Scheme for B. Tech. in Chemical Engineering 1st Year

I Semester:

S. No.	Course Code	Course Title	Category	Type	Credit	L	T	P
1.		Mathematics I	IC	Theory	3	2	1	-
2.		Chemistry (IC bucket*)	IC	Theory	3	3	-	-
3.		Makers Lab (ME+EE+ECE)	IC	Lab	6	-	3	6
4.	26CHT101	Data Analytics	IC	Theory	2	2	-	-
5.		Chemistry Lab (IC Lab bucket*)	IC	Lab	1	-	-	2
6.	26CHT102	Introduction to Chemical Engineering	PC	Theory	2	2	0	0
7.	26CHT103	Computer Aided Numerical Methods	PC	Theory	2	2	0	0
8.	26CHP101	Computer Aided Numerical Methods Lab	PC	Lab	1	0	0	2
Total					**20**	**11**	**4**	**10**

Course Details
Data Analytics | 26CHT101 | 2 0 0 0

PREREQUISITE:
NIL

COURSE OBJECTIVE(S):
To develop students ability to analyze, interpret, visualize, and apply statistical and data-driven techniques for solving engineering problems and supporting informed decision-making.

COURSE OUTCOMES:

CO1 : Summarize and visualize engineering datasets using descriptive statistics.

CO2 : Apply probability concepts to analyze uncertain engineering systems.

CO3 : Perform basic statistical inference including confidence intervals and hypothesis testing.

CO4 : Apply tools in Python/R/Excel for data analysis.

SYLLABUS:

UNIT I (7 Lectures): Statistics in engineering and data science, Types of data, Population and sample, Variables and measurement scales, Data collection methods, Sampling techniques, Sources of bias, Data quality. Dataframe in Python/R.

UNIT II (7 Lectures): Frequency distributions, Scatter plot, Histograms, Bar charts, Pie charts, Box plots, Stem-and-leaf plots. Measures of central tendency: mean, median, Mode. Measures of dispersion: Range, Variance, Standard deviation, Interquartile range, Outlier detection. Application in Python/R.

UNIT III (7 Lectures): Random experiments, Events, Sample space, Probability axioms, Conditional probability, Bayes theorem, Independence, Random variables, Expectation, Variance, Discrete and continuous random variables. Probability Distribution: Binomial distribution, Poisson distribution, Normal distribution, Central Limit Theorem. Use cases in Python/R/Excel.

UNIT IV (7 Lectures): Sampling distribution, Confidence interval, Hypothesis testing, p-value, Errors in hypothesis testing. Case studies such as air quality parameters, detection of defective products, energy consumption in buildings, climate data analysis, healthcare data analysis, etc.)

EVALUATION
Final grades will be weighted average of performance in

Continuous Assessment	20%
Midterm Exam	30%
Endterm Exam	50%

depending on the institute's academic policy.

Textbook(s):

1. Montgomery, D.C., Runger, G.C., Hubele, N.F., Engineering Statistics, 5th edition, Wiley, 2011.
2. Navidi, W., Statistics for Engineers and Scientists, 6th edition, McGraw Hill, 2024.
3. Bruce, P., Bruce, A., Gedeck, P., Practical Statistics for Data Scientists, 2nd edition, O'Reilly, 2020.

Reference book(s):

Online/E-Resourses:

Malaviya National Institute of Technology Jaipur
Department of Chemical Engineering

Course Details
Introduction to Chemical Engineering | 26CHT102 | 2 0 0 0

PREREQUISITE:
NIL

COURSE OBJECTIVE(S):
To introduce the basic features and concepts of Chemical Engineering to the students.

COURSE OUTCOMES:

CO1 : Understanding the chemical engineering and its future prospects.
CO2 : To acquire knowledge of chemical process industries.
CO3 : To acquire knowledge of basic principles of chemical engineering.
CO4 : Knowledge of new developments in chemical engineering and career prospects.

SYLLABUS:

UNIT I (8 Lectures): Definition of chemical engineering, historical perspective and contribution, job description and attributes of a chemical engineer, chemical engineering and its seamless integration with other sciences and engineering disciplines, Societal needs and role of chemical engineer for society development, Economic scale of production, Waste utilization and recycle, sustainable technology, Employment opportunities, knowledge resources, Frontiers & future roadmap, Challenges of chemical engineering practice.

UNIT II (7 Lectures): Framework of chemical industry and its classification, Evolution of chemical industries, Technological developments in major challenges, Chemical industries structure and segments of chemical industry, raw material and production pattern, Petroleum, petrochemical and fertilizer industry integration, Cleaner and greener technologies.

UNIT III (7 Lectures): Basic principles of chemical processes, unit processes and unit operations and various routes to produce chemicals, Material and Energy balances, Basic concept of mass, energy, and momentum transport, Equilibrium and rate-based processes.

UNIT IV (7 Lectures): Reaction engineering and reactors, Measuring instruments, automation, and control, Concept of equipment design, modelling and simulation

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Continuous Assessment	20%
Midterm Exam	30%
Endterm Exam	50%

depending on the institute's academic policy.

Textbook(s):

1. Nnaji, U., "Introduction to Chemical Engineering: For Chemical Engineers and Students", Wiley. 2019.
2. Solen, K.A. and Harb, J.N., "Introduction to Chemical Engineering Tools for Today and Tomorrow", 5th edition, John-Wiley. 2011
3. Denn, M.M., "Chemical Engineering: An Introduction", Cambridge University Press. 2012

Reference book(s):

1. Pushpavanam, S., "Introduction to Chemical Engineering", PHI Learning Pvt. Ltd. 2012.
2. Ghosal, S.K., Sanyal, S.K., Datta, S., "Introduction to Chemical Engineering", Tata McGraw Hill. 1997
3. Himmelblau D.M. and Riggs J.B., "Basic Principles and Calculations in Chemical Engineering", 8th Edition, PHI. 2014.

