERING MATHEMATICS WITH MATLAB, ADVANCED ENGINEERING MATHEMATICS WITH MATLAB, Dean G. Duffy, CRC Press, 2010

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember / Knowledge	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Higher order Thinking / Creative**
10.00	10.00	20.00	15.00	25.00	20.00

Instructional Method:

1 Lecture and Discussion

Supplementary Resources:

1 https://nptel.ac.in/courses/111/105/111105121/