Online/E-Resourses:

Course Details
Computer Aided Numerical Methods | 26CHT103 | 2 0 0 0

PREREQUISITE:
NIL

COURSE OBJECTIVE(S):
To learn the different numerical techniques for solving algebraic, ordinary differential, partial differential equations and curve fitting of experimental data.

COURSE OUTCOMES:

CO1 : Apply numerical techniques for solving linear and nonlinear problems, including polynomials, single equation problems, and systems of linear and nonlinear equations.

CO2 : Use the regression techniques for linear and nonlinear parameter estimation.

CO3 : Able to apply the different techniques of numerical differentiation and integration.

CO4 : Use the numerical techniques for solving all the different types of ordinary and partial differential equations.

SYLLABUS:

UNIT I (6 Lectures): Introduction, Gauss-Elimination, Gauss-Siedel and LU Decomposition methods, Thomas' algorithm.

UNIT III (6 Lectures): Least squares curve fit, Newton's interpolation formulae, Lagrangian interpolation, Pade approximation, Cubic spline approximation. Numerical differentiation& Integration.

UNIT IV (4 Lectures): Single variable and multivariable successive substitution method, single variable and multivariable Newton-Raphson technique, Polynomial root finding methods.

UNIT IV (7 Lectures): Ordinary Differential Equations - Initial Value Problems: Explicit Adams Bashforth technique, Implicit Adams-Moulton technique, Predictor-corrector technique, Runge-Kutta methods, Stability of algorithms. Ordinary Differential Equations - Boundary Value Problems: Finite difference technique, Orthogonal Collocation (OC), Shooting Techniques.

UNIT V (5 Lectures): Partial Differential Equations (PDE) – Classification of PDE, Finite difference technique (Method of lines), Case Studies. Use of spreadsheets.

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depending on the institute's academic policy.

Textbook(s):

1. Sastry, S. S., Introductory Methods of Numerical Analysis, 5thEd., PHI, New Delhi. 2012
2. Gupta, S. K., Numerical Methods for Engineers, 4th Ed. New Age International Ltd., New Delhi. 2019.

Reference book(s):

1. Constantinides, A., and Mostoufi, N., Numerical Methods for Chemical Engineers with MATLAB Applications, Prentice Hall. 1999.
2. Hanna, O.T. and Sandall, O. C., Computational Methods in Chemical Engineering, Prentice-Hall. 1995.
3. Davis, M. E., Numerical Methods & Modeling for Chemical Engineers, John Wiley. 1984.
4. Finlayson Bruce A., Introduction to Chemical Engineering Computing, Wiley. 2012.

Online/E-Resourses:

Malaviya National Institute of Technology Jaipur
Department of Chemical Engineering

Course Details
Computer Aided Numerical Methods Lab | 26CHP101 | 0 0 2 0

PREREQUISITE:
NIL

COURSE OBJECTIVE(S):
To develop proficiency in applying numerical methods and programming skills using simulation software to solve chemical engineering problems, including algebraic equations, data analysis, and differential equations relevant to process modeling and simulation.

COURSE OUTCOMES:

CO1 : Implement and apply numerical methods (e.g., Bisection, Newton-Raphson, Regula-Falsi, Gauss elimination, and interpolation techniques) to solve algebraic and data-driven chemical engineering problems using simulation software.
CO2 : Develop programs for numerical integration, curve fitting, and solution of ordinary differential equations (ODEs) to model and analyze chemical engineering systems.
CO3 : Utilize simulation tools and plotting techniques to visualize results, interpret numerical solutions, and evaluate the accuracy and stability of different numerical methods.

SYLLABUS:

EXPERIMENT I (2 Hours): Basics of simulation software, plotting & error analysis

EXPERIMENT II (2 Hours): Nonlinear equations: Bisection, Regula-Falsi, Secant, Newton–Raphson.

EXPERIMENT III (2 Hours): Multi-variable nonlinear algebraic equations: Newton–Raphson Method

EXPERIMENT IV (2 Hours): Linear equations: Gauss Elimination, Gauss Jordan, LU decomposition.

EXPERIMENT V (2 Hours): Numerical differentiation methods.

EXPERIMENT VI (2 Hours): Data fitting using least squares & regression

EXPERIMENT VII (2 Hours): Interpolation: Newton, Lagrange methods.

EXPERIMENT VIII (2 Hours): Numerical integration: Trapezoidal, Simpson's methods.

EXPERIMENT IX (2 Hours): ODE-IVP: Euler, Modified Euler, Runge–Kutta methods.

EXPERIMENT X (2 Hours): ODE-BVP: Finite difference & Thomas algorithm, Shooting method, Orthogonal Collocation method.

EXPERIMENT XI (2 Hours): Simulation-based mini case study.

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1. Sastry, S. S., Introductory Methods of Numerical Analysis, 5thEd., PHI, New Delhi. 2012.

Reference book(s):

1. Hanna, O.T. and Sandall, O. C., Computational Methods in Chemical Engineering, Prentice-Hall. 1995.
2. Davis, M. E., Numerical Methods & Modeling for Chemical Engineers, John Wiley. 1984.

Online/E-Resourses